PROCEEDINGS

OF THE

Academy of Natural Sciences

OF

PHILADELPHIA

VOLUME LXII

1910

PHILADELPHIA :
THE ACADEMY OF NATURAL SCIENCES
LOGAN SQUARE
1910–1911

The Academy of Natural Sciences of Philadelphia,

February 2, 1911.

I hereby certify that printed copies of the Proceedings for 1910 were mailed as follows:—

Pages 1–32	March	29, 1910.
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" 145–254	May	23, 1910.
" 255–270	May	26, 1910.
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" 495–534	October	6, 1910.
" 535–566	December	13, 1910.
" 567–614	January	14, 1911.
" 615–694	January	27, 1911.

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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1910.

JANUARY 4.

J. PERCY MOORE, PH.D., in the Chair.

Twelve persons present.

The Council reported the appointment of the following standing Committees to serve during the year:

FINANCE: John Cadwalader, Edwin S. Dixon, Effingham B. Morris, James D. Winsor, and the Treasurer.

PUBLICATIONS: Henry Skinner, M.D., Witmer Stone, Henry A. Pilsbry, Sc.D., William J. Fox, and Edward J. Nolan, M.D.

LIBRARY: Thomas Biddle, M.D., Thomas H. Fenton, M.D., Henry Tucker, M.D., and Frank J. Keeley.

INSTRUCTION AND LECTURES: Benjamin Smith Lyman, Henry A. Pilsbry, Sc.D., Charles Morris, Witmer Stone, and Henry Tucker, M.D.

The death of Israel W. Morris, a member, December 17, 1909, was announced.

HENRY LEFFMANN, M.D., made a communication on parasitism in plants. (No abstract.)

JANUARY 18.

HENRY SKINNER, M.D., in the Chair.

Twenty-five persons present.

The deaths of the following were announced: Edward A. Jessup, a member, April 4, 1909; John Ford, a member, January 10, 1910; Peter MacOwen, a correspondent, December 1, 1909; R. Bowdler Sharp, a correspondent, December 25, 1909.

DR. WILLIAM MORTON WHEELER made a communication on the effects of parasitic and other kinds of castration on insects. (No abstract.)

Hamilton D. Carpenter was elected a member.

The following were ordered to be printed:

ON THE ORTHOPTERA OF BERMUDA.

BY JAMES A. G. REHN.

In the spring of 1909 the Academy received from Mr. Frank M. Jones a collection of Bermudan Orthoptera which had been secured by him during a residence of some months in the islands. This sending was supplemented later by several others, the whole series, while not large, being of considerable interest, as Mr. Jones endeavored to secure every species seen during his stay, which lasted from December, 1908, to the latter part of April, 1909. The examination of the literature on Bermudan Orthoptera demonstrated how imperfect and unsatisfactory was the last summary of the Bermudan representatives of the order, that of Verrill. In consequence the published records were gathered together, the determinations of necessity being given as recorded unless the synonymy was well known and established, the results of the material on hand and the published records being incorporated into the paper here presented.

Twenty-eight species are here recorded, of which two taken from previous authors have only generic reference. A tabulation of the species according to their distribution (omitting the two without specific identification) gives the following results:

Peculiar to Bermuda	2
Tropical and subtropical America	2
South America, Antilles and Bermuda	1
North America and Bermuda	5
Circumtropical	3
North America, West Indies and Bermuda	3
Cosmopolitan	5
All America	2
North America, Bahamas and Bermuda	1
North America, Mexico, Cuba, Bahamas and Bermuda	1
North America, Mexico and Bermuda	1

From this it would appear that the greater portion of the Orthopterous fauna of the region is closer related to that of the mainland than to that of the Antilles, excluding, of course, from consideration the cosmopolitan and circumtropical forms, which probably have been introduced by commerce.

The author wishes to express his indebtedness to Mr. Jones for his interest and energy which brought to light the most remarkable of the two known endemic species.

DERMAPTERA.

LABIDURIDÆ.

Labidura bidens (Olivier).

Five adult males, one immature male and three adult females from Paget West, taken December 9 to March 24, have been examined and compared with Georgian and Cuban material of the species. This species has been recorded (as *L. riparia*) by Uhler, Dahl, Scudder and Verrill. The latter states (p. 827) that it is "not uncommon, occurring among débris along the shores, and also in storehouses," Uhler (p. 156) has suggested the probability of its introduction by commerce.

Anisolabis maritima (Bon.).

According to Verrill (p. 827) this species is common under decaying débris and stones at high-tide mark. No Bermudan specimens have been seen by us, and no other author has recorded the species from the islands.

Anisolabis annulipes (H. Lucas).

This widely distributed species is represented by a male and four female individuals taken in Paget West, December 9 to March 30. One female, taken March 30, 1909, has the femoral annuli practically absent. Kirby[1] has described the Bermudan insect as distinct, but Caudell had shown it is not separable from the typical form of this almost cosmopolitan species.

ORTHOPTERA s. s.

BLATTIDÆ.

Blattella germanica (Linnæus).

Verrill (p. 826) recorded this species on local authority, but no specimens had been seen by him.

Ceratinoptera diaphana (Fabricius).

Scudder recorded this species from the collection made by J. M. Jones, while the present series contains three adult males, three adult females and five immature individuals taken in Paget West, January 2 to May 17. The collector's notes are to the effect that the specimens

[1] *Anisolabis antennata, Journ. Linn. Soc. London*, XXIII, p. 517, 1891.

were beaten from cedar trees and the species was found rarely under stones in woods.

The species is widely distributed in the West Indies.

Blatta orientalis Linnæus.

Included on the authority of Verrill, who states (p. 825) that it is mostly confined to dwellings and ships.

Periplaneta americana (Linnæus).

This widely distributed species has been recorded by J. M. Jones, Uhler, Dahl, Hurdis and Verrill, and is represented in the series in hand by a single male from Paget West. It is stated to be extremely abundant during the hot summer months, particularly in old houses surrounded by trees, and Verrill (p. 824) entertains the possibility of its being indigenous. F. M. Jones' note, "Not often seen, perhaps more abundant indoors," may be explained by the season when collecting was done not being the hot summer months, although the suggestion of greater abundance indoors is probably the more potent explanation.

Periplaneta australasiæ (Fabricius).

Scudder and Verrill have both recorded this species, the latter author considering it common in the fields, under stones and in buildings. An adult male from Paget West and one nymph from the same locality, taken May 8, are before us. The collector's notes are to the effect that the species is very abundant under stones out of doors.

Leucophæa maderæ (Fabricius).

This widely distributed species has been recorded from Bermuda by J. M. Jones, Uhler, Hurdis and Verrill. The latter author states that it is very common in storehouses, while Jones and Hurdis agree in considering it less abundant than *P. americana*. The former of these two last mentioned authors states (p. 110) that it is rarely seen except in cellars and other dark places, and that it is known locally as the "knocker," from a habit of making a noise like a person gently tapping on a box or board. The present collection contains one female from Paget West, the notes accompanying which are the same as those on *Periplaneta americana*, and which can probably be explained in similar fashion.

Pycnoscelus surinamensis (Linnæus).

This species has been recorded by Scudder, Dahl and Verrill, and is represented in the present series by two adult females and five immature specimens, taken in Paget West, December 11 to January 24. It is found under stones and considered common.

MANTIDÆ.

Stagmomantis sp.

Verrill (p. 823) records on Henshaw's authority a species of this genus in Bickmore's collection from Bermuda. Mr. F. M. Jones (in litt.) comments as follows on this record: "The mantis recorded was perhaps a stray specimen, otherwise I should have seen at least the egg-masses before this."

PHASMIDÆ.

Anisomorpha buprestoides.

On Henshaw's authority Verrill (p. 823) also records this species as taken in Bermuda many years ago (about 1861) by A. S. Bickmore. The fact that both this and the preceding species have been unnoticed by other collectors, in spite of their conspicuousness wherever found, leads one to suspect the possibility of erroneous labelling.

ACRIDIDÆ.

Orphulella pelidna (Burmeister).

Uhler (p. 152) has recorded this species as *Stenobothrus maculipennis*, one of its synonyms. Probably *O. olivacea* is the species to which the reference should belong.

Orphulella olivacea (Morse).

Scudder (p. 43) has recorded this species, and a series of two males and five females taken in Warwick Parish, December 11 to April 18, are now before us. Probably Dahl's record of a species of *Orphula* and J. M. Jones' "small yellowish-brown colored grasshopper" belong to this species. The latter author says (p. 111) the species is "common on open tracts, particularly where the sandy waste is relieved by tufts of grass." The notes with the specimens in hand are to the effect that it is not rare and found on the south shore of Warwick Parish.

Orphulella speciosa Scudder.

This species was recorded by J. M. Jones in 1876 on Scudder's determination, the record being published as *Stenobothrus bilineatus*, one of the synonymic names of the species. It appears probable to the author that the record really refers to *O. olivacea*, a species unrecognized at that date.

Dissosteira carolina (Linnæus).

This species has been recorded by Jones and Verrill, and three females from Paget West, December 16–27, 1908, and summer of 1909 are in the present series. The two December specimens were the only ones seen by the collector during his stay, the summer individual having been sent him by a friend. These specimens have the median carina of the pronotum lower and more uniform in elevation than in the majority of specimens from the United States.

Schistocerca americana (Drury).

Caudell (p. 330) has recorded this species from Bermuda.

Paroxya bermudensis Rehn.

1909. *Paroxya bermudensis* Rehn, Ent. News, XX, p. 343. [Warwick Parish, Bermuda.]

The full data for this most interesting species are given in the original description. It is apparently a form which matures late in the fall and in early winter, as search in March, April and May in the section where the types were taken on January 15 revealed only immature individuals.

TETTIGONIDÆ.

Neoconocephalus triops (Linnæus).

Verrill (p. 821) has recorded this species as *Conocephalus dissimilis* on Henshaw's authority.

Neoconocephalus maxillosus (Fabricius).

This Antillean species is represented in the present series by a single male and two females taken in Paget West, December–January and summer of 1909, and at Walsingham, February 16.

These specimens are smaller than Redtenbacher's measurements of the species, but otherwise no differences exist. The male Paget West individual measures as follows:

Length of body	24.0 mm.
Length of fastigium	1.2 "
Length of pronotum	7.5 "
Length of tegmen	30.5 "
Length of caudal femur	18.0 "

This is the first record of the species from Bermuda.

Neoconocephalus fusco-striatus (Redtenbacher).

Scudder (p. 43) has recorded this species, and a pair taken in Paget West, December to January, are before us. According to the accompanying notes the species is not common at that season.

Orchelimum vulgare Harris.

Uhler (p. 158) has recorded this species on the basis of a badly broken female individual.

Conocephalus fasciatus (DeGeer). (*Xiphidium fasciatum* Auct.)

One male and three females of this species taken in Paget West are in the present series. This is the first record of the species from Bermuda, where it is said to be locally abundant.

GRYLLIDÆ.

Gryllus bermudensis Caudell.

This form, recently described on the basis of a single specimen, is represented in the present collection by an interesting series of forty-one individuals taken in Warwick Parish, in Paget West and on St. George Island, on a number of dates in December, January, April and May. The majority of the specimens are accompanied by habitat data, and the whole series presents some light on the extent of variability in size, proportions and coloration in material of this genus from a circumscribed locality.

The striking coloration of the type is hardly equalled in the series before us, although closely approached, but in no case is the extent of ochraceous on the head as great as originally described. Mr. Caudell, while in Philadelphia, kindly looked over some of the material treated in this connection and, as far as memory served him, he considered the specimens to belong to his species. It is apparent that the majority of specimens are darker and less contrastingly colored than the type, and it is as evident that a considerable amount of color variation is present in the species. From a type with the head and pronotum blackish, marked on the genæ, shoulders of pronotum, borders of the lateral lobes, cephalic edge of pronotal disk and around the eyes with ochraceous, and having the tegmina and limbs rufo-testaceous, the series can be laid in a graduated transition to a nearly uniform blackish type. The specimens from the south shore of Warwick Parish exhibit a constant type of coloration for the habitat, four males and two females from this section, all taken in April and May, having the head and pronotum shining black, with little or no ochraceous and comparatively pale tegmina and limbs. A depauperate pair from the meadows of Paget West, all seen from the locality, are blackish brown without any pale color, except on the angle of the tegmina where there is a touch of testaceous. The other series are either of a uniform type, blackish brown with a limited and variable amount of ochraceous on the genæ and pronotum, or each locality has several different shades of coloration.

In size we have an interesting case of depauperation in five specimens from Paget West and Warwick Parish Meadows and Warwick Parish without further data, all the other material being of what might be considered more normal size.

Careful tabulation of the proportions of the ovipositor and caudal femora reveals a variable disparity between the two, and while the correlation with the habitat is barren of results of a positive character, the suggestions are rather significant. The proportions of the females are as follows:

	Caudal femora.	Ovipositor.
Meadow: Warwick Parish	9.3 mm.	9.0 mm.
" " "	10.3 "	10.5 "
" Paget West	10.0 "	9.2 "
South shore: Warwick Parish	12.0 "	16.5 "
" " "	11.5 "	16.0 "
Inland: Paget West	12.8 "	18.0 "
" " "	10.2 "	12.0 "
" " "	10.8 "	11.8 "
" Warwick Parish	11.5 "	13.0 "
" " "	10.8 "	10.5 "
" " "	11.3 "	12.5 "
" " "	11.5 "	11.8 "
" " "	11.3 "	12.5 "
" " "	12.8 "	13.0 "
No habitat given: Paget West	11.5 "	11.5 "
" " "	12.8 "	16.5 "
" " "	11.0 "	13.8 "
" " "	11.8 "	13.0 "
" Warwick Parish	10.0 "	9.5 "
" " "	12.0 "	15.0 "
St. George Island	11.2 "	13.5 "

Retabulating the same specimens for the excess of one of these proportions over the other we have the following:

	Caudal femora exceeding ovipositor.	Ovipositor exceeding caudal femora.
Meadow: Warwick Parish	3 mm.	—— mm.
" " "	— "	.2 "
" Paget West	.8 "	—— "
South shore: Warwick Parish	— "	4.5 "
" " "	— "	4.5 "
Inland: Paget West	— "	5.2 "
" " "	— "	1.8 "
" " "	— "	1.0 "
" Warwick Parish	— "	1.5 "
" " "	.3 "	—— "
" " "	— "	1.2 "
" " "	— "	.3 "
" " "	— "	1.2 "
" " "	— "	.2 "
No habitat given: Paget West	0 "	.0 "
" " "	— "	3.7 "
" " "	— "	2.8 "
" " "	— "	1.2 "
" Warwick Parish	— "	.5 "
" " "	— "	3.0 "
St. George Island	— "	2.3 "

The series is divided as follows on wing length:

	Short-winged.		Long-winged.	
	♂	♀	♂	♀
Meadows: Warwick Parish	2	–	1	2
" Paget West	–	–	1	1
South shore: Warwick Parish	2	2	–	–
Inland: Paget West	1	1	3	2
" Warwick Parish	2	2	–	5
No habitat given: Paget West	2	3	3	1
" Warwick Parish	–	1	–	1
St. George Island	–	–	–	1

It is interesting to note that the depauperate individuals are all long-winged.

At the present time it does not appear desirable to attempt to make any statement on the systematic relationship of this species. To regard it as an entity worthy of a name, whether specific or subspecific, appears to us to be a necessary course, but what its possible origin was or nearest affinities are can only be determined by careful quantitative work on not only this, but also the closely related North American and West Indian species of the genus. Mr. Jones' notes are to the effect that the species is very abundant under stones.

Gryllus luctuosus Serville.

This species has been recorded by Uhler and Verrill, and also as the synonymous *abbreviatus* by the latter author. It is quite probable that these references really belong to the preceding species, *G. bermudensis.*

Gryllus assimilis Fabricius.

Dahl has credited this species, but no doubt the reference really belongs to *G. bermudensis.*

Liphoplus krugii Saussure.

Four females of this species, taken January 6 and 18 in Paget West, are in the collection. When compared with Cuban specimens they are found to be inseparable. The collector's notes are to the effect that the species is not frequent and that the specimens were beaten from cedar trees.

This is the first record of the species from the Bermudas.

Cylindrogryllus sp.

Dahl has recorded an undetermined species of this South American genus as living in numbers on a gray-leafed shrub growing in moist places. A strong suspicion exists in the author's mind that the well-known *Liphoplus krugii* may have been erroneously determined as a *Cylindrogryllus* by Dahl.

Literature.

1859. Jones, J. M. *The Naturalist in Bermuda.* London.
Orthoptera on pp. 109–112. Five species mentioned.

1876. Jones, J. M. *The Visitor's Guide to Bermuda, with a Sketch of its Natural History.* London.
Orthoptera by Scudder, p. 144.

1889. Uhler, P. R. Observations on the Insects of the Bermudas. In Angelo Heilprin, *The Bermuda Islands*, pp. 152–158.
Six species of Orthoptera mentioned.

1892. Dahl, Fr. Die Landfauna von Bermuda. In *Ergebnisse Plankton-Expedition der Humboldt-Stiftung*, Bd. I, pp. 104–112, taf. III.
Six species of Orthoptera mentioned on page 109.

1897. Hurdis, J. L. *Rough Notes and Memoranda relating to the Natural History of the Bermudas.*
Notes on three species of Orthoptera on pp. 326–327.

1897. Scudder, S. H. [Note on Bermuda Orthoptera.] *Psyche*, VIII, p. 43.
Six species listed.

1902. Verrill, A. E. The Bermuda Islands: Their Scenery, Climate, Productions, Physiography, Natural History and Geology; with sketches of their Early History and the changes due to Man. *Trans. Conn. Acad. Arts and Sci.*, XI, pt. II.
Orthoptera on pp. 821–828. Eighteen species recorded with more or less certainty.

1903. Caudell, A. N. Notes on the Orthoptera of Bermuda, with the Description of a New Species. *Proc. Ent. Soc. Wash.*, V, pp. 329–331.
Thirteen species mentioned.

SOME NOTES ON IDAHO ORTHOPTERA, WITH THE DESCRIPTION OF A NEW SPECIES OF TRIMEROTROPIS.

BY JAMES A. G. REHN.

The following notes and records are based on a small but interesting collection of Orthoptera made in the month of July at Springfield, Bingham County, Idaho, by Dr. Henry Skinner. One of the most interesting species in the collection is *Trimerotropis rebellis* Saussure, a form which stood on our lists as a species unrecognized in American collections for several decades.

MANTIDÆ.

Litaneutria minor (Scudder).

One female.

This is the first exact record of the species from Idaho, Scudder's only record from that State being "Southern Idaho," taken from Bruner's record of "*Ameles* sp."

ACRIDIDÆ.

Cordillacris affinis Morse.

Four females. July 25.

These specimens agree with the characters given by Morse for separating this species from *C. occipitalis*, and in addition the species is seen to differ in the narrower interspace between the eyes. This species was described from Ormsby County, Nevada, and is here recorded from outside that State for the first time.

Stirapleura delioatula (Scudder).

One female. July 25.

This is the first Idaho record of the species.

Hippisous neglectus (Thomas).

One female. July 25.

This specimen lacks the pale line along the posterior anal vein seen in some individuals.

Hippiscus validus Scudder.

Two females. July 24.

These specimens have the tegmina several millimeters longer than the measurement given by Scudder for the species, which was described from Blaine County, Idaho, and also exhibit other minor differences; but inasmuch as the specimens show considerable individual variation in themselves, it appears preferable to regard the material in hand as *validus*, at least until further information is available.

Conozoa wallula Scudder.

One female. July 25.

Trimerotropis rebellis Saussure.

Two males, one female. One dated July 25.

These specimens fully agree with the original description of the species which was described from California. Rehn and Hebard's *T. bilobata* is the closest relative of this species, differing, however, in the characters given in the diagnosis of their species.

Trimerotropis gracilis (Thomas).

One female.

This species has been recorded from Birch Creek, Idaho.

Trimerotropis arenaceus n. sp.

Types: ♂ and ♀; Springfield, Bingham County, Idaho. July 25, 1906. (Henry Skinner) [Acad. Nat. Sci. Phila.]

Related to *T. albolineata* Bruner and *T. cristata* McNeill, with specimens of both of which it has been compared, differing from both in the more robust build, the glaucous caudal tibiæ and the suppression of the dark dorsal bar on the entire length of the lateral lobes of the pronotum. The general color is much like that of *Trimerotropis maritima interior*, but the pronotal crest is very much more decided than in that race.

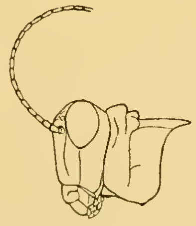

Fig. 1.—*Trimerotropis arenaceus* n. sp. Lateral outline of head and pronotum of male type. (× 3.)

Size slightly less than the average for the genus; form moderately slender; surface of the body more or less distinctly punctate except for the glabrous venter of the thorax and abdomen. Head with the occiput and interocular region strongly arcuate and distinctly elevated dorsad of the disk of the pronotum, the interspace between the eyes being hardly (♂) or distinctly (♀) broader than twice the width of the basal antennal joint; fastigium nearly half again as long as broad, decidedly excavate with a low medio-longitudinal carina, lateral carinæ well elevated, the depression extending caudad to between the eyes and not markedly delimited from the occiput, cephalad separated more or less distinctly by a V-shaped carina from the frontal costa; lateral forveolæ distinct, impressed, trigonal; frontal costa compressed dorsad of the insertion of the antennæ, expanding between the antennæ, very slightly constricted ventrad of the ocellus and thence expanding to the clypeal suture, moderately sulcate for a short distance ventrad of the ocellus, slightly sulcate dorsad of the same; eyes quite (♂) or moderately (♀) prominent, in length about equal to (♂) or slightly shorter than (♀) the infraocular sulcus;

Fig. 2. — *Trimerotropis arenaceus* n. sp. Dorsal view of female type. (× 2.)

antennæ distinctly exceeding the head and pronotum in length. Pronotum with the greatest dorsal width about equal to the greatest length; median carina distinctly elevated and cristate on the prozona, divided rather deeply into two lobes of which the cephalic is twice the length of the caudal, although but slightly higher than the caudal, the outlines of the lobes being rounded, except for the caudal portion of the margin of the cephalic lobe which is subangulate, varying in the two types, median carina distinct on the metazona, but not elevated except cephalad; lateral angles distinct, irregular cephalad, carinate on the cephalic portions of both the prozona and metazona; cephalic margin broadly obtuse-angulate, caudal margin slightly obtuse-angulate, metazona about one and one-half times the length of the prozona; lateral lobes deeper than long, subequal in width, ventral margin oblique, the ventro-caudal margin rounded, ventrad with a very blunt and low process. Tegmina exceeding the apex of the abdomen by about (♀) or nearly (♂) the length of the head and pronotum together, rather slender, the greatest width contained about five and one-half times in the length, the apex oblique rotundato-truncate. Wings rather narrow, the greatest width very slightly more than half the length. Caudal femora of medium build, the ventral carina hardly arcuate and not produced; caudal tibiæ with eight to nine spines on the external margin.

General color very pale pinkish ochraceous, becoming yellowish on the abdomen and venter, the overlying markings being dull, burnt umber. Head with the occiput obscurely mottled, the genæ pale but clouded with pale bluish and the carinæ beaded with the darker color, a faintly indicated transverse bar indicated by very weak clouds and clustered beading on the carinæ being present immediately ventrad of the antennæ and another midway between this and the sutural margin; eyes raw sienna; antennæ regularly annulate umber and pinkish, the annulations usually occupying a whole joint each. Pronotum uniformly stippled with the umber dorsad the lateral lobes with the metazona nearly uniform with the dorsum, the prozona with two longitudinal umber bands, one dorsad and the other mesad, the area between pale, a more or less distinct hoary white spot present about in the middle of the lateral lobes. Tegmina with the punctations of umber grouped irregularly into a median and one or two proximal groups, very poorly defined and limited almost entirely to the discoidal field, the distal half occasionally (♂ type) with an additional small irregular group indication and always with distinct infuscation of the longitudinal veins, infuscate cross veins in some cases forming contrasting cells. Wings with the proximal half pale greenish yellow, the apical portion hyaline with the principal veins blackish brown; transverse bar blackish brown varying some in intensity, narrow, in no case solid but always with the vein infuscation giving the body to the bar, nearly or quite reaching the caudal margin but not continued on it toward the internal margin; spur rather broad, reaching halfway to the base of the wing, separated by a very narrow hyaline area from the wing band. Cephalic and median limbs annulate more or less distinctly by clouds and bead grouping on the carinæ. Caudal femora with four distinct black areas on the internal face, one proximal, one distal, one premedian, one postmedian, the base color here pale greenish yellow, external face with two more or less distinct oblique bands, dorsal face with the bars of the internal face continued more or less distinctly upon it, ventral face dull yellowish with a distinct preapical black band and occasionally (♀ type) a median one is more or less distinctly indicated; caudal tibiæ glaucous, cream colored proximad with the genicular section blackish on the internal face, spines with their apical halves black; caudal tarsi pinkish ochraceous.

Measurements.

	♂	♀
Length of body	20.5 mm.	27.0 mm.
Length of pronotum	4.0 "	5.5 "
Length of tegmen	21.5 "	29.0 "
Length of caudal femur	11.5 "	15.0 "

A series of five male and three female paratypes have also been examined. These exhibit a slight amount of variation in size and an appreciable amount of difference in the intensity of the depth and size of the tegminal color blotches and in the intensity of the femoral bars. The wing bar is variable in intensity, but not in position or extent, and the general pale color varies only in two lines, *i.e.*, one toward a more pinkish type, the other toward a more distinctly ochraceous shade. The dorsal section of the frontal costa is distinctly sulcate in the majority of the paratypic males, but this is not nearly so apparent in the females. In one of the few specimens in which a median blackish spot is present on the ventral sulcus of the caudal femora it extends distinctly toward the base.

Trimerotropis laticincta Saussure.

One female. July 25.

This specimen has the left tegmen considerably aborted, its length being but three-fourths that of the normal right one.

Trimerotropis vinculata Scudder.

Ten males, fourteen females. Several dated July 25, remainder not dated.

One specimen has the head, thorax and abdomen hoary, while the majority of the series are slightly darker and more contrasted in coloration than the usual type, the markings being blackish brown.

Circotettix carolinianus (Thomas).

Three males, one female. July 25.

These specimens are similar in size to a pair from Soda Springs, Idaho. In two of the males which are spread the wings are without infuscation except along the radiate veins.

TETTIGONIDÆ.

Idiostatus variegata Caudell.

Two females.

The type material of this species consisted of a single female taken at Pocatello, Idaho, which remained unique until the present time. The measurements of the caudal femora and ovipositor of the Springfield specimens are as follows:

Length of caudal femora	19.5 mm.	22.5 mm.
Length of ovipositor	18.5 "	18.2 "

Stenopelmatus fasciatus Thomas.

Two females.

A NEW SPECIES OF ENCHYTRÆID WORM FROM THE WHITE MOUNTAINS.

BY R. SOUTHERN, B.SC.

In the late summer of 1907, after the meeting of the International Zoological Congress at Boston, Dr. Scharff visited the White Mountains in New Hampshire. He informs me that earthworms were very rarely met with in the forests at elevations of 2,000–3,000 feet, but he succeeded in finding a few specimens of *Helodrilus* (*Dendrobæna*) *rubidus* Savigny, *forma typica*, under the bark of trees. The typical form of this species has not yet been recorded with certainty from North America. Michaelsen, in 1900,[1] doubtfully includes North America, but later[2] he confines its distribution to Europe and Asia. The variety *subrubicunda* (Eisen) is widely distributed over the whole Northern Hemisphere. The typical form is endemic in the British Isles, Germany, France, Switzerland, Siberia and Iceland. Its occurrence on the latter island and on the eastern side of North America is interesting with reference to theories of a former land connection between Europe and North America by way of Iceland and Greenland.[3] After a close examination of the American specimens, I was unable to find a single character distinguishing them from the same species, which occurs commonly in Ireland.

In some damp moss, in which Dr. Scharff brought back some living slugs and newts from the White Mountains at an elevation of 2,000 feet, I found a single mature specimen of an Enchytræid worm which appears to be new to science, and for which I propose the name

Henlea scharffi sp. n.

It is 10 mm. long, and milky-white in color. The epidermis of the prostomium and first segment is covered with small glandular papillæ. The clitellum is formed by a mosaic of large granular glands, and occupies the 12th segment. In the anterior ventral bundles there are 5 setæ, which are approximately equal in length, slightly curved,

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[1] *Das Tierreich, Oligochæta*, Lief. 10, 1900, p. 490.
[2] *Die Geographische Verbreitung der Oligochæten*, Berlin, 1903, p. 140.
[3] R. F. Scharff, On the Evidences of a Former Land-bridge between Northern Europe and North America, *Proc. Royal Irish Academy*, Vol. XXVIII, B, 1909, p. 1.

and widely separated at the base. The head-pore is situated between the prostomium and first segment.

The brain (fig. 1) is concave before and behind. The length exceeds the breadth, and the greatest breadth is near the posterior end. No salivary glands were observed. The cœlomic corpuscles are large, flat, broadly oval to circular disks.

.The intestine widens out somewhat gradually at the beginning of the 9th segment. There are no intestinal pouches. The dorsal vessel rises in the 9th segment, and the blood is colorless. Three pairs of septal glands are present in the 4th, 5th and 6th segments.

The nephridia (fig. 2) have a large anteseptal, somewhat longer than broad. The postseptal is 2 to 3 times as long, and the duct,

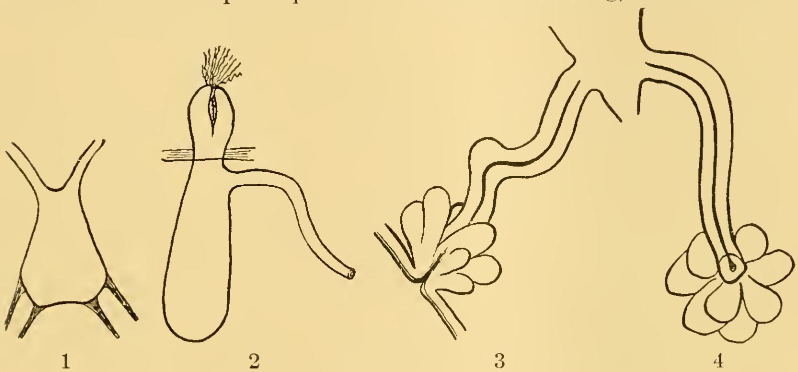

Fig. 1.—*Henlea scharffi* sp. n. The brain.
Fig. 2.—The nephridium.
Fig. 3.—The spermatheca.
Fig. 4.—The spermatheca seen through the body of the worm.

which equals the postseptal in length, rises from the anterior end. The spermathecæ, which lie in the 5th segment, are long and slender, showing no differentiation into duct and ampulla (figs. 3 and 4). The opening to the exterior is surrounded by a large rosette of glands. Fig. 4 shows this from the inside.

This description is very inadquate, owing to the lack of material, but sufficient was seen to differentiate this form from all other species of the genus. *H. scharffi* is characterized by the structure of the nephridia and spermathecæ, the number of setæ, the place of origin of the dorsal vessel, and the absence of salivary glands and intestinal pouches.

This species falls into that somewhat unsatisfactory section of the genus which is characterized by the absence of intestinal pouches. This group includes:

1. *Henlea dicksoni* (Eisen).

2. *H. rosai* Bretscher.
3. *H. pratorum* Br.
4. *H. sulcata* Br.
5. *H. lefroyi* Beddard.
6. *H. dorsalis* Br.
7. *H. rhætica* Br.
8. *H. stolli* Br.

None of these species have yet been recorded from North America. They may be separated as follows:

1. Salivary glands { present .... 2.
   absent .... 6.
2. No sharp distinction between œsophagus and intestine.......*H. lefroyi.*
   Very sharp distinction between œsophagus and intestine..........3.
3. Nephridial duct rises at the front end of the postseptal....*H. dicksoni.*
   Nephridial duct rises at the back end of the postseptal..........4.
4. Dorsal vessel rises in the 8th segment..........*H. rosai.*
   Dorsal vessel rises in the 7th segment..........5.
5. Nephridia with broad anteseptal..........*H. pratorum.*
   Nephridia with small anteseptal..........*H. sulcata.*
6. Swelling of gut in the 8th segment..........7.
   No swelling of gut in the 8th segment..........8.
7. Setæ of anterior ventral bundles 4–6..........*H. dorsalis.*
   Setæ of anterior ventral bundles 6–8..........*H. rhætica.*
8. Spermathecæ uniform in width; dorsal vessel rising in the 9th segment..........*H. scharffi.*
   Spermathecæ differentiated into duct and ampulla; dorsal vessel rising in the 8th segment..........*H. stolli.*

Members of this genus are characterized by the sudden change in diameter of the gut, where the œsophagus passes into the middle intestine, and by the frequent presence at this point of intestinal outgrowths or pouches. In *H. scharffi* these pouches are absent and the change in diameter is gradual, and is spread over half a segment. In this feature it bears some resemblance to the species *H. lefroyi*, described by Beddard[4] from India. In the latter species Beddard—working on preserved material—found that the œsophagus passed without any abrupt change in dimensions into the middle gut. The two species also resemble each other in being without the intestinal pouches. The genus *Henlea* includes a somewhat heterogenous assembly of species, and will probably be found to contain several distinct generic types. However, the present species may be placed provisionally in this genus.

The type-specimen is preserved in the Irish National Museum, Dublin.

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[4] *Proc. Zool. Soc. London*, 1905, II, pp. 61–64.

VARIATION OF POLYGYRA ALBOLABRIS IN MICHIGAN.

BY BRYANT WALKER.

Polygyra albolabris Say is not only the largest, but one of the most abundant and widely distributed species of the genus. It inhabits the whole of the Eastern States and Canada, ranging north to the Saskatchewan, south to Florida and west to Nebraska, Kansas and Texas. It may be fairly said to be the characteristic land snail of the region.

In view of the enormous extent of territory which it occupies, and the very diverse environmental conditions to which it is subjected, it would naturally be expected to show a very considerable range of variation. This is true particularly in the Southern States, where in the southeast two well-marked varieties (*major* Binn. and *fuscolabris* Pils.) have been developed, and in the southwest a third (*alleni* Weth.), which practically replaces the typical form west of the Mississippi from Missouri to Texas.

In the region north of the valley of the Tennessee River and east of the Mississippi, however, the typical form is everywhere present and, except in size and contour, presents no substantial variation.

Barring var. *dentata* Tryon, a dentate form, and var. *fusca* Billings, a color variation, which do not come within the province of this paper, the only varieties to receive recognition have been based mainly on size. There have been three of these to appear in the literature, of which only one has been fully described, viz.: var. *maritima* Pils.[1] from the New Jersey coast. Var. *minor* Sterki[2] from New Philadelphia, O., is simply stated to be "a peculiar, small, thin-shelled form." While var. *traversensis* Leach[3] was never described at all, but was a MSS. name attached to a small form collected by Leach near Traverse City, Michigan, which is stated by Pilsbry[4] to be "scarcely distinguishable" from var. *maritima*.

In the preparation of the writer's *Illustrated Catalogue of the Mollusca*

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[1] *Proc. Acad. Nat. Sci. Phila.*, 1890, p. 283.

[2] *L. and F. W. Mollusks of New Philadelphia, O.* (1894). The var. *minor* of Wetherby (1881) and of Sampson (1893) are referred to var. *alleni* Weth. by Pilsbry, *Proc. Acad. Nat. Sci. Phila.*, 1903, p. 197.

[3] *Manual of Conch.*, IX, p. 76 (1894).

[4] *Cat. Land Shells of Am.* (1898).

of Michigan, the fact of these references to a small form of *Polygyra albolabris* raised a question as to whether there was really a small race in Michigan worthy of varietal distinction or not, and led to the investigation, the results of which are embodied in this paper.

The material used consisted of 511 specimens, contained in six distinct sets as follows:

Fig. 1.

I. Two hundred and twenty-five specimens, representing the writer's collection of Michigan *albolabris.* These shells are from all parts of the State. It contains 53 separate lots, varying from 1 to 11 in number, from 38 of the 83 counties of the State. The accompanying chart shows the various counties represented in the collection, and the larger figures the total number of specimens from each county. While an inspection of this chart shows a lamentably large number of counties wholly unrepresented, it is to be borne in mind that the physical conditions of Michigan are much more uniform than in many other States where there is a greater diversity of surface, and that, therefore, as far as they go the specimens from the region south of the Saginaw-Grand Valley may be fairly considered as representative of all the counties in that district; the shells from the Grand Traverse region as of those characteristic of the sandy plains of the northern part of the Lower Peninsula, and those from the Upper Peninsula as representative of that region.

The small number of specimens from so large an area is, of course, unfortunate, but that could not be helped.

In considering the results of a study of this series, it is necessary to bear in mind the manner in which it has been accumulated. It is not an entirely "unprejudiced" series of specimens, *i.e.*, it does not include in every instance *all* the specimens that were collected at the locality represented. The collection in this particular may be divided into three classes:

1. A very considerable number of sets, mostly small in number of individuals, which are all the specimens that were collected at the particular place represented.

2. Sets received from correspondents, which were, no doubt, selected from a more or less extensive series of duplicates.

3. Sets collected by myself and selected from a larger number of specimens. In such cases it has always been my intention to preserve a representative series, consisting of the extreme forms and a fair representation of what appeared at the time to be average specimens. But, of course, the proportion of extreme specimens would be largely in excess of what it would be had the whole series been retained.

In view, therefore, of the very large proportion of selected specimens included in the series, it would seem likely that the series as a whole would give results, especially as to size, that would be in excess of that obtained from an entirely unprejudiced series.

II. One hundred and twenty-four specimens from Isle Royale, Lake Superior, Mich., collected by the University of Michigan Expedition in 1906. This series includes all the specimens collected on the island. The number of specimens was so much larger than the series from any other Michigan locality that it was deemed best not to incorporate it with the general Michigan series, on account of the preponderating influence it would have in determining the extent of variation in the shell as a whole. As shown by figs. 5 and 7, however the results, so far as the variation in height and width are concerned would not have been substantially changed. But the size of the average shell would be considerably reduced.

III. One hundred and fifty-two specimens from Cincinnati, O., collected by the late A. G. Wetherby. This was Prof. Wetherby's duplicate series, and may be fairly considered to be a representative series from that locality. It was used as being the only large series from a single locality available as a basis of comparison with the Michigan specimens.

IV. Seven specimens of *P. albolabris maritima* Pils. from Cape May, N. J., viz.: 3 from the collection of Mr. G. H. Clapp; 3 from that of the writer and the type as given by Pilsbry in the original description.

V. Three specimens of *P. albolabris minor* Sterki from New Philadelphia, O., received from Dr. Sterki.

VI. Nine specimens of the original lot of *P. albolabris traversensis*, collected by Leach near Traverse City, Mich. This set is also included in the general Michigan series (I).

For the purpose of comparing these different series and platting the results, three different measurements have been used:

1. The height, which is the distance from the apex to the lower base of the lip, measured on a line parallel with the axis.

2. The greater diameter, measured on a line at right angles to the axis and including the lip.

3. The ratio of the height to the diameter, obtained by dividing the altitude by the width, the resulting percentage being the axial index of the shell.[5] This method in the case of *albolabris* gives a reasonable basis of comparison as to the proportionate height of the shell, although it is obvious that it is neither accurate nor satisfactory as a basis for a comparison of shape, as two shells may have the same axial index and yet one be trochiform and the other planorboid. Owing to the comparatively low spire and large body whorl of *albolabris*, no satisfactory method of determining the comparative elevation of the spire and angular divergence of its sides has been suggested, and attempts in that direction were abandoned as futile.

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[5] See Baker, *Am. Nat.*, XXXVIII, p. 661 (1904).

The Cincinnati Series.

Say did not give the locality of his type of *albolabris* nor its height. Its width is given as one inch. W. G. Binney (*Manual Am. Land Shells*, p. 299) gives 30 x 17 mm. as the size of typical *albolabris*, but gives no information as to the basis on which the measurement was determined.

In the absence of any better basis for comparison, the Cincinnati series was adopted as probably representative of the species in the Ohio Valley and a locality about midway between the northern and southern range of the typical form.

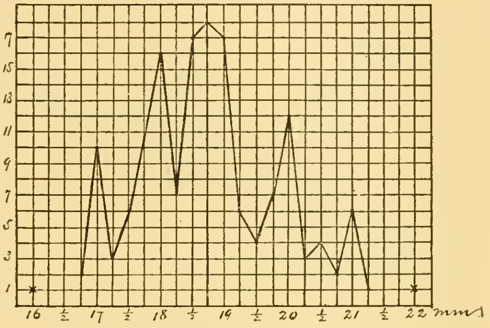


Fig. 2—Heights—152 Cincinnati.

The Cincinnati shells exhibit considerable variation in height, but within comparatively narrow limits, ranging from 16 to 22 mm., the average being 18.78. The major mode is at 18.75, with minor modes at 17, 18, 20 and 21. It is to be noted that practically one-half (75) of the specimens are from 18 to 19 mm. in height.

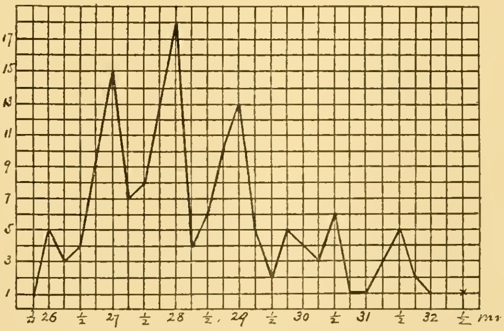


Fig. 3—Widths—152 Cincinnati.

The variation in width is within rather larger limits, ranging from 25.75 to 32.5 mm., with an average of 28.35. The curve is practically trimodal, the major mode being at 28 and the minors at 27 and 29. Ninety-four specimens or nearly 62 per cent. are from 27 to 29 mm. in diameter. It is also to be noted that only a single example is less than 26 mm. in diameter.

Fig. 4—Axial index—152 Cincinnati.

In comparison with the variability in height and width, the curve of the axial index is remarkably simple, showing great uniformity in the series in the general proportions of the shell. The curve is practically unimodal, culminating at 67 per cent., the average being 66 per cent. Eighty-nine specimens or 58 per cent. have an index between 66 and 68 per cent.

The Minor Varieties.

The number of authentic specimens of the three smaller varieties available for study is too small to justify platting a curve for them separately.

The dimensions of the several specimens of each form are as follows:

1. Var. *maritima* Pils.:

Alt..........	13.00[6]	17.50	15.25	15.25	16.00	17.00	15.00
Diam......	22.00	24.00	23.00	22.00	22.50	24.00	21.50
Index......	.59	.73	.66	.69	.71	.71	.70

[6] Pilsbry's type.

The average shell is 22.7 x 15.6 mm., with an index of .68. Compared with the remainder of the series, the type is more depressed, having an index of .59 as against an average index of .70.

2. Var. *minor* Sterki:

Alt	15.75	13.75	13.25
Diam	24.00	20.50	19.25
Index	.66	.67	.69

The average shell is 21.25 x 14.25 mm. with an index of .67.

3. Var. *traversensis* Leach:

Alt	14.00	13.50	13.75	13.00	12.25
Diam	23.75	21.25	20.50	21.00	19.75
Index	.59	.61	.67	.62	.67

Alt	15.00	13.75	12.50	12.00
Diam	23.00	22.00	20.50	20.00
Index	.65	.63	.61	.60

The average shell is 21.31 x 13.31 mm. with an index of .63. At the same time that Dr. Leach collected these recent shells, he also collected a series of fossil shells from the marl lying beneath the present forest, where the typical set was found. The series is of interest as showing that, as a local form, this variety has existed in the same place for a very long period of time and substantially unchanged in character. The dimensions of this series (14) are as follows:

Alt	15.00	17.75	17.00	15.75	16.50
Diam	23.00	25.75	26.00	23.25	23.00
Index	.65	.67	.65	.68	.72
Alt	16.00	14.50	14.50	13.00	14.00
Diam	25.00	22.00	22.25	21.25	21.50
Index	.64	.66	.65	.61	.65

Alt	14.75	12.00	12.75	12.50
Diam	22.50	18.00	19.00	17.50
Index	.66	.66	.67	.71

The average shell is 22.14 x 14.71 mm. with an index of .66. Comparing this series with the recent shells, it is to be noted that while the range of variation both in height and width is greater in the fossil series, the average shell in each series is very nearly the same. The fossil shell, however, is slightly larger, .83 mm. in diameter and 1.4 mm. in height, and proportionately higher.

Comparing the average shell of the four series, we have:

	Alt.	Diam.	Index.
maritima	15.60	22.70	.68
minor	14.25	21.25	.67
traversensis (recent)	13.31	21.31	.63
" (fossil)	14.71	22.14	.66

This shows that, while all the western shells are smaller and more depressed than the eastern form, the average *minor* and fossil *traversensis,* though somewhat smaller than the average *maritima,* have nearly the same index. The recent *traversensis,* however, are not only considerably smaller but also proportionately more depressed. While the recent shells are too few in number and too variable to establish a satisfactory curve, the following arrangement of the several frequencies in the 19 specimens is nevertheless of interest, both as showing the range of variation and for comparison with other series.

Diam	19.25	19.75	20.00	20.50	21.00	21.25
No	1	1	1	3	1	1

Diam	21.50	22.00	22.50	23.00	23.75	24.00
No	1	3	1	2	1	3

Average, 22.97 mm.

Alt	12.00	12.25	12.50	13.00	13.25
No	1	1	1	2	1

Alt	13.50	13.75	14.00	15.00	15.25
No	1	3	1	2	2

Alt		15.75	16.00	17.00	17.25
No		1	1	1	1

Average, 14.21 mm.

Index	.59	.60	.61	.62	.63	.65
No	2	1	2	1	1	1

Index	.66	.67	.69	.70	.71	.73
No	2	3	2	1	2	1

Average, .66.

Comparing these results with those derived from the Cincinnati series, it is to be noted:

1. That while both series vary greatly in diameter they do not overlap, there being a break of 1.75 mm. between the largest of the "minor" series and the smallest of the Cincinnati shells. The average diameter of the minor series is 22.97, as against 28.35 mm. in the Cincinnati series, and that while 62 per cent. of the Cincinnati series are from 27 to 29 mm. in diameter, more than 68 per cent. of the minor series are from 20 to 23 mm. in width.

2. That notwithstanding this great difference in size, the proportions of the shells of both series are substantially the same, the index of the minor series ranging from .59 to .73 and that of the Cincinnati series from .60 to .74, the average index in both series, however, being the same, .66.

3. That while perhaps it may be claimed that the minor series is too small, in proportion to the Cincinnati series, to give any satisfactory comparison, nevertheless the evidence, such as it is, certainly tends to show the existence of a smaller race of substantially the same general shape, but averaging 5.36 mm., or 19 per cent., smaller in diameter.

The General Michigan Series.

As shown by the figure, this series exhibits great variability in

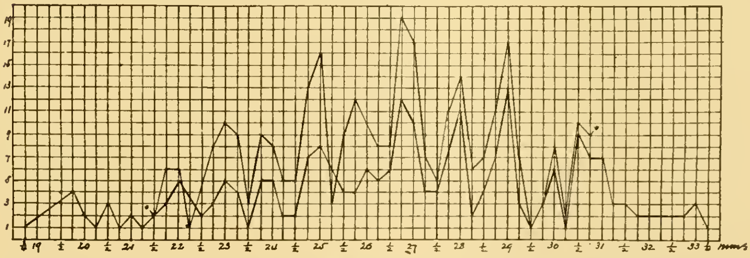


Fig. 5—Widths—Upper line, 225 Michigan and 124 Isle Royale. Lower line, 225 Michigan.

size, ranging from 18.75 to 34.25 mm. in width, with an average of 26.95. The major mode is at 29, with minor modes at 30.5, 28, 26.75 and 25. The average is 26.95 mm. There is a decided break at 24.5, below which there is a series of minor modes at 24.23, 22 and 19.75.

Were it not for the strong minor mode at 24.75 and 25, the break at 24.5 would be much more conspicuous. As the fifteen specimens aggregated at these points are from twelve different localities, scattered all over the State and in both peninsulas, it is evident that this is a feature of the Michigan race as a whole, and not the result of a few sets of strongly characterized local forms. The same peculiarity appears in the Isle Royale series (fig. 12), and is intensified when the two series are combined (fig. 5). It is similar to the strong minor mode culminating at 30.25. Indeed, the diversion of the whole series between 24.50 and 34.25 mm. into five well-marked groups is quite striking. In the same way the minor series below 24.5 is divided into five similar groups.

It is to be noticed that the break in this series at 24.5 is substantially at the same place where the break occurs between the Cincinnati and the "minor" series. This is apparently more than a mere coincidence. It is certainly corroborative evidence tending to strengthen the inference drawn from the comparison of those series.

Of the 225 specimens in the Michigan series, 55 are 24.5 mm. in diameter or less and 170 are more than 24.5. Of the smaller group 8 are from the Upper Peninsula and 47 from the Lower. Of the larger series 34 are from the Upper and 136 from the Lower Peninsula. That is, in the Upper Peninsula 19 per cent. belong to the smaller race and 26 per cent. in the Lower Peninsula.

In fig. 1 the number of specimens of 24.5 mm. or less in diameter from each county are represented by the smaller figure. Thus in Kent County, of the 30 specimens in the series, 9 are of the smaller race.

In considering the probability of the existence of a small race, it is necessary to distinguish between dwarf individuals, which occur occasionally in all series of any extent, and a *race* of small individuals, which are all more or less characterized by their diminutive size. It is only the latter, of course, that is entitled to recognition in any proper varietal sense.

From an inspection of fig. 1, it will appear that, while the small individuals are fairly well scattered over the State and in some cases are no doubt individual dwarfs, they are nevertheless more numerous in the northern part of the State, where the environmental conditions are generally more unfavorable to molluscan life and likely to affect the species as a whole. And it is significant also that of the entire series of 55, no less than 37 occur in the four counties of Charlevoix, Grand Traverse, Huron and Kent. The series from Kent is peculiar in being from so far south and in a county where the typical form is also well represented. The series, however, is well marked and probably the result of some peculiar local conditions. Unfortunately all data on this point are lacking.

On the whole, therefore, there seems to be reasonable ground for dividing the Michigan series into two groups at this point (24.5 mm.), and for the purposes of this paper they will be treated on that basis, although there is no doubt but that a certain proportion of the series of smaller shells are individual and not racial diminutives. For purposes of convenience and ignoring all questions of synonomy between the varietal names of *maritima*, *minor* and *traversensis*, the smaller race will be termed the "minor" form and the larger race will be referred to as the "major" form.

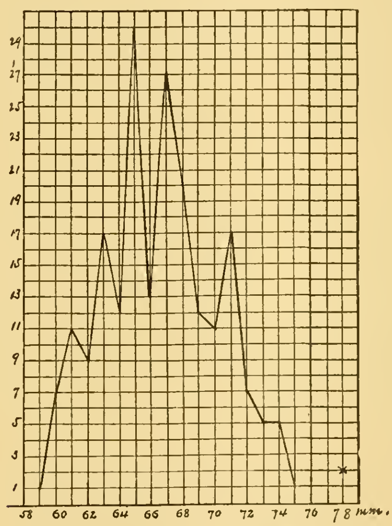


Fig. 6—Axial index—225 Michigan.

The range of variation in the axial index of the Michigan series, taken as a whole, is very considerable, ranging from .59 to .75, with an average of .67. The curve is multimodal, but within rather narrow limits, the major mode being at .65, a conspicuous minor mode at .67, and two others of the same height at .63 and .71. Compared with the Cincinnati series, it shows much greater variability but with nearly the same average proportion. One hundred and seven specimens, or 48 per cent., are between .64 and .68, while only 63, or 28 per cent., are between .66 and .68, as against 59 per cent. in the Cincinnati series.

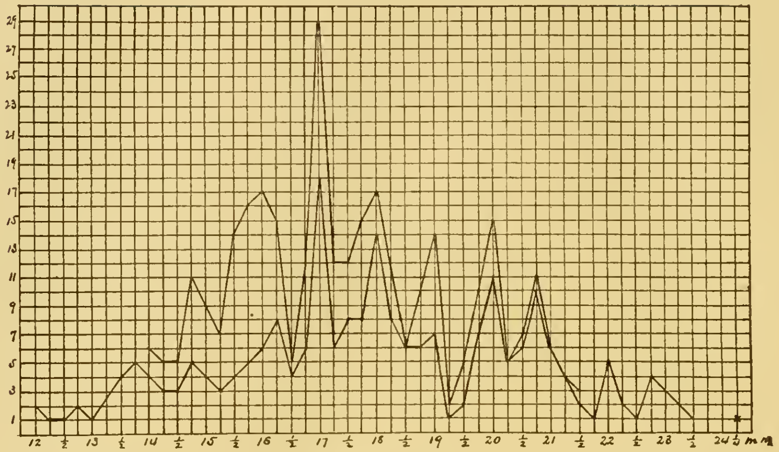


Fig. 7—Heights—Upper line, 225 Michigan and 124 Isle Royale. Lower line 225 Michigan.

The 170 specimens of the major form vary in height from 15.25 to 24.25, with an average of 19.06 mm.

The major mode is at 17, with well-marked minor modes at 18, 20 and 20.75.

In width (fig. 5) the series vary from 24.75 to 34.25 mm., with an average of 29.31. The major mode is at 29, with conspicuous minor modes at 25, 26.75, 28 and 30.5.

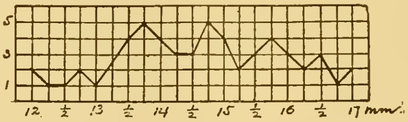


Fig. 8—Heights—55 Michigan, minor form.

The 55 specimens of the minor form vary from 12 to 17 mm. in height, with an average of 14.67. The curve is practically trimodal, with the modes at 13.75, 14.75 and 15.75.

In width (fig. 5) this series ranges from 18.75 to 24.5 mm., with an average of 22.3. The curve is multimodal, with nearly equal modes at 19.75, 20.5, 22, 23, 23.75 and 24, indicating a higher degree of variability than in the major form.

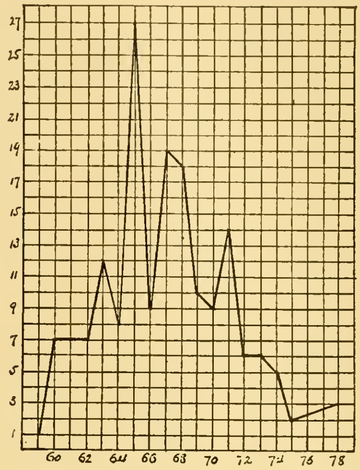


Fig. 9—Axial index—170 Michigan, major form.

The axial index of the major form varies from .59 to .78, with an average of .67.

The curve is multimodal, culminating at .65, with minor modes at .63, .67 and .71.

The similarity between this curve and that for the entire Michigan series is very striking, and both have a general resemblance with that of the Cincinnati series, but show greater variability.

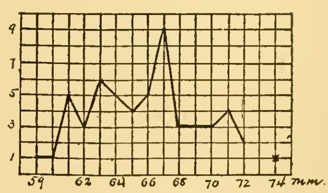


Fig. 10—Axial index—55 Michigan, minor form.

The index of the minor form ranges from .59 to .74, with an average of .66. The curve is also multimodal, but shows greater variability than in the typical series. The major mode is at .67, with minor modes at .61, .63 and .71.

The Isle Royale Series.

This series is of interest as being, like that from Cincinnati, representative of a comparatively restricted region with no great variation

3

in the environmental conditions. Compared with the general Michigan series, coming from a very much greater extent of territory and representing the effect of very diverse conditions of environment, it would naturally be expected, like the Cincinnati series, to show much less variation. This is true so far as the height of the shell is concerned. But in width the range of variation is much greater and is more similar to that of the general Michigan series. This is owing to the fact that both the Isle Royale and Michigan series extend below 24.5 and include the minor race, which does not appear in the Cincinnati series.

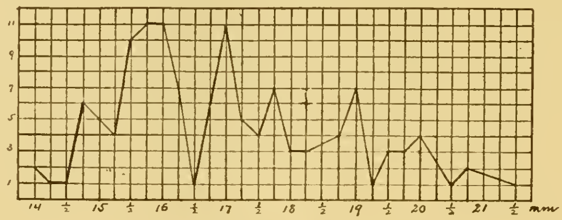


Fig. 11—Heights—124 Isle Royale.

In height the Isle Royale series varies from 14 to 21.5 mm., with an average of 17. As in the Cincinnati series, the curve shows considerable variation, but within narrower limits than in the general Michigan series, the range of variation in both being within 7½ mm., while in the general Michigan series the range of variation covers 12½ mm. The curves of both the Isle Royale and Cincinnati series are very similar, the former, however, showing somewhat great variability and averaging 1.78 mm. lower. Fifty-seven specimens or 46 per cent. are between 15.5 and 17 mm. in height, as against 50 per cent. between 18 and 19 mm. in the Cincinnati series.

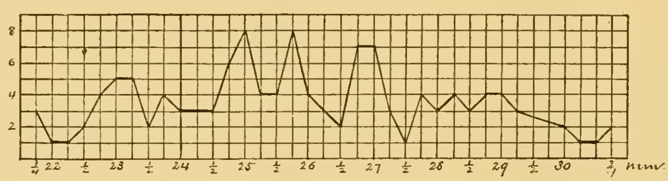


Fig. 12—Widths—124 Isle Royale.

In width the Isle Royale series varies from 21.75 to 30.75 mm., with an average of 25.86. The curve is very similar to that of the general Michigan series, but within somewhat narrower limits, 21.75–30.75

as against 18.75–34.25. The average shell is smaller, being 25.86 as against 26.95 mm.

It is to be noted that a decided break occurs in the curve at 24.5, as in the general Michigan series. Thirty-six specimens or 28 per cent. are 24.5 or less in diameter, as against 24 per cent. in the general series.

Eliminating these, the curve of the remaining 88 specimens of the major form is quite similar in a general way to that of the Cincinnati series and to that of the major race in the general Michigan series, but is like the latter in showing greater variability as compared with the Cincinnati series. The range of variation in the Isle Royale and Cincinnati series is about the same, but only two-thirds that of the general Michigan series. The three series may be compared as follows:

Cincinnati varies from 25.75 to 32.5 or within 6.75 mm.; average 28.35.
Michigan varies from 24.75 to 34.25 or within 9.50 mm.; average 29.31.
Isle Royale varies from 24.75 to 30.75 or within 6.00 mm.; average 26.97.

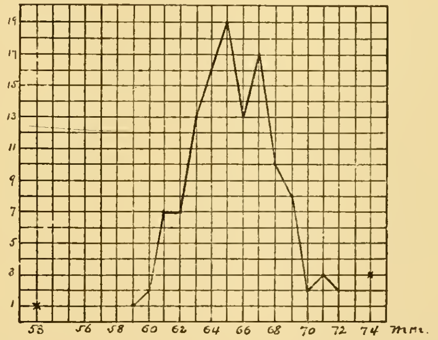


Fig. 13—Axial index—124 Isle Royale.

The axial index of the Isle Royale series varies from .59 to .72, with an average of .65. The curve is bimodal, with the major mode at .65 and the minor at .67. It is intermediate between that of the Cincinnati series and that of the general Michigan series, which it resembles more than it does the former, differing mainly in being more simple by the suppression of the conspicuous minor modes at .61, .63 and .71.

Comparative Notes upon the Different Series.

1. The shells of the Upper and Lower Peninsulas.

Of the general Michigan series, 42 are from the Upper Peninsula and 183 are from the Lower. As shown by figs. 5 and 12, the curve of widths in both series is very similar. This being so, if the Upper Peninsular examples from the general series are added to the Isle Royale series, we shall have a fair basis for comparison of the species as between these two portions of the State. There are then 166 Upper Peninsular specimens and 183 from the Lower Peninsula.

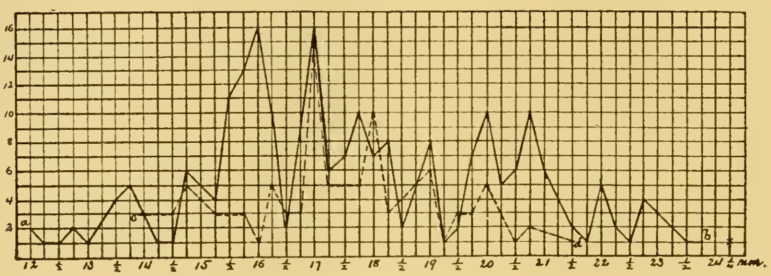


Fig. 14—Heights—*a* to *b*, 183 Lower Peninsula; *c* to *d*, 166 Upper Peninsula.

The Lower Peninsular series varies in height from 12 to 24.25 mm. with an average of 18.10. The Upper Peninsular series ranges from 14 to 21.50 mm., with an average of 17.02.

The Lower Peninsular series not only has a much wider range of variation, but is more variable within that range.

Both series are alike in having a conspicuous mode at 17 mm. But the conspicuous modes at 16 and 21.75 mm. in the Lower Peninsular series are practically lacking in the Upper Peninsular series. In other respects the two curves are very similar.

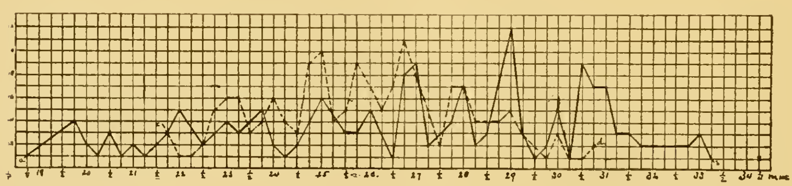


Fig. 15—Widths—*a* to *b*, 183 Lower Peninsula; *c* to *d*, 166 Upper Peni nsu

In width the two series show the same general similarity, exhibiting great variability with conspicuous modes at nearly the same points, the Lower Peninsular series differing mainly in the prominent modes at 29 and 30.5 mm. and in the greater range of variation.

The Upper Peninsular series varies from 21.75 to 30.75 mm. with an average of 25.81, while the Lower Peninsular series ranges from 18.75 to 34.25 mm. with an average of 27.10.

It is to be noted that both curves show the same decided break at 24.5 mm.

Forty-seven or 25.7 per cent. of the Lower Peninsular and 44 or 26.5 per cent. of the Upper Peninsular shells are 24.5 mm. or less in diameter, while 122 or 73.5 per cent. from the Upper Peninsula and 136 or 74.3 per cent. from the Lower belong to the major race so called.

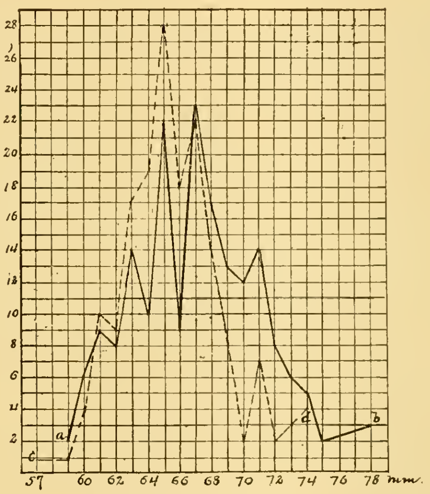


Fig. 16—Axial index—*a* to *b*, 183 Lower Peninsula; *c* to *d*, 166 Upper Peninsula.

The curves of the axial index of the two series are almost exactly the same, the modes being in every instance at the same point, but with some slight variation in the number of frequencies and with a slightly larger range of variation in the Lower Peninsular series. The average index in the Upper Peninsular series is .654, as against .677 in the Lower Peninsula.

The average shells of the two series compare as follows:

	Alt.	Diam.	Index.
Upper Peninsular	17 02	25.81	.654
Lower Peninsular	18.10	27.10	.677

The average Upper Peninsular shell is 25.81 x 17.02 mm. If it were of the same proportions as the average Lower Peninsular shell, it should be 17.24 mm. in height and of course with the same index.

That is, the average Upper Peninsular shell is smaller by 1.08 mm. in height and 1.29 mm. in width and proportionately more depressed by .22 mm.

2. The Minor Races.

The several series of the "minor" form may be tabulated as follows, using the average shell as a basis of comparison:

	Alt.	Diam.	Index.
1. *maritima*	15.60	22.70	.68
2. *minor* Sterki	14.25	21.25	.67
3. *traversensis*	13.31	21.31	.63
4. Upper Peninsular series	15.44	23.31	.66
5. Lower Peninsular series	14.04	22.18	.66
6. General Michigan series	14.67	22.30	.66
7. Total Michigan series (4 and 5)	14.74	22.75	.66

From this table it will be seen—

1. That all the Michigan shells of the minor form are more depressed than the typical *maritima* and *minor* Sterki. This is specially true of the typical *traversensis*.

2. That, with the exception of the typical *traversensis* series, all the Michigan series have the same index. It is to be noted, however, that the *traversensis* series is included in series 5, 6 and 7, and that, if that series was eliminated, the index of these series would be somewhat increased and more closely approximated to that of *maritima* and *minor* Sterki.

3. That the Upper Peninsular series average larger than that of the Lower Peninsula by 1.4 mm. in height and 1.13 mm. in width. This is in marked contrast with the major forms of the two series, in which the Lower Peninsular shell is larger by 1.08 mm. in height and 1.29 mm. in width. This is well shown by comparing the two curves in fig. 15.

4. On the whole, however, the several series show a remarkable uniformity. It would seem to be reasonably clear that the minor form of *albolabris* varies in about the same way within certain fairly defined limits. There is reason to believe that in certain locations these peculiarities affect the whole race, and in such cases is worthy of varietal recognition. It is equally true, no doubt, that many of the minor shells are merely depauperate individuals. But whichever is the case, so far as size and proportion are concerned, the amount and range of variation is substantially the same. The explanation of this probably is that the amount of depauperization that the species will sustain and still exist is substantially the same everywhere,

and that consequently the result of unfavorable conditions, whether applied to the individual or to a local colony, will be within certain limits very similar.

It is to be noticed that the axial index of the major and minor forms is substantially the same. That is to say, that while there is a well marked division into two races, the variation is mainly one of size and not of proportion.

3. The Major Races.

The average of the several "major" series may be compared as follows:

	Alt.	Diam.	Index.
1. Cincinnati series	18.78	28.35	.66
2. Upper Peninsular series	17.59	26.79	.65
3. Lower Peninsular series	19.44	29.26	.677
4. General Michigan series	19.06	29.31	.67
5. Total Michigan series (2 and 3)	18.52	28.03	.665

Taking the average Cincinnati shell as a basis for comparison, we find that the Upper Peninsular shell is smaller both in height and width and also more depressed; while the Lower Peninsular shell is both higher and wider and proportionately more elevated. This is also true of both series 4 and 5, the latter, however, being very close to the Cincinnati type in every particular.

As it is a matter of common knowledge that the southern *albolabris* are usually larger than those from the Northern States, the larger size of the average Lower Peninsular shell seems peculiar. But this is probably owing to the fact that the series is not an "unprejudiced" one, but, as already explained, contains a larger proportion of selected specimens than would occur in a natural series.

The inclusion of a certain proportion of Upper Peninsular shells in the general Michigan series serves to reduce the average size, and in series 5 a still greater addition of the smaller northern form brings the average down nearly to that of Cincinnati. It seems probable, therefore, that a large and unprejudiced series of southern Michigan shells would show an average not to exceed and quite likely somewhat smaller than the Cincinnati type.

While it is true that the results obtained from the Lower Peninsular series are perhaps subject to criticism as to size, there does not seem any ground to question the results obtained by a comparison of the axial indices, which show that the Upper Peninsular shell is somewhat more depressed, while the Lower Peninsular type is considerably more elevated than the Cincinnati shell.

In this connection it is to be noted that the axial index shows simply the proportion between the height and the width. It does not necessarily show that one race is more conical than the other. It is to be regretted that no satisfactory method for definitely determining this fact was found. In the absence of specific proof, it is only possible to record the writer's impression, derived from a careful study of the material, that as a rule the Lower Michigan shells are not only proportionately more elevated, but are actually more conical in shape.

Conclusions.

From a careful study of the foregoing data, the following conclusions seem to be justified:

1. That *Polygyra albolabris* in Michigan exhibits great variability in size.

2. That both the Upper and Lower Peninsular series show a well-marked division into two parts, the dividing line being at 24.5 mm. in width.

3. That this dividing line corresponds quite exactly with that separating the several described minor varieties and the typical form as exemplified by the Cincinnati series.

4. That the evidence tends to show that when depauperization takes place in *P. albolabris,* whether in individuals or in local races, the results are within certain fairly definite lines.

5. That when depauperization affects substantially the whole race in a particular locality or district, it is sufficiently permanent to be worthy of varietal recognition.

6. That the depauperate shells of the Lower Peninsula are on an average smaller and more depressed than those of the Upper Peninsula.

7. That the major (or typical) series of the Upper Peninsula is smaller and more depressed than that from the Lower Peninsula.

8. That the major series of the Lower Peninsula is larger and more elevated than the Cincinnati series.

9. That this is probably to be accounted for by the fact that the Michigan series is not an unprejudiced one and contains a large proportion of selected specimens.

10. That the average shell of both Michigan series combined is substantially the same as that of the Cincinnati series.

11. That the great variability of the Michigan series, taken as a whole, as compared with the Cincinnati series, is due mainly to the greater diversity of environmental conditions.

February 1, 1910.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Twelve persons present.

The reception of a paper entitled "Mollusca of the Southwestern States: IV. The Chiricahua Mountains, Arizona," by H. A. Pilsbry and J. H. Ferriss (January 26, 1910), was announced by the Publication Committee.

Henry A. Pilsbry, Sc.D., made a communication on parallel and convergent evolution in snails. (No abstract.)

Dr. Nolan exhibited and commented on specimens of Cingalese script. (No abstract.)

February 15.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Twenty-eight persons present.

The Publication Committee reported the reception of papers under the following titles:

"Cratægus in Pennsylvania, II," by C. S. Sargent (February 8, 1910).

"A new Species of Marinula from near the head of the Gulf of California," by Henry A. Pilsbry (February 12, 1910).

John M. Macfarlane, Ph.D., made a communication on variation, hybridization and heredity in native plants, illustrated by specimens. (No abstract.)

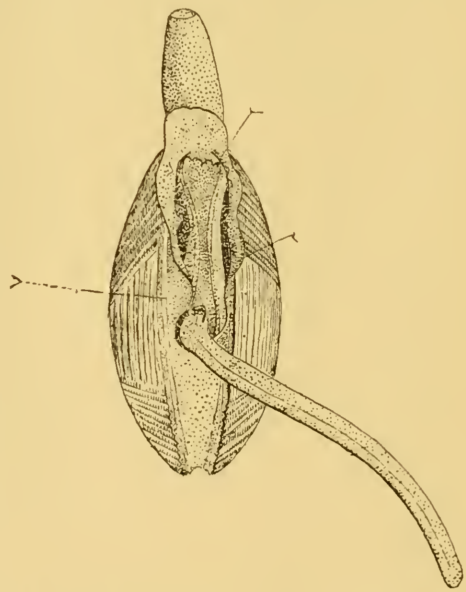
Merkel H. Jacobs, E. Waterman Dwight and Edward Anthony Spitzka, M.D., were elected members.

The following were ordered to be printed:

MODIOLARIA MARMORATA AND THE SURFACE FILM.

BY HAROLD SELLERS COLTON.

That small organisms act to the surface film of the water very much as they would react to a solid substratum is a matter of common observation. Thus we see *Hydra* and various colonial protozoa hanging from the surface film, and such mollusks as *Lymnœa* and *Physa* crawling on its under side. Although the writer has never seen it reported, yet it is not strange that lamellibranch mollusks should react likewise. To be sure few lamellibranchs use their foot in a manner comparable to the broad crawling organ of the gasteropod, yet young ones oftentimes use their ciliated foot in a similar fashion. However, one morning last winter at Naples, the writer observed an adult *Modiolaria* crawling on the surface film by means of its byssus. Being at once struck by seeing so large an animal suspended by such slender threads attaching it to so uncertain a substratum, he at once made a sketch of it (see figure).



View of *Modiolaria marmorata*, looking down upon it as it was suspended from the surface film. The threads represent the byssus, and the "V" at the end, the depression of the surface film.

The specimen in question was found hanging by three threads and was already secreting a fourth. In other words it was progressing exactly as *Mytilus* would have done on a solid substratum. Where the threads were fast to the surface the film was depressed. Although *Lymnœa* and *Physa* expose a large area of foot to the film, this animal, not so big it is true, hangs from three or four points.

The specimen has been very kindly identified by Dr. Henry A. Pilsbry as *Modiolaria marmorata* Forbes. This is a small Modiolaria (8 mm. x 5 mm.) which for protection buries itself deep in the test of such large Ascidians as *Phalusia mammilata* or *Ascida mentula.* It is an abundant form at Naples, and well worth a more extended study.

MOLLUSCA OF THE SOUTHWESTERN STATES: IV. THE CHIRICAHUA MOUNTAINS, ARIZONA.

BY H. A. PILSBRY AND J. H. FERRISS.

CONTENTS.

The Chiricahua Mountains stand near the southeastern angle of Arizona, extending for about fifty miles from northwest to southeast, being one of the numerous short roughly parallel ranges of that part of New Mexico and Arizona. The Peloncillo range, lower and very arid, sharply limits the horizon eastward, distant about twenty miles. The next range westward is the Dragoon Mountains, fully thirty miles away. These ranges are separated by mesa having an elevation of about 5,000 feet, but lower in the middle.

The northwestern end of the range is known as the Dos Cabezas Mountains, being separated from the main range by a depression to 5,500 feet near Fort Bowie. The mountains as far south as White Tail Canyon are rather arid, the trees stunted oaks and piñons, with small beech, walnut, willow, buttonwood, etc., in the canyons. The Cave Creek region is much more verdant and at elevations of 8,000 feet and over there are fine pine and spruce forests.[1] The mountains are rugged, almost everywhere cut into sharp ridges and peaks, the slopes steep and stony or rocky, often broken by cliffs. The accompanying map gives a general idea of the positions of the various valleys or canyons mentioned herein. Various maps of single canyons give the locations of collecting stations.[2]

[1] For an account of the flora of the Chiricahuas see J. C. Blumer, The Plant Geography of the Chiricahua Mountains, *Science*, XXX, p. 720, November 19, 1909.

[2] The general map of the range and that of Cave Creek Canyon were drawn from sketches made by both authors, with some few additions to the general map from a map of the Chiricahua Forest Reserve, published by the Forest Service, U. S. Department of Agriculture, 1906. This map is very inaccurate in many details, yet useful in the absence of anything better. The other maps of canyons are from the note-book of one of the authors. Elevations where given herein are in part from the Forest Reserve map, in part estimated; and all must be accepted as only approximate.

The highest part of the range, and that florally and faunally richest, has been included since 1906 in a U. S. Forest Reserve; the rest of the range has no timber large enough to tempt the lumberman, and

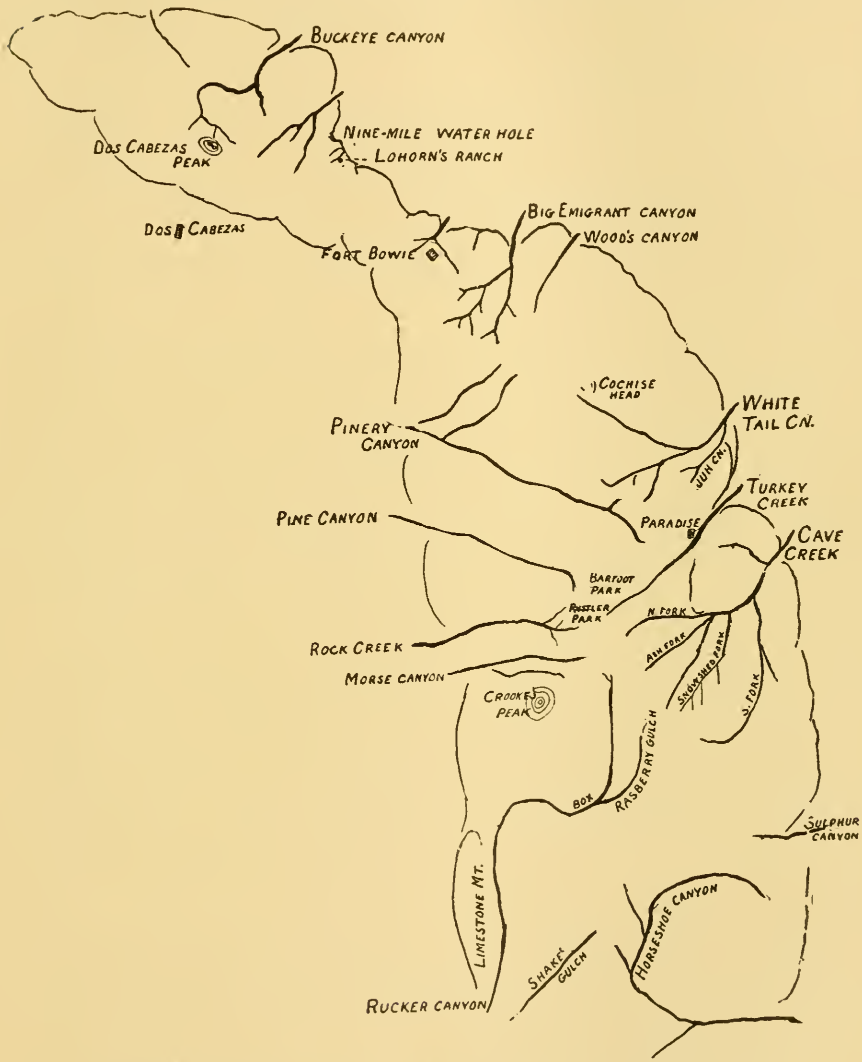


Fig. 1.—Map showing positions of the canyons in the Chiricahua range.

serves as cattle ranges. The conditions of molluscan life are likely to remain undisturbed for many years.

We have herein given an account of the present status of the molluscan fauna as full as circumstances permitted. In many of the canyons we have endeavored to locate the individual snail colonies with sufficient detail to insure their recognition by subsequent observers, so that their further evolution may be followed. Large areas still remain to be explored, and neither author has had time to fully study the material collected.

The first record of mollusks from the Chiricahuas was made by Dr. R. E. C. Stearns, who in 1890 describes specimens of *Holospira arizonensis*,[3] collected by Mr. Vernon Bailey for the U. S. Department of Agriculture at Dos Cabezas, in the western foothills of the Dos Cabezas Mountains. In 1895 Dr. W. H. Dall described *Polygyra chiricahuana* and subsequently (1897) he reported *Pyramidula striatella*, *Thysanophora ingersolli* and *Zonitoides arborea*,[4] all from Fly's Park in the central Chiricahuas, collected by Dr. Fisher. No other species were known from the range prior to the first visit by Mr. Ferriss in February, 1904. Numerous new species were found during this brief visit, notwithstanding the unfavorable season. In November, 1906, both of us collected in the range, exploring the principal canyons from Buckeye in the north to Cave Creek and the parks about its head. In November, 1907, Messrs. Ferriss and L. E. Daniels spent two weeks in the Chiricahuas, and in 1908, from September 20 to November 15, Ferriss continued the work of exploring the southern canyons.

I. Conditions Determining the Isolation of Snail Colonies.

The faunas of the several mountain ranges of southern Arizona are separated one from another by the intervening nearly level mesa, where snails are absolutely wanting and cannot exist. This is due not alone to their greater aridity, higher temperature and xerophytic flora, but chiefly we believe to the absence of rocks, in the interstices of which snails might burrow below the dry surface to depths where a certain amount of moisture is retained. The mesa forms a barrier as impassable to land snails as an equal expanse of sea; and can be surmounted only by minute forms light enough to be transported by the wind. During the existence of the present conditions, which probably were initiated in the Pliocene, the larger snails of each range have been absolutely isolated.

Owing to the general north and south trend of the ranges, the main canyons run eastward or westward, thus exposing a very hot slope

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[3] *Proc. U. S. Nat. Museum*, XIII, 1890.
[4] *Proc. U. S. Nat. Museum*, XVIII, 1895, and XIX, 1897.

with little vegetation northward and a more shaded slope on the south side, having more vegetation, but deeply interrupted by side canyons and ravines. These conditions may be illustrated by the map of White Tail Canyon (p. 75). It will be noticed thereon that on the southern side of the canyon the collecting stations are nearly all on *northwestern* slopes, none on northeastern. The latter are barren, and except near the top of the ridge form impassable barriers to mollusks. In the more arid portion of the range, snails are rarely found, often wholly wanting, on the slopes with mainly southern exposure. These conditions of exposure determine the limits of snail colonies, absolutely inhibiting migrations of much extent, though the anastomosing heads of adjacent canyons sometimes supply favorable slopes.

The isolation of snail colonies is further favored by the habits of most of the Helices, which live deep in rocky talus or slides. They probably crawl about in the open only on rare occasions, and are wholly incapable of crossing slopes where shelter is lacking. We have never found living Helices on the surface in the Chiricahua Mountains, and with the exception of *Oreohelix chiricahuana*, living individuals were always found well buried in the rocks. Of some species, not even dead shells have been found on the surface. Some of these races apparently live and die under the surface.

The progressive growth of the canyons by the deepening of lateral ravines and formation of new ones constantly accentuates the isolation of colonies by forming new slopes, of which one in each case is likely to be arid and therefore a barrier to the spread of snails. Moreover, the removal by erosion of stratified rocks, especially limestone, exposes ridges of granitic or eruptive rocks, in which snails are generally scarce, and some genera never present. Since the period of isolation of the several ranges, there has therefore been progressive isolation of colonies within each range.

II. Influence of Environment on the Shell.

Relation of Climate to Shell-texture.—Notwithstanding the aridity of the climate, the Chiricanuan snails show none of the characteristics which some recent authors have considered to be the direct reactions to the desert environment. With the exception of *Oreohelix chiricahuana*, none of the species are conspicuously earthy, and none differ markedly in sculpture from snails of more humid districts.

Rude, irregular sculpture and opaque chalky substance characterize land snails which live *exposed to the sun.* In such places their active life and periods of growth are certainly limited to dewy nights and times of rain,[5] whether they live in a reasonably humid region, as *Cerion* on the coast of Cuba, or in an arid region, as some Oreohelices of the Rocky Mountains. Pulmonate land snails which pass their lives hidden from the sun or shaded by dense foliage, do not have notably chalky shells, even in Arizona where a great part of the year is dry. We regard the opacity and cretaceous texture of exposed snails as in no way due to the direct action of climatic factors,[6] but as a protective adaptation to excessive sunlight, which would readily penetrate thin shells, or those composed largely of conchiolin.[7]

Oreohelix chiricahuana and in some cases *Holospira* are the only Chiricahuan snails which live on or close to the surface, uncovered or only partially protected; these are also the only snails which have the shell notably chalky and opaque. The snails of the dryest (Dos Cabezas) part of the range are not "desert snails" in appearance. They live where little light or none can penetrate.

Relation of Exposure to Size.—The size of individual snails (excepting the heliophilous group discussed above) is almost wholly a function of the exposure. *Snails living on northern or northwestern exposures are invariably larger than those from southern or eastern exposures,* regardless of elevation,[8] unless other conditions are conspicuously unfavorable. This is apparently due to the more abundant cryptogamic or other plant food, the growth of which is favored by the more humid slopes,[9] as well as the greater duration of humid growing periods. As would naturally be expected, the difference in size of the snails is more marked in rather dry or semi-arid regions than in those abundantly watered and shaded. Our measurements of *Sonorella* support the observations already published on other species.

In some cases the divergence has proceeded so far that diversity of size becomes an important specific character, as in the case of *Sonorella leucura* and *micra*, living on opposite sides of White Tail

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[5] Additions to the shell are made only when the animal is active, during humid periods, and thus exposed neither to arid winds or alkaline dust. Growth of the shell does not proceed when the snail is retracted and at rest, but only when it is in full activity, with the mantle fully produced.

[6] As claimed by Dr. W. H. Dall, *Proc. A. N. S. Phila.*, 1896, pp. 411, etc.

[7] A long list of conspicuously opaque, chalky snails which æstivate in the full glare of the sun could be given. We may mention *Leucochroa*, *Cerion incanum maritimum*, etc., *Bulimulus alternatus*, *Oreohelix strigosa huachucana*. Allied species which live in more shaded places tend to lose their opacity; *cf. Oreohelix barbata* and *O. clappi*.

[8] At least within limits of two or three thousand feet.

[9] We have already given data in support of this fact in *Proc. A. N. S. Phila.*, 1906, pp. 552–555, and in other places.

Canyon. Where snails are gathered from one limited region and those from various colonies are not kept separate, the measurements of such series when plotted may form conspicuously bimodal curves, due to the mixture of shells from different exposures. Such results are entirely worthless in the study of the relations of organism to environment.

We have made no exhaustive series of measurements to ascertain whether the height of the spire varies with elevation of the station, but such observations as we have made indicate that it does not. In the helices there is rather wide individual variation in height of spire at all levels indifferently.[10]

Influence of the Character of the Rock.—Land snails are notoriously more abundant on limestone than where the country rock is igneous. They are also usually heavier, the shell-walls thicker, though this is not the case with all species. The individuals apparently reach at least as large a size where lime is scarce as where it is abundant, if other conditions (exposure and humidity) are about equal. In several cases the largest individuals occurred under granitic rock, as in the case of *Sonorella bicipitis* at Nine-mile water-hole.

Enemies.—Field mice are apparently the chief enemies of the larger snails of the Chiricahuas. We often found unmistakable evidences of their destructive activity. The crevices of rock-piles which harbor most of the snails are often accessible to mice; and no protective device seems to have arisen effective against the latter. *Oreohelix barbata,* which from the dirt on its hairy coat is rather hard to see, we noticed on several occasions had been cruelly preyed upon by mice. We can offer observations upon predacious insects.

III. Factors in the Formation of Races and Species.

The several modifications of the shells which we have noted above as correlated to some extent with external factors are only in minor part such features as serve to signalize species.[11] Thus in *Sonorella* the species are based mainly upon characters of the genitalia. In *Ashmunella* upon the teeth of the aperture and the shape of the last whorl. In *Holospira* the shape of the spire and its sculpture are the chief differential features. Moreover, in many cases, allied but

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[10] Bellini's recent claim that on Capri the snails from greater elevations have higher spires, due to diminished atmospheric pressure, seems to us fantastic in the extreme.

[11] In White Tail Canyon, however, *Sonorella micra* and *Ashmunella lepiderma* differ from their fellows on the more shaded side of the canyon by features mainly traceable to the different exposure and rock.

distinct species live under conditions which so far as we can see are identical. The subterranean Sonorellas, such as *bicipitis*, *optata*, *bowiensis* and *leucura* inhabit slopes having similar exposure, vegetation, elevation, and rock cover, yet they differ characteristically in genitalia. At the same time, one style of genital organs seems to be as fit as another. Nearly all of the Holospiras live in very similar places. The local differences in the stations of the typical colonies of *Oreohelix chiricahuana*, *obsoleta* and *percarinata* are apparently less than the differences between the several stations of colonies of *chiricahuana*. If the conditions seem practically identical on parallel slopes of different canyons, it seems hopeless to search for differential conditions among several rock-piles or taluses along one canyon side, having the same exposure, composed of the same rocks, separated perhaps only by arid gulleys or barren earth slopes; yet such taluses often harbor perceptibly different colonies of the same species.

The facts developed in our Arizona work lead us to doubt the potency of environment as a direct agent in effecting specific differentiation, or at least to assign such factors a wholly subsidiary role. The facts seem explicable only on the hypothesis of variations existing or arising in the constitution of the egg, leading to modifications of the adult organism which for the greater part are indifferent as affecting the well-being of the race. Such adaptation as exists would apparently be due to selection. The isolation of small colonies in these mountains must favor the survival of what are currently called mutations occurring therein. The occasional mingling of neighboring colonies in which diverse variations have arisen seems to have led to such heterogeneous colonies as we have described in *Holospira*.[12]

We have no definite evidence to offer bearing upon the amplitude of individual variations or "mutations," yet we may again mention the fact that in many species nearly every colony has its minor peculiarities—peculiarities far below the grade usually called "specific," yet appreciable to the trained eye.[13] It may be inferred from this fact that the amplitude of "mutations" is ordinarily not great.

IV. Distribution of Chiricahuan Mollusks.

The snail fauna of the Chiricahuas consists of 51 species, falling into two main categories:

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[12] We believe this to be the explanation of the diversity of colonies in the polychromatic arboreal snails such as *Partula* and *Liguus*, in which some colonies of a given species are homogeneous, while others are heterogeneous, snails of several definite color-patterns being the offspring of a single mother.

[13] Only the application of careful biometric methods can fully or definitely bring out these minute differences.

1. *Species peculiar to the range:* all forms of the genera *Sonorella*, *Oreohelix*, *Ashmunella* and *Holospira*, 21 species with 14 subspecies. These are the larger snails of the fauna, without exception larger and heavier than any of the snails ranging also outside of the Chiricahuas. The members of this group of forms have probably been isolated in these mountains since the beginning of the present climatic cycle. They are too heavy to be transported across the mesa by wind, and the probability that they would be carried by birds or other accidental means is so remote as to be negligible. All of them were apparently derived from not more than six ancestral specific stocks; the species of *Ashmunella* and *Holospira* forming homogeneous groups probably of common ancestry, while in *Sonorella* and *Oreohelix* the species fall into two groups.

2. *Species having a distribution outside of the range:* all of them smaller than the preceding and many minute.

(*a*) Alpine forms, mainly living above 7,500 feet, and elsewhere found only in the Canadian zone of the Rocky Mountains northward. Those found also in the Huachuca range are indicated by the letter H.

Thysanophora ingersolli meridionalis.
Vitrina alaskana, H.
Euconulus fulvus alaskensis, H.
Pyramidula cronkhitei, H.
Vertigo columbiana utahensis.
" *modesta parietalis*, H.
" *coloradoensis basidens.*

(*b*) Transition zone forms chiefly having an almost continental distribution in that zone, also ranging into higher and lower zones.

Zonitoides arborea, about 8,000 feet, H.
Cochlicopa lubrica, 6,000–8,000 feet, H.
Pupilla hebes, 7,500–8,000 feet, H.
Vertigo milium, 8,000 feet, H.
Succinea avara, about 6,500 feet, H.

The species of groups (*a*) and (*b*) are forms which from their wide distribution must be of considerable antiquity, all probably having existed practically unchanged since before the initiation of present climatic conditions in Arizona. The absence of any form of the *Oreohelix strigosa* group is remarkable, on account of the very wide distribution of this Transition zone type in the Rocky Mountains.

(*c*) Upper Sonoran species, most of them widely distributed in the Southwest, some ranging into the Lower Sonoran. Those found also in the Huachuca and Florida ranges marked with the letters H. and F.

Thysanophora hornii,[14] H. F.	*Bifidaria pellucida hordeacella.*
Agriolimax hemphilli ashmuni,[15] H.	" *quadridentata*,[15] H.
Zonitoides milium meridionalis, H.	" *pilsbryana*, H. F.
" *minuscula alachuana*, H.	" *perversa.*[14]
Vitrea indentata umbilicata, H.	" *ashmuni*,[14] H. F.
Helicodiscus eigenmanni arizonensis, H.	" *cochisensis*,[14] H.
Radiodiscus millecostatus,[15] H.	" *dalliana.*[14]
Punctum californicum.[15]	" *tuba.*[14]
Vallonia perspectiva,[14] H. F.	*Pisidium abditum huachucanum*[15], H.

With the single exception of *Agriolimax*, all of these are very small or minute snails, certainly capable of being carried long distances by cyclonic winds, and it is likely that their wide distribution may be attributed in part to such means, though it is not improbable that a considerable number of the forms may have existed before the isolation of the Arizona ranges.

Twenty-two of the thirty species of groups 2 (*a*, *b*, *c*) have been found in the Huachuca range.[16] These are indicated in the list above by the letter H. Four species, marked F in the list, occur in the far poorer fauna of the Florida Mountains.

Faunal zones represented in the Chiricahuas are the Canadian, the Transition, and the Upper Sonoran. Zones dependent upon elevation are less distinctly marked in mollusks than in plants or vertebrates, local exposure and suitable conditions of moisture controlling the distribution of species to such an extent that the elevation zones are extremely irregular. It appears, however, that the Canadian zone forms are strictly confined to the high "parks" and peaks. The characteristic Transition zone species are also for the most part high on the range, as are also five species which, from their distribution elsewhere, are considered to be Upper Sonoran. Seven of the eighteen Upper Sonoran species have been found only below 7,000 feet, while six have a general range.

In the group of species peculiar to the Chiricahua range, and which must apparently be considered Upper Sonoran, many of the forms are very local in distribution and belong to the middle and lower zones of the range. Those having a wider distribution often have a great vertical range, as the following examples:

---

[14] Found only low, below 7,000 feet.

[15] As yet found only at about 8,000 feet or above, but none of them known from much further north than the Chiricahua range.

[16] *Proc. A. N. S. Phila.* for 1909, pp. 498–516.

Sonorella virilis, 6,000 to 9,000 feet.
Oreohelix clappi, 6,000 to over 8,000 feet.
Ashmunella chiricahuana, 6,000 to 8,500 feet.
" *angulata,* 6,000 to over 8,000 feet.

Sonorella virilis leucura, S. micra, Ashmunella proxima, A. fissidens and their subspecies, and *Holospira,* seem, in their several areas, to range from low to as high as suitable cover and slope-exposure are found. *Ashmunella esuritor, metamorphosa* and *duplicidens* belong to the higher levels (where the flora is very different), while *A. ferrissi* has not been found over 6,500 feet, if so high as that.

In general, the specially Canadian and Transition species seem to be more sharply limited in their range downward than the Upper Sonoran forms are in their extension upward. We attribute this as much to the difference in plant life as to any more direct climatic conditions.

The Lower Sonoran zone, in this area, has no land molluscan fauna, but *Physa* and *Lymnæa* occur in the *cienega* east of the Chiricahuas.

V. Systematic Descriptions of Species.

Family HELICIDÆ.

This family comprises four genera in Arizona: *Sonorella* Pils., *Oreohelix* Pils., *Ashmunella* Pils. and Ckll., and *Thysanophora* Strebel. *Ashmunella* is confined to a comparatively small area in the southeastern corner of the territory; but the other genera extend to the northern border, but they are only locally distributed, and some or all may be absent over areas of hundreds of square miles. *Ashmunella* and *Sonorella* are Upper Sonoran genera. *Oreohelix* belongs to the Transition zone, often extending into the Canadian (where it is usually dwarfed), and sometimes into the Upper Sonoran zone, where it is mainly represented by special species.

The genera *Ashmunella* and *Sonorella* are curiously diverse in modes of racial differentiation. In *Ashmunella* the *shell* has been most modified. In series of allied forms from successive canyons of a single range the shells will show much greater divergence than the soft parts. This is well illustrated by the Huachucan series, which, with conspicuous differences among the shells, shows hardly any in the soft parts. In *Sonorella,* on the other hand, the shells from a series of successive canyons may show barely perceptible differences, but the genitalia have been so modified in detail that the species are instantly recognizable from these organs. The conditions in *Sonorella* form a strong argument against modification by the action of environment. The differentiation affects internal organs concerned solely in the act of reproduction, and only in the most remote manner connected with parts directly acted upon by external factors.

Genus **SONORELLA** Pilsbry.

Sonorella is the most characteristic Helicid snail of the mountains of southern New Mexico and Arizona. It is more widely distributed than either *Ashmunella* or *Oreohelix*, inhabiting mountains too arid to support either of the other genera, such as the Peloncillo, Dos Cabezas and Rincon ranges. In the Grand Canyon of the Colorado we dug them from the cruelly sharp rock-slides of the pre-Cambrian zone, in deep, sunless canyons where no other snails penetrate; and they exist equally on the plateau at the rim, 5,000 feet above the sea.

This tolerance of untoward conditions is doubtless due in part to their deep digging habit. *Sonorella* is usually found well down in the rocky talus or slide, in the layer against the earth, where a certain degree of moisture remains. In some places *Ashmunella* accompanies *Sonorella* in the same slides. This is especially the case in the more verdant and humid canyons, such as Cave Creek in the Chiricahuas, where *Sonorella*, *Ashmunella* and *Oreohelix clappi* may be found together.

Oreohelix (except *O. clappi* and *O. barbata*) lives on the surface, on or under the top stones, or around dead mescal, bear grass or yuccas. While apparently fitted to live in exposed and extremely arid places, yet in southern Arizona *Oreohelix* certainly does not inhabit the more arid ranges where *Sonorella* exists.

Oreohelix and *Ashmunella* may sometimes be collected in copious quantity, but *Sonorella* is almost always rare. In the Dos Cabezas range a half dozen living adults would be a good day's bag for any collector, and in dry weather, at least, this would mean very hard work. In less arid localities the snails are less scarce; but as a general rule to collect living Sonorellas successfully is the most strenuous physical labor, occasionally enlivened by danger of broken limbs from falling rocks or caving in of holes, in slides of heavy rock. Strong gloves are necessary in "quarrying" for *Sonorella*. In spite of strained muscles, bruises and bleeding fingers, the fascination of *Sonorella* hunting is irresistible. The game gains in value from the hardihood brought out in the chase, and it is only after one has forgotten the labor that he can part with a single specimen of the rarer species.

Chiricahuan Sonorellas belong to two very diverse groups distinguished as follows:

Key to Chiricahuan Species of Sonorella.

a.—Penis comparatively short, very much less than the diameter of the shell, and about $\frac{1}{4}$ to $\frac{1}{2}$ the length of spermatheca and its duct (Group of *S. hachitana*).

b.—Penis-papilla annulate, the free end more or less pointed; epiphallus less than half the diameter of shell; whorls $4\frac{3}{4}$ to $5\frac{1}{4}$.

c.—Flagellum wanting or vestigeal; diameter of shell 15.5 to 25 mm. .... *S. optata.*

c[1].—Flagellum distinct but minute; diameter of shell 18 to 26 mm. .... *S. bicipitis.*

b[1].—Penis-papilla plain, cylindric with obtuse end; epiphallus about half the diam. of shell; penis larger; whorls about $4\frac{1}{2}$.

c.—Umbilicus contained about $5\frac{1}{2}$ times in diameter of the shell, which is depressed, 15 to 18 mm. in diameter. *S. bowiensis.*

c[1].—Umbilicus contained about 10 times in diameter of shell, which is subglobose, 13.5 to 20 mm. in diameter. *S. binneyi.*

a[1].—Penis very large, its length exceeding the diameter of the shell, and not differing much from the length of spermatheca and duct; penis-papilla and vagina very long (Group of *S. virilis*).

b.—Shell moderately solid, larger.

c.—Diameter of shell 16 to 21 mm. .... *S. virilis.*

c[1].—Diameter of shell 18 to 25 mm.; more depressed. *S. v. leucura.*

b[1].—Shell thin, smaller, diameter 12 to 15 mm. .... *S. micra.*

Group of Sonorella hachitana.

Sonorella bicipitis n. sp. Pl. 1, figs. 1–5.

Shell of the group of *S. hachitana*, the umbilicus about one-seventh the total diameter, and one-third covered by the dilated columellar lip; brown, fading to white around the umbilicus, encircled above the periphery with a dark chestnut band bordered above and below with white bands of about the same width; the brown band visible on about two whorls of the spire, the upper white band visible also on the penultimate whorl. Whorls $4\frac{3}{4}$ to 5, rather slowly increasing at first, the penultimate and last whorls rapidly widening. Surface nearly smooth to the eye, glossy. Embryonic shell consisting of $1\frac{1}{2}$ whorls. The first half whorl has distinct radial ripples; the next whorl has close, fine wrinkles in the direction of growth-lines, and interrupted by delicate, spirally descending threads. The third whorl shows some very sparse punctation. Later whorls are marked with fine growth-ripples, and usually show, under a strong lens, some excessively faint spiral lines above the periphery. The last whorl descends moderately in front, and is well rounded on periphery and base, as usual. The aperture is large, oblique, rounded, nearly as high as wide. Peristome thin, narrowly expanded outwardly, the basal margin a trifle reflexed, columellar margin dilated in a curved triangular plate over about one-third of the umbilicus. Alt. 14, diam. 23 mm.; aperture, alt. 12, diam. 13 mm.

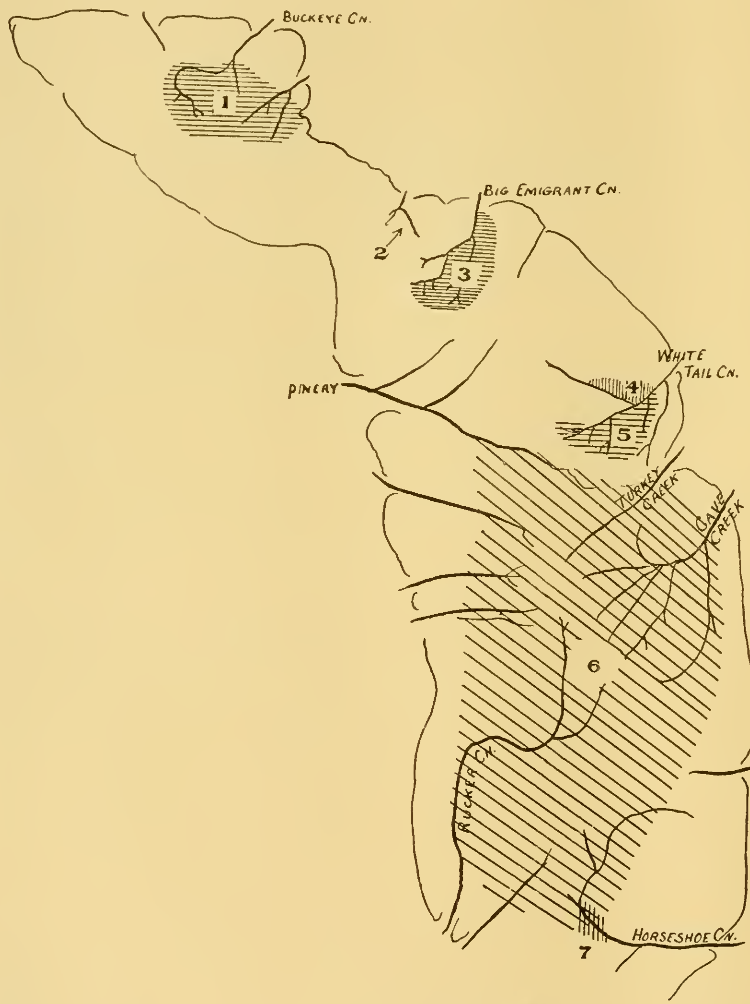

Fig. 2.—Distribution of *Sonorella* in the Chiricahua Mountains: 1, *S. bicipitis*; 2, *S. bowiensis* (at point of the arrow); 3, *S. optata*; 4, *S. micra*; 5, *S. virilis leucura*; 6, *S. virilis*; 7, *S. binneyi*. Large areas between 1 and 2 and between 3 and 4 are unexplored.

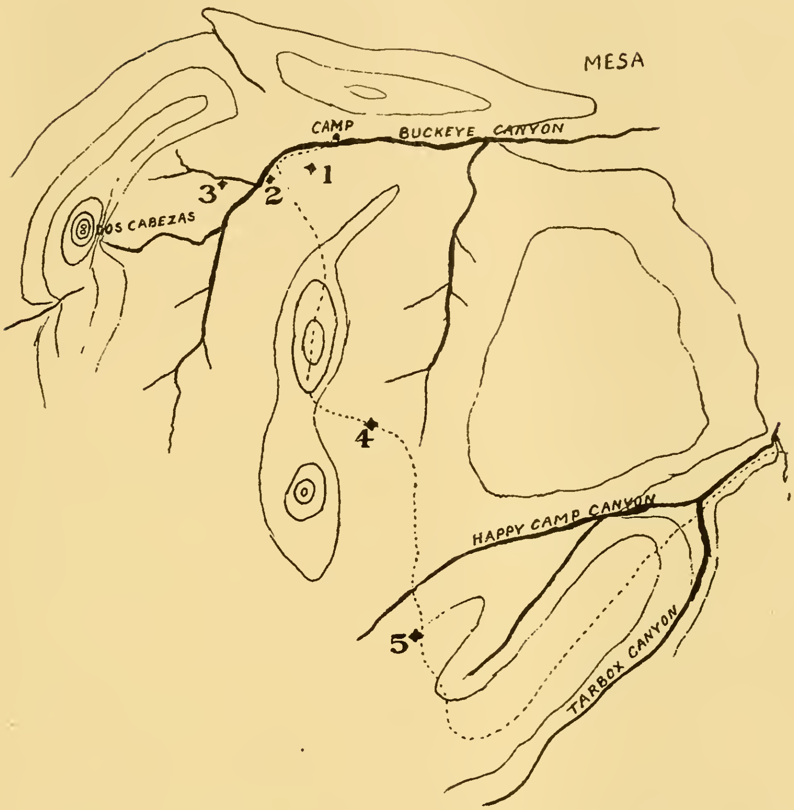

Fig. 3.—Principal collecting stations in the northern canyons of the Dos Cabezas range.

Genitalia, Pl. III, figs. 1, 2, 4, 7. Penis of moderate length, somewhat less than one-third the length of spermatheca and duct, with a long retractor muscle; the penis-papilla (*pp.*) cylindric, annulated distally, with conic tip. Epiphallus somewhat shorter than penis; flagellum 0.6 or 0.7 mm. long. Vagina generally not much longer than the penis. Sole (in alcohol) ochre or dirty white, uniform or with slightly darker sides. Back gray, the flanks and tail very pale.

Jaw with 6 to 8 ribs, grouped in the median half. Radula with 26,12,1,12,26 to 27,13,1,13,27 teeth, centrals and laterals without ectocones; some of the marginals with both cusps bifid.

Type No. 94,328 A. N. S. P., from Buckeye Canyon, Dos Cabezas range of the Chiricahua Mountains, at Station 1, fig. 3.

It ranges throughout Buckeye and Happy Camp Canyons, and at

Nine-mile Water-hole, living deep under stones and rocks. Buckeye Canyon is the first from the northern end of the range. Its upper branches drain the eastern flanks of Dos Cabezas Peak. At the time of our visit in November there was water at intervals in the stony bed of the canyon as far down as our camp, near the reduction plant of the Buckeye gold mine. Tarbox and Happy Camp Canyons unite into a wide valley about a mile from the mesa. The mouth of this valley is half closed by a great reef of light gray granite rocks which forms a conspicuous landmark from the mesa. The country rock of these canyons is mainly metamorphic, but in part granitic.

This species has the same apical sculpture as *S. bowiensis* and *S. optima*. It differs from *optima* in the shape of the penis-papilla, the presence of a flagellum, the shorter inner cusp of the marginal teeth, the larger aperture and narrower umbilicus. *S. hachitana* from the Big Hachet Mountains has a decidedly smaller aperture. In shell characters *S. bicipitis* stands nearest *S. huachucana*, but the apical sculpture of the latter is much less distinct, without the oblique threads on the last embryonic whorl which are characteristic of *S. bicipitis* and related forms. This species is represented by 43 adult shells, of which 17 were taken alive, and many young ones. The colonies are widely separated[17] and small; living shells are rare, and their collection involves the removal of much rock. The physical conditions are very similar in all the stations in Buckeye and Happy Camp Canyons. All the stations are on steep well-drained slopes facing northward, the earth very dry (in November), even under a couple of feet of rock, and scantily protected by low scrubby oak brush. At Nine-mile Water-hole the conditions are quite different as noted below.

In the type locality, Station 1 (pl. I, figs. 1, 2, 3, and pl. III, fig. 7), we took 7 living adult and 6 young specimens measuring as follows:

Alt.	14.8	14.2	14	13	13	13	12.2 mm.
Diam.	24	23.3	23	22	22	21	20.2 mm.

This station is high on the steep south side of the canyon.

In a lot of 23 from Station 3 (No. 94,326), 7 are adult living shells, measuring:

[17] This must be understood in a comparative sense, as indicating that many apparently suitable situations examined were found barren. Doubtless a longer search would show that a large number of small colonies exist. We worked two days in Buckeye and several hours in Nine-mile.

Alt.	12.8	12.2	12.2	12.7	12	11.8	11.5 mm.
Diam.	21	21	20.5	20	19.2	19	18.5 mm.

Ten adults from the slopes around the head of the southeastern branch of Buckeye Canyon, Station 4, vary from 18.7 to 22 mm. diameter (No. 94,325).

Thirteen adults were taken at Station 5, near the head of Happy Camp Canyon, only one alive.

Alt.	13	13	12.6	12.3	12.3	11	11.7 mm.
Diam.	22.3	21	20.7	20	20.2	20	19 mm.

Alt.	11.7	11.8	12	11.2	11	10.5 mm.
Diam.	19.2	19.2	19	19.2	19	18 mm.

At Nine-mile Water-hole we obtained a single living adult snail and 8 young (No. 99,324). These, with a specimen taken by Mr. Ferriss in 1905, indicate a large race at this place, with a slightly larger umbilicus than the types, and more closely approaching lip-ends (pl. I figs. 4, 5). The soft anatomy, sculpture and color are like typical *S. bicipitis*. Whorls barely 5. Two adults measure:

Alt.	15	15 mm.
Diam.	26	25.5 "
Aperture alt.	13	13 "
" diam.	14	14.5 "

The genitalia are figured pl. III, fig. 2.

Nine-mile Water-hole is a shallow amphitheatre open eastward to the mesa, its slopes covered with great weathered boulders of coarse-grained light gray granite, among which ferns grow luxuriantly. A tiny stream trickles among the rocks, collecting into a stagnant pool at the base. A man can make his way in the interstices between and under the rocks, in some places, but as very few of them are movable, it is almost impossible to obtain the shells.

Specimens were dissected from Stations 1, 3, 4, 5 and from Nine-mile Water-hole. All have a distinct sheath at the base of the penis, attached also to the epiphallus and partially enveloping the latter throughout a part of its length. This sheath varies from about one-third the length of the penis in the type lot, to about a half in that from Nine-mile. The penis-papilla in transverse section (fig. 7, *pp.*) shows a group of minute ducts, but there seems to be a single terminal orifice. The vagina is longer in the types than in other lots examined.

Measurements of genitalia in millimeters.

Locality.	Penis.	Penis-papilla.	Epiphallus and flagellum.	Flagellum.	Vagina.	Spermatheca and duct.	Penis retractor.	Diameter of shell.	Museum No.
Station 1, fig. 7	8	4.5	6.5	0.6	14.5	29	long	23	94,328
Station 3, fig. 1	9.5	6	8	0.7	9.5	......	"	21	94,326
Station 4, fig. 4	7	6	7	0.6	....	......	......	19	94,325
Nine-mile, fig. 2	9	4.3	7	0.6	10	29	14	26	94,324

In the alcoholic specimen from Nine-mile, the sole is tripartite by faint longitudinal impressed lines, with a median groove due to partial folding of the foot. There are transverse lines as shown in pl. III, figs. 3 and 6. The granulation above is fine and pebble-like as usual in *Sonorella*. The œsophagus is short, expanding into a large crop, on which the loose and open salivary glands lie. The liver is reddish purple. The buccal retractor and left ocular retractor are united in their posterior third, the tail and right ocular retractors being free to their common insertion. The lung is like that of *Sonorella optata*.

In the specimens from Stations 3, 4 and 5, no longitudinal impressed lines could be traced on the sole.

The jaw varies a good deal; a specimen from the type lot has six wide ribs. From Station 4 and Nine-mile the jaw has eight narrow ribs.

All of the radulæ examined agree in having decidedly fewer teeth in a transverse row than *S. hachitana flora* or *S. optata*.

Sonorella optata n. sp. Pl. I, figs. 6–12, 17–19.

The shell is umbilicate, umbilicus slightly less than one-seventh the diameter, similar to *S. hachitana*. Pale brown, fading to whitish around the umbilicus, encircled by a rather wide dark chestnut band above the periphery, bordered above and below with paler, whitish bands. The spire is low conic. Whorls $5\frac{1}{4}$, slowly increasing to the last, which is much wider, and descends deeply in front. The embryonic shell consists of $1\frac{1}{2}$ whorls. The first half whorl has radial wrinkles, and begins in a smooth tip; then a small areolate area follows, after which there are curved, forwardly descending delicate threads reaching the suture below, but weak or obsolete on the summit of the whorl, which is irregularly roughened; there are also some forwardly ascending threads in places. The first neanic whorl has sculpture of slight growth ripples and an indistinct roughening or punctation. Subsequent whorls are lightly marked with growth-lines only. The aperture is very oblique, subcircular; peristome thin, a little expanded, narrowly reflexed below, the columellar margin dilated. Alt. 15, diam. 24 mm.; alt. aperture 11.7, width 13 mm.

Penis small, usually shorter than the vagina, and less than one-third as long as the spermatheca and duct. Epiphallus short, the *flagellum apparently absent* or reduced to a very minute adnate cœcum (pl. IV, figs. 1, 2, 3, 4, 5, 7). Radula with 35, 1, 35 (summit of Cross J Mt.) to 38, 1, 38 teeth, about 14 laterals, an ectocone appearing on the 11th to 13th. The entocone is bifid on the outer 15 to 18 marginals, and the ectocone occasionally so on some teeth, though generally simple. Six radulæ from 5 stations examined. The jaw has 5 ribs in two, 6 and 7 in two other examples. The crops and œsophagus as far as the stomach are conspicuously sulcate or corrugated longitudinally.

Type locality, head of Big Emigrant Canyon at Station 1, on a steep slope shaded by pinyons, under large stones (limestone). The species occurs in numerous colonies throughout Big Emigrant Canyon, except on slopes with southern exposure. See map on p. 121.

This handsome species, like others of the *hachitana* group, is ill-characterized as far as the shell is concerned, but the genitalia are characteristic by the small penis and absence of a free flagellum. In the Chiricahua Mountains it is related to *S. bicipitis* of the Dos Cabezas range, but in that the penis is well developed and the flagellum, though small, seems to be invariably present. In all of the numerous examples opened the crop and intestine to the stomach are deeply furrowed longitudinally, a condition observed in no other *Sonorella*. To what extent this corrugation may be due to the state of the specimens is uncertain. It happened that by some unaccountable oversight all of the Big Emigrant Sonorellas were cooked and pulled without drowning, and then were preserved in alcohol too strong to give the best results.

All of the following colonies but one are on limestone.

Type locality, Station 1. Thirty adult specimens were taken, ten of them alive. They measure as follows:

Diam. in mm.........26	25.3	25	25	25	25	24.8	24.8
Alt. in mm............15.3	15	16.3	14.9	14.2	14.2	15	15
Diam. in mm.........24.3	24.3	24.3	24.2	24.2	24	24	
Alt. in mm............15	14.6	14.3	15	14	16	15.2	
Diam. in mm.........24 (three)		24	24	24 (three)		23.3	23
Alt. in mm............15		14.5	14.3	14		14	14

Diam. in mm	23	23	23	23	22.8
Alt. in mm	14	13.5	13.1	13	13.5

The total variation in diameter in this colony is 3.2 mm. The variation in altitude is comparatively greater, owing to the varying degree of elevation of the spire. 70 per cent. of the lot are from 24 to 25 mm. in diameter. Figures 6–9 were drawn from specimens of the type lot from this Station.

Station 4. Cleft in the rocky summit of hill at fork of Big Emigrant Canyon, facing mouth of canyon (pl. I, fig. 10). Ten specimens, two alive, measure:

Diam. in mm	26	25.5	25.5	25	25	25	24	23.7	23.3	23.3
Alt. in mm	15	16	14.7	16	15	15	14.7	13.3	13	13

They differ from the type lot in having the aperture barely perceptibly larger, umbilicus smaller. In a specimen of the type lot 25 mm. in diam. the aperture measures 11.4 x 13.1 mm. In one of the same diameter from Station 4 it is 12 x 13.4 mm.

Spirally striate forms.—The shells from Stations 2, 3, 5, 6—Big Emigrant Mountain and Cross J Mountain—usually show numerous spiral striæ on the upper surface of the last whorl, but this character is variable; in some shells of each lot no spiral striæ can be made out.

Station 2. Close to the creek in the middle branch of Big Emigrant Canyon, under stones. Three dead shells measuring 23.5, 22.3 and 21.8 mm., and similar to those from Big Emigrant Mountain. This place is probably about 1,000 feet lower than the type locality.

Station 3. Big Emigrant Mountain. This name is given to a mountain about four miles above the fork of Big Emigrant Canyon on the left side of the east branch. November 11 and 12 it was visited. On the side toward the canyon, under a rocky bluff, under stones among scrub oaks (*Quercus hypoleuca*?), in a situation resembling that of *Sonorella bowiensis*, numerous specimens of a small form were taken, almost all dead shells. Sixty-five adults taken measure in diameter as follows:

Diam. in mm	20.5	20	19.5	19.3	19	18.8	18.5	18.3
No. of shells	1	1	4	1	6	4	7	6
Diam. in mm	18	17.8	17.5	17.3	17	16.5	16	15.5
No. of shells	7	4	4	5	7	3	4	1

The shells are in the average more depressed than typical *S. optata*. The largest measures, alt. 10.5, diam. 20.5, aperture 9.2 x 11.2 mm. Another, alt. 10.5, diam. 18.5, aperture 8.3 x 9.9 mm. There are about $4\frac{1}{2}$ whorls, the last with some spiral lines on the upper surface, sometimes very faint.

From the west side of Big Emigrant Mountain (pl. I, figs. 11, 12, 18, 19) a lot of 32 living adults was taken, of almost equally small size (No. 94,320).

Diam. in mm	21.4	20.5	20	19.75	19.5	19	18.7	18.3
No. of shells	2	2	4	6	7	9	1	1

The degree of elevation is somewhat variable. In one specimen (pl. I, fig. 19) the dark band is wanting. This is tne only case of the kind among our Chiricahua Sonorellas.

Another lot of 35 living adult shells from another place on Big Emigrant Mountain average larger.

Diam. in mm	23	22.5	22	21.5	21	20.5	20	19.8	19
No. of shells	1	1	1	7	8	7	8	1	1

Station 6, high in the valley north of Cross J Mountain, 42 adult shells, most of them "dead," measure:

Diam. in mm	22.8	22.5	22.3	22	21.8	21.5	21.3	21	20.5	20
No. of shells	2	3	2	6	3	4	3	10	4	5

Most shells show spiral lines, as in those from Big Emigrant Mountain. The specimens were taken in the area indicated in the sketch on p. 87, but similar dead shells were seen throughout the valley, on both sides of the ravine. The rock of this valley is limestone.

Eastward from this valley (Station 6) a rugged ridge of coarse crumbling granitic rock runs towards the mouth of the canyon (see map). Five dead shells found on the outer side of the crest of this ridge are like those from the valley, but smaller, diam. 18.5 to 20.5 mm.

Station 5. Among rocks at and near the north side of the summit of Cross J Mountain. The rock here is angular, friable and cherty. The shells, 29 adults, mostly "dead," resemble the larger colony from Big Emigrant Mountain, most of them showing fine spiral lines. The elevation is estimated at 8,000 feet. See sketch on p. 87.

Diam. in mm	23	22.8	22.2	22	21.8	21.5
No. of shells	2	1	1	5	4	1

Diam. in mm	21.2	20.8	20.5	20.2	20	19.8
No. of shells	5	1	4	1	1	3

Small form of S. optata (pl.I, fig. 17). Some very small specimens were taken near the head of Big Emigrant Canyon south of Station 1, the exact spot not noted. Two living ones measure, alt. 9.8, diam. 16 mm., and alt. 9.2, diam. 16 mm.

A bleached shell was found at Station 2; alt. 11, diam. 18 mm.

Soft anatomy of S. optata. Specimens from four colonies have been dissected. In the type lot from Station 1, the sole is pale, unicolored. In some other lots the narrow side areas are a shade darker. The genitalia (pl. IV, fig. 1–4, 7) are characterized by the very small penis and absence of a flagellum, verified in several examples opened. The lung (fig. 4, right fig.) has venation much as I have

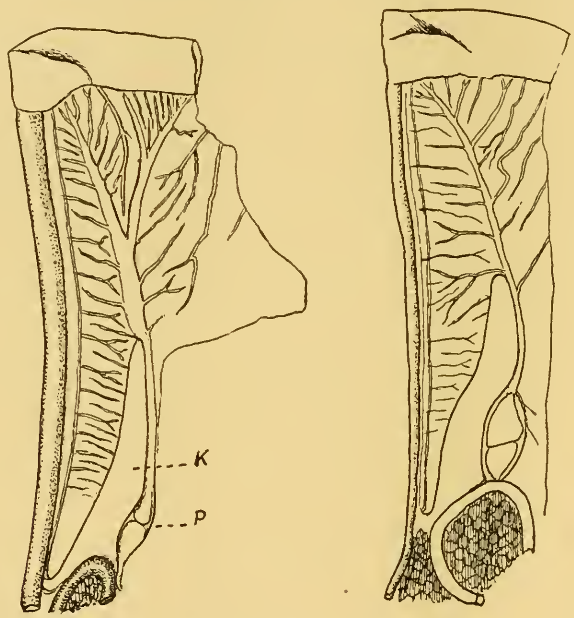

Fig. 4.—Pallial region of *Sonorella optata*, two individuals. K, kidney; P, pericardium.

described for *S. ashmuni*. The secondary ureter is open throughout, being defined by a thread-like ridge only. Length of lung 26, of kidney 14, of pericardium 5 mm. The foregut and crop are deeply sulcate longitudinally.

In specimens from the cleft in Big Emigrant Canyon (No. 94,321), the penis is rather larger (pl. IV, fig. 4). It has a thin, rather short basal sheath and long retractor. The penis-papilla is slender, cylindric, weakly annulate, with obtusely conic end. There is an excessively short cœcum representing the flagellum, not free from the integument and hardly visible except by transmitted light. The crop and foregut are longitudinally sulcate. Salivary glands long, united over the upper surface of the crop.

The form from north side of Big Emigrant Mountain (Station 3, No. 94,322) is similar. Genitalia (pl. IV, fig, 1) with long penis-papilla, its end long-conic. Flagellum a barely perceptible bud bound in the integument. Lung with venation typical or (in one of several examined) the pulmonary vein has a large branch on the cardiac side, where the venation is otherwise very faint. Length of lung 27, of kidney 14, of pericardium 4.5 mm. (fig. 4, left fig.). The crop and foregut are deeply sulcate longitudinally. No. 94,320, from west side of Big Emigrant Mountain are similar. As usual in this species, the penis-papilla has a somewhat glans-like end (fig. 2).

No. 94,323, from summit of Cross J Mountain, has the sole pale in the middle, shading into gray at the sides. No flagellum. Foregut corrugated. The penis-papilla is obtuse, but the specimen is not quite mature (pl. IV, fig. 7). A half-grown shell has very minute genitalia (pl. IV, fig. 5) with a very short papilla.

Measurements of genitalia of S. optata in mm.

Locality	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.	Penis retractor.	Diameter of shell.	Museum No.
Station 1, fig. 3	5	3	3.3	0	8	....	10+	25	94,319
Station 4, fig. 4	7	4	3.5	vestigeal	8	26	7.5	25.5	94,321
Station 3, fig. 1	4.5	4	5	"	6	24	....	18.5	94,322
Near Station 3, fig. 2	5	2.6	5	"	5	20	....	19.5	94,320
Station 5, fig. 7	4.6	2.6	2.75	0	7	....	long	20	94,323

Sonorella bowiensis Pils. Pl. I, figs. 13–16.

Sonorella hachitana bowiensis Pils., Proc. A. N. S. Phila., 1905, p. 260, pl. XVIII, figs. 29–32 (shell); pl. XX, figs. 10, 11 (genitalia); pl. XXIII, fig. 22 (jaw).

Forty-one living and twenty-eight dead adult specimens were taken at the type locality in 1906. It is a very pretty shell, quite constant in all its characters.

The shell is somewhat transparent, pale corneous-brown becoming lighter almost corneous-whitish near the umbilicus. There are usually one or two obliquely radial whitish streaks on the last whorl. The chestnut band above the periphery is about one millimeter wide, is visible on 2½ to 3 whorls, and has a very faint paler border below, hardly visible; no noticeable pale border above the band. Whorls

$4\frac{1}{2}$, rather slowly widening to the last, which is nearly double the width of the preceding, and well rounded peripherally. The embryonic shell consists of $1\frac{1}{2}$ whorls; the apex is smoothish; then a radially wrinkled area follows to the end of the first half whorl; the next whorl has forwardly descending delicate threads on its outer or peripheral half, the inner half being irregularly, shallowly pitted and roughened. The succeeding neanic whorls are lightly striate obliquely and very slightly, minutely roughened. The last whorl descends rather deeply in front. The umbilicus is contained about $5\frac{1}{2}$ times in the diameter of the shell. The aperture is very oblique, peristome expanded, the ends strongly converging, the columellar end dilated, slightly impinging on the umbilicus.

Measurements of seven specimens were given in our former paper, with diameters of 15 to 17.8 mm. Sixty-nine adults taken in 1906 have the following diameters:

Diam. in mm	15	15.5	15.8	16	16.2	16.3
No. of shells	4	3	2	22	2	7
Diam. in mm	16.5	16.7	16.8	17	17.8	18
No. of shells	5	4	6	12	1	1

About 84 per cent. are from 16 to 17 mm. in diameter, and the total range in diameter is only 3 mm.[18] Otherwise variation is seen only to a very slight extent in the width and intensity of the band and in the degree of deflection at the aperture.

Type locality.—Quartzite Hill, back of Dixon's place, about a mile south of old Fort Bowie. It has been found nowhere else.

The locality was wrongly given as "Bowie" in our former paper. Bowie is a station on the S. P. Railway about 15 miles from Fort Bowie, and on the mesa where no snails live. Fort Bowie is now deserted, and only the roofless adobe buildings and the cemetery remain.

Sonorella bowiensis was found only in one colony very limited in extent but prolific in individuals. This colony—the only place where we have ever found *Sonorella* in abundance—is in a small thicket of long-leaved scrub-oaks with some underbrush of service berries (*Amelanchier* sp.) under a low cliff, somewhat more than half way to

[18] The concentration around the diameters 16 and 17 mm. is partly due to the fact that all shells more than 15.8 and less than 16.2 were counted as 16, and similarly with 17, giving a wider range than with any intermediate measurements.

the summit of Quartzite Hill, back of Dixon's place, shown at (1) in the photographic reproduction below. The snails were under small stones and dead leaves. The abundant shelter and food and favorable northeastern slope apparently led to an unusual multiplication of individuals, but no environmental factor seems to account for their very small size. We searched the neighboring Bull Hill thoroughly for *Sonorella*, but without success. Probably a more extended exploration would result in finding other colonies in the Fort Bowie Valley. Bowie Mountain and Helen's Doom should be examined.

The single locality of *S. bowiensis* lies between the ranges of *S. bicipitis* and *S. optata*.

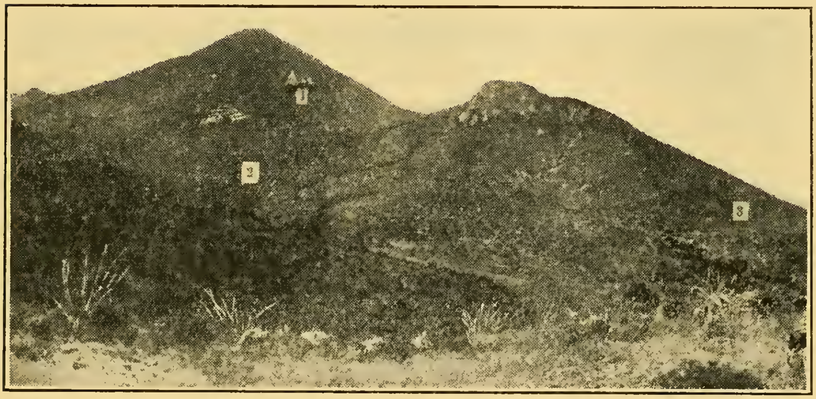

Fig. 5.—Quartzite Peak and Bull Hill, from the ridge on east side of the creek, looking across Dixon's place, showing type localities of *Sonorella bowiensis* (1) and *Holospira cionella* (2).

S. bowiensis differs from *S. bicipitis* by the rounded end of the penis-papilla and the actually and comparatively longer penis, over half the length of spermatheca and duct, though the shell is smaller. The shell differs by its smaller size and the faintness or absence of white bands bordering the chestnut zone.

The living animal is slate color on head and back, sides of foot pale blue, borders of the foot orange; liver brown. In alcohol the back is slate, sides, tail and sole whitish. The sole has slightly darker lateral areas marked off with faint grooves. The crop is long and smooth.

I have figured the genitalia of a specimen (pl. IV, fig. 6) for comparison with that previously published. The well-developed penis has a long basal sheath, the lower part of the penis itself being quite slender. The papilla is cylindric, somewhat more than one-third the length of the penis, with a blunt, rounded end. The penis retractor is long. The organs measure as follows: length of penis 12 mm.; of penis-papilla 4.4 mm.; epiphallus and flagellum 12; flagellum 0.6; vagina 10; spermatheca and duct 21.5 mm. The atrium is extremely short.

In its genitalia this species resembles *S. binneyi* from the southern end of the range, and to a less extent *S. rowelli.* The embryonic sculpture is like that of *S. bicipitis*, but the spirally protractive threads are more numerous and closer.

S. binneyi differs from *S. bowiensis* by the very much smaller penis, only half the length of that of *S. bowiensis* in a larger shell; by the different shape of the papilla, and the absence or very minute size of the flagellum. The shell also is invariably larger than *S. bowiensis*, even in the most arid situations.

Sonorella binneyi n. sp. Pl. II, figs. 13–18.

The shell is depressed globose, narrowly umbilicate, quite thin but moderately strong; pale brown with some whitish oblique streaks, and fading to opaque white around the umbilicus, encircled with a narrow chestnut band at the shoulder, narrowly showing above the suture on the penultimate whorl. Surface slightly shining, marked with fine, rather sharp growth-striæ. Whorls $4\frac{1}{2}$, convex, the first minutely roughened but without distinct pattern of sculpture. The last whorl is very wide (viewed from above), inflated, rounded peripherally, very convex beneatn. It descends in front. The aperture is very large, strongly oblique, elliptical, the ends of the lip converging. Peristome thin, very slightly expanded throughout, dilated at the columellar insertion.

Alt. 13, diam. 20; width of aperture 12.8, oblique alt. 11 mm.; width of umbilicus 1.7 mm.

Alt. 11.5, diam. 18 mm.

Alt. 10.5, diam. 16 mm.

Horseshoe (Mo) Canyon, the types from Station 1, two miles up the Canyon. Also found near the red box of Horseshoe Canyon.

The genitalia (pl. III, fig. 5). The penis is somewhat longer than the vagina. It contracts into a narrow neck at the base, and contains a cylindric papilla, obtuse at the free end, and from one-sixth to about one-third the length of the penis. Epiphallus not very unlike the penis in length. Flagellum as usual in the genus. The vagina is short. Spermatheca oval, on a long duct. Two specimens of No. 97,414 measure:

Length of penis	8	11.5 mm.
" " epiphallus	9	8 "
" " papilla	3	2.5 "
" " flagellum	1	.... "
" " vagina	6	.... "
" " spermatheca and duct	22	.... "

The jaw has five ribs. The pericardium is about half as long as the kidney.

In its soft anatomy, this species resembles *S. bowiensis* Pils. and also *S. rowelli* (Newc.), but differs from the latter by having a distinct flagellum. The shell is more like *S. rowelli*, but differs from both species by its more inflated contour and very large aperture. In conchological characters the species is, for a *Sonorella*, very distinct, and unlike other known Chiricahuan snails.

The smallest specimen seen measures, alt. 8, diam. 13.5 mm. This species is named in memory of William G. Binney.

Group of Sonorella virilis.

These forms are distinguished from all other Helices known to us by the enormous length of the penis and its papilla. *Sonorella rinconensis*, which has an equally long penis, but a comparatively short papilla, is apparently the most nearly related species. All other known Sonorellas have the penis short or of moderate length. All known species of this group are Chiricahuan. The sculpture of the embryonic shell resembles that of the group of *S. hachitana*, but usually the pattern is very indistinct.

Sonorella virilis Pils. Pl. II, figs. 1–6.

> *S. virilis* Pils., Proc. A. N. S. Phila., 1905, p. 266, with var. *circumstriata*, p. 267.

This species was described from a single shell which so far as we can learn was probably taken in Rucker Canyon. The variety *circumstriata* was described from the talus at the foot of Reed's Mountain, about a half mile below Reed's place, Station 11 in Cave Creek. The series now available shows that this variety is scarcely distinct enough for recognition, or at least that it is difficult to decide upon some specimens. Figures 1, 2, 3 represent specimens from Station 11, at the foot of Reed's Mountain, Cave Creek Canyon. Figs. 4, 5 are from about two miles up the south fork of Cave Creek. All of these are of the form *circumstriata.*

Fig. 6 is from Spring branch near Rucker Camp, head of Rucker Canyon. This shell, and others from the head of Rucker, has a broad conspicuous white border above the brown band, a narrower one below it; the brown band is broader than in Cave Creek shells. The spire, viewed from above, is narrower, the last whorl therefore wider.

Specimens from further down Rucker have much less conspicuous white borders along the band, and are like the type of *virilis.*

This species also occurs in Morse Canyon. tne foot of Bonito Canyon, and Shake Gulch, and in Horseshoe Canyon near the Red Box.

In the Cave Creek Canyon Valley it may be found almost anywhere suitable rock cover exists, though there are large areas without it, where the slope is slight or with southern exposure. Rock "slides" or northern exposures with abundant rock are its chief haunts. It was taken at Stations 3, 4, 5, 11, 12, 13, 14, also near the branch leading toward Paradise, in the ravines west of Reed's Mountain, and various places throughout the South Fork as far as explored—about two miles up. None were taken on the great ridge where Stations 6 and 7 are situated, or on the ridge marked 10. The valley south of the stream from the falls has not been explored. The Sonorellas were also found in a great rock slide (trachyte?) on the south side of a peak near the sawmill, in Barfoot Park, Station 1, and in the head of the adjacent canyon running westward. See map on p. 107.

S. virilis (*circumstriata*) was found also in Paradise Canyon about two miles below Paradise, and in Pine Canyon.

Variation.—There is the usual variation in degree of elevation of the spire, and slight variation in ground color of the shell, in all of the lots examined, but various colonies differ in size, as may be seen by the table of measurements of specimens from four places. This size variation is not in the least correlated with elevation, but is invariably connected with the exposure to the sun. Thus it will be noted that at Stations 1 and 12 the mode is at 18 mm. diameter, the total range from 16 to 20 mm. Both of these stations are on *sunny southern slopes,* Station 1 being Barfoot Park at an elevation of over 8,000 feet, while Station 12 is only about 100 feet above the bottom of Cave

Creek, at an elevation of about 6,000 feet. These small specimens contrast with those from Stations 13, *from shaded slopes,* where the mode is at 20 to 20.5 mm., and the range from 17.75 to 21 mm. Large shells occur at Station 11, at the shaded and humid base of Ried's Mountain, about 6,000 feet elevation, and at the head of Pine Canyon, at about 8,000 feet, also in a comparatively humid and well-shaded situation. The shells from other places, while too few to be worth tabulating, or to give reliable curves, support the above conclusions as far as they go.

Diameter in mm.	Sta. 1.	Sta. 4.	Sta. 11.	Sta. 12.	Sta. 13	Head Pine Canyon.
16	....	....	....	1	....	....
16.25	1	....	....	....	....	....
16.5	....	....	....	....	....	....
16.75	....	....	....	....	....	....
17	2	....	....	1	....	....
17.25	3	....	....	1	....	....
17.5	....	....	....	1	....	....
17.75	4	1	....	3	1	....
18	5	3	....	5	....	....
18.25	1	....	....	1	....	....
18.5	....	2	....	....	1	1
18.75	....	....	....	1	....	1
19	4	1	....	2	2	1
19.25	....	....	....	1	....	....
19.5	....	2	....	....	....	....
19.75	....	....	....	1	4	1
20	2	....	5	....	5	1
20.25	....	....	....	....	1	....
20.5	....	....	5	....	....	1
20.75	....	....	....	....	1	....
21	....	....	1	....	1	2
22	....	....	....	....	....	1
Total	22	9	11	18	16	9

The sole, in alcoholic examples, is yellowish in the central field, the lateral areas grayish, grooves rather indistinct. The back is blackish, sides pale.

Specimens from numerous lots were dissected, genitalia of two being figured (pl. V. fig. 6, No. 94,335 from Station 13, South Fork of Cave Creek, and fig. 4, No. 94,332, from Station 11, Cave Creek). The penis is longer than in the original type specimen, but in about the same proportion to the length of the vagina, which varies considerably. This difference in length is perhaps due to the different modes of preservation. The basal sheath of the penis and its retractor are both quite short. The arcuate shape of the penis is due to its position near the periphery of the last whorl when the animal is retracted.

Measurements of the genitalia in millimeters.

Species.	Penis.	Penis-papilla	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.	Penis retractor.	Diameter of shell.	Museum No.
1. *S. virilis*........	29	24	18	....	23	....	6.5	19	94,335
2. "	30.5	29	19	0.7	26.5	31	6	20	94,332
3. "	34	29	22	1	16	24	....	19.5	79,622
4. "	30	....	22	....	19.5	....	....	22	97,409
5. "	27	....	....	....	....	....	....	22	97,409
6. "	28	....	....	....	....	....	....	19	97,408
7. *S. v. leucura*........	31	28	15	0.6	17	26	....	21	94,331
8. "	28.5	25	21	0.6	21	....	....	23	99,682
9. "	25	21.2	19	0.6	15	25	....	19	99,681

The specimens measured are from the following localities:

1. South Fork of Cave Creek.
2. Foot of Reed's Mountain, Cave Creek.
3. Rucker Canyon (?). Original type of *S. virilis.*
4, 5. Head of Rucker Canyon.
6. Rucker Canyon at mouth of Raspberry Gulch.
7. White Tail Canyon, Station 4.
8. White Tail Canyon, Station 14.
9. White Tail Canyon, Station 00.

Sonorella virilis leucura subsp. nov. Pl. II, figs. 7–9.

The shell is decidedly *more depressed* than *S. virilis* or *S. v.* "*circumstriata*," though the spire is about equally convex; the umbilicus is wider; the aperture is smaller, and the ground-color is paler, subopaque, whitish, tinted more or less with brown, nearly white on each side of the dark band, and pale around the umbilicus.

Embryonic and neanic stages.—There are $1\frac{3}{4}$ embryonic whorls. The depressed tip is smoothish, followed by only a few radial wrinkles; following embryonic whorl is roughened with low granules lengthened in a radial direction, or short, irregularly waved or vermiculate radial wrinkles; over these there is a pattern of grains in regular squares at first, but soon forming protractive rows, the grains becoming indistinct. On the first post-nepionic whorl the fine striæ are more or less interrupted or minutely indented in places. The post-nepionic whorls as far as *the fourth whorl are clothed with very short deciduous hairs,* so delicate that the slightest attempt to clean the shell removes them, and they probably never persist in the adult stage. All immature specimens taken by us in November, from diam. 10 mm. on, have *a strong callous rib within the lip-edge.*

Adult stage.—There are 4½ whorls in small, 4¾ in large individuals of the type lot, slowly increasing at first, the last whorl seen from above about twice as wide as the penultimate. The lip is blunt with rusty edge, but not thickened within. The outer margin is slightly expanded, the basal a trifle more so; parietal callus rather thick at the edge, straight. The umbilicus contained about 5.2 times in the total diameter. Alt. 11.8, diam. 23.5 mm.; aperture 10 x 11.3 mm.

Distribution: Southern side of White Tail Canyon, Chiricahua Mountains, Stations 1, 2, 3, 4, 5, 9, 12, 14. Type locality, Station No. 14. Also in Jhu Canyon. See map, fig. 6, p. 75.

This is the only *Sonorella* on the southern side of White Tail Canyon, living on steep slopes varying from northeast to north or northwest. It occurs (in November) rather deep under rocks, and excepting on the more arid slopes and ridges, colonies may be found where suitable shelter occurs throughout the length of the canyon, generally rather high on the slopes, but in at least one case only about 20 feet above the bed of the canyon. The more favorable slopes, such as those Stations 5, 14, 15 are situated on, are wooded with pinyon below, oak and a few long-leaf pine above. The ridges and slopes with southern or eastern exposure are barren or nearly so. The rock is limestone, mostly with covering of earth and fine stone, and there are no rock slides. Stations 1, 2, 4, and 9 are decidedly more arid and barren than 5 and 14, Station 5 being near the bottom of a deep narrow ravine, densely wooded, while Station 14 is on a steep shady northern slope. The lots taken show that the shells respond to more favorable conditions by reaching a larger size, as seen in the table of measurements.

The shells from Station 5 have the spire somewhat more depressed than any other lot. Those from near Jim Artels' old camp, near head of White Tail not far from Station 1, are the smallest.

The table following shows the shells from high on the ridge (Stations 1 and 4) to be in the main smaller than those from the mid-slope; but this ridge becomes very dry above, with less shade, while the slope lower down is well shaded on northwest exposures (caused by the lateral washes and ravines, running northward), the northeast exposures being for the most part barren. The size of individuals in the colonies collected appear, therefore, to be related to the amount of shade and moisture.

Measurements of 152 shells from six stations follow:

Diameter in mm.	Near Sta. 1.	Sta. 4.	Sta. 2.	Sta. 5.	Sta. 9.	Sta. 14.
18	1	....	....	....	....	....
18.25	2	....	....	....	....	....
18.5	2	....	....	....	....	....
18.75	9	....	....	....	....	....
19	4	....	....	....	....	....
19.25	2	....	....	....	....	....
19.5	1	....	....	....	....	....
19.75	3	1	....	....	1	....
20	1	1	....	....	2	....
20.25	....	....	....	....	....	1
20.5	....	....	....	....	....	....
20.75	....	2	1	....	3	....
21	....	2	....	....	10	7
21.25	....	....	2	....	3	5
21.5	....	1	....	1	2	3
21.75	....	4	2	....	....	9
22	....	2	....	2	1	11
22.25	....	....	....	2	....	4
22.5	....	....	....	2	....	3
22.75	....	1	....	....	....	5
23	....	1	1	4	....	6
23.25	....	....	....	3	....	....
23.5	....	....	....	....	....	1
23.75	....	....	....	3	....	....
24	....	....	2	5	....	1
24.25	....	....	....	2	....	....
24.5	....	....	....	....	....	....
24.75	....	....	....	1	....	....
25	....	....	....	....	....	....
25.25	....	....	....	1	....	....
No. of shells	25	15	8	26	22	56

Soft anatomy.—Several specimens were dissected, from three stations, 14, 4 and from near Station 1. The genitalia do not differ from these organs in *S. virilis circumstriata.* Measurements may be found on p. 72. An example from Station 4 (No. 94,331) is illustrated (pl. V, fig. 5). It shows the penis kinked in a way unusual in the species.

The sole is tripartite in color, the central area, half the total width, being pale isabelline, the side areas gray. The foot is gray above, darkest on the back; top of the tail of a dirty yellow tint.

Sonorella micra n. sp. Pl. II, figs. 10–12.

The shell is small, thin, the umbilicus contained about five times in the total diameter; pale brownish-corneous, a little paler around the umbilicus, and with scarcely perceptible pale borders above and below the dark chestnut band above the periphery; only slightly glossy. Spire very low. The embryonic shell consists of $1\frac{1}{2}$ convex whorls; after the smooth apex, there are a few arcuate radial ripples; and the

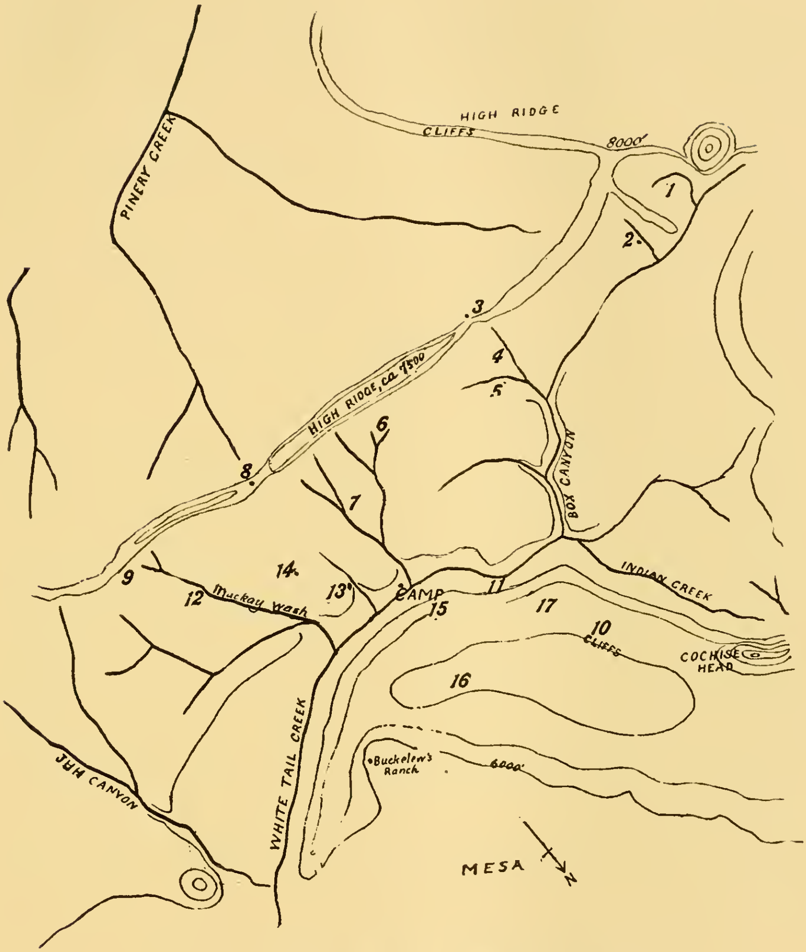

Fig. 6.—Collecting stations in White Tail Canyon.

rest of the embryonic shell has irregular rugosities or asperities, short, but longest in a radial direction; over these there are granules arranged as in *S. v. leucura.* When absolutely unworn they bear delicate hairs in young shells. The following post-embryonic whorls are delicately striate, and as far as the beginning of the fourth whorl, fresh and uncleaned young shells have close, short and very delicate hairs. The last whorl has delicate growth-lines, but no trace of spiral striæ; it is rounded at the periphery and descends a little in front. The aperture is oblique, rounded. The peristome is thin, outer margin scarcely noticeably expanded, basal margin somewhat more so; columellar margin rather broadly dilated and brought forward. The parietal callus is short, thin and transparent.

Alt. 7.2, diam. 14.5 mm.; aperture 7.5 mm. wide, 7 high. Whorls $4\frac{1}{4}$.

Distribution: North side of White Tail Canyon, in slides of igneous rock (rhyolite), at Stations 10, 11, 15, 16, 17. Type locality, Station 10. See map on p. 75.

This is the smallest *Sonorella* yet known from the Chiricahuas. It is allied to *S. virilis* by the genitalia and the indistinct sculpture pattern on the embryonic whorls, but differs by its diminutive size, thin shell, comparatively narrower umbilicus and the absence of distinct white borders along the brown band.

S. micra occupies the north side of White Tail Canyon to the exclusion of *S. virilis leucura*, which lives on the opposite or south side. It lives in "slides" of angular, dark purplish-gray rock (rhyolite), together with *Ashmunella lepiderma*, and can be found only deep in the rocks, where they rest on the earth below. The slopes are mainly toward the south and west, hence exposed to the direct sun, rarely shaded to any extent by the small trees. The snails are found from the bottom of the canyon (Station 11) to perhaps 6,800 feet (Station 16), where they occur over the crest of the ridge, in an extensive slide sloping northward. The type locality, Station 10, is below the great cliffs along Indian Creek. The lower stations are easily accessible, but the higher call for arduous climbing and, from the nature of their haunts, the work of quarrying the snails out is severe. We secured but few living specimens, but many dead shells, more or less fresh, show the species to be remarkably constant. Besides a slight variation in elevation of the spire, no variation in form is noticeable. Measurements of two lots follow:

Diam. in mm	12.75	13	13.25	13.5	13.75	14	14.25
Station 10	1	0	0	1	2	7	4
Station 17	0	1	0	4	4	10	4

Diam. in mm	14.5	14.75	15	15.25
Station 10	4	7	7	1
Station 17	1	3	2	0

On the southern side of the canyon we found a few dead specimens among limestone rocks about 20 feet above the bed of the canyon, below the junction of Indian Creek. They agree fully with those from the north side of the canyon.

S. micra occurs associated with *Ashmunella lepiderma* in the same rock slides. Both are modified in the same manner, the shell differing from allied species in being smaller, thinner, dull, with a greater or less development of cuticular processes. The reduced size compared with the species on the opposite side of the canyon is without much doubt due to the sun-scorched exposure. We have not found that living on igneous rock has any tendency to dwarf Sonorellas, though the tenuity of the shell may fairly be attributed to that influence.

The animal in alcohol is pale grayish, darker on the back. Sole with the usual pale central area and slightly darker side areas, not defined by lines.

The genitalia of a drowned specimen in good condition from Station 10 is drawn in pl. V, figs. 1, 2. Unfortunately the penis was exserted in all of this lot. Except in being smaller and *more slender*, the organs resemble closely those of *S. virilis*. The penis in this figure is shown partially everted, the long papilla (*pp.*) projecting. In fig. 2 the epiphallus is shown partially uncoiled. The flagellum is well developed for a *Sonorella*. Pl. V, fig. 3, represents the organs of another specimen, from Station 17, with the penis normally retracted. The end of the penis-papilla is shown in outline

Measurements in millimeters of the genitalia of two specimens follow:

Penis.	Papilla.	Epiphallus.	Flagellum.	Vagina.	Sperma-theca and duct.	Penis retractor.	Diameter of shell.	Museum No. of shell.
17	14	10.5	0.6	8	16	8+	14.8	94,334
14	11	13	0.5	9	17	4.5	14	94,330

Genus OREOHELIX Pilsbry.

The Chiricahua Mountains harbor two groups of *Oreohelix* with a well-developed nearly black, green or yellow cuticle, so far unknown elsewhere. In one of these, the *barbata* group, the shell is bi-convex, with whorls of small calibre, a wide umbilical cavity and numerous spiral wreaths of cuticular fringes. The other, the *O. clappi* group, has an orbicular shell usually banded, with large tubular whorls and a smaller, rapidly diminishing umbilicus. In one of the forms both the cuticle and the shell beneath possess well-defined spirals similar to the cuticular fringes of *O. barbata;* but here the likeness ends. In general appearance these Chiricahuan forms have little resemblance to groups of *Oreohelix* in the Huachucas or elsewhere. The *clappi* group further differs from the *O. strigosa* group in possessing radially costulate apical whorls.

Snails of both of these groups live immured in the shaded rocks of the mountain "slides," composed of broken rock or spawls tumbled down from the peaks above. *O. clappi* lives from 5,000 to 7,000 feet, and *O. barbata* from 7,000 to 10,000 feet above the sea. The dead shells are seldom found upon the surface. *Oreohelix chiricahuana*, in the same mountain range, requires but little covering, and is found in dry situations, often with but a single leaf or a small spawl for protection. It agrees with the Oreohelices of other regions in having a very thin cuticle, often wanting. Dead agavas and yuccas furnish a home for these, the Holospiras and *Succinea avara;* but *O. barbata* and *O. clappi*, the Ashmunellas and Sonorellas require an atmosphere with more moisture, and dwell from one to two feet below the surface. He who finds must dig.

All Chiricahuan Oreohelices are confined to that range, and none of them are closely related to species found elsewhere. All are conspicuously variable in each colony and in different colonies, nearly every one of which shows a degree of racial differentiation, so that one acquainted with these shells, even as imperfectly known at present, could locate himself if lost in the Chiricahuas by digging for Oreohelices!

No adequate discussion of these shells can be entered into without more and better illustrations than are possible to us at this time, and long series of measurements. We have merely indicated briefly the salient features of each colony.

The Oreohelix clappi series.

The group of local races which for taxonomic purposes is considered to compose the species *O. clappi* comprises about a dozen colonies, scattered over the range for a distance of about 44 miles. The relationships of the snails of these colonies may be expressed diagramatically thus:

Emigrans—Onion Creek—Reed's Mt.—type———Cataracta
|
Horseshoe—Shake Gulch—Rucker Box

The forms toward the left in this diagram are successively more roughly sculptured, toward the right they are smoother. The type happened to be of intermediate character, and near the central point of the range of the species. The upper line forms a variation-series extending from Big Emigrant Canyon (*emigrans*) to the Falls of

Cave Creek (*cataracta*). The lower line is a similar but independent chain from the southern canyons, a considerable distance from the nearest of the more northern group.

From Big Emigrant Canyon to Shake Gulch the Stations mentioned above run in a general direction from northwest to southeast. From the *emigrans* station to Onion Creek station is about 16 miles; thence to Cave Creek, 4; to Cave Creek Falls (var. *cataracta*), 2; to Rucker Box, 12; to Shake Gulch, 12. Total, 44 miles as the crow flies; but it is 55 by trail.

One peculiarity runs throughout the entire *clappi* series: they are hard to catch. Except at Onion Creek they were grouped in small families and the families did not seem to be upon speaking terms. They were clannish and confined their travels to one particular rock slide. In only two instances was the same form found in two slides of rock, though the rocks were well explored for miles around. At Onion Creek they were plentiful; about 100 were collected there in an hour.

Oreohelix clappi emigrans n. subsp.

This shell is similar in outline to *O. clappi*, but more sharply angular at the periphery, or even carinate in front. Cuticle thicker, rough, usually persistent, dark olive brown in color, lusterless, not banded, coated and caked with a deposit of humus. The sculpture after the embryonic shell consists of oblique, uneven, rather sharp striæ, and

Fig. 7.—*Oreohelix clappi emigrans.*

on the last whorl some coarse wrinkles. The striæ are sharper than in *O. clappi* and close together up to the last whorl; on the base they are *thread-like, crimped and waved* at the intersections of four or five circular rows of short cuticular appendages, which are usually retained only on the latter part of the base. In immature shells the thread-like striæ are surmounted by delicate cuticular laminæ, more or less felted together by the adhering dirt. The aperture is roundedpiriform, the lip margins converging, thickened at the ends and connected by a thin film across the parietal wall. Interior bluish white. Alt. 9, diam. 16 mm., whorls 5.

Big Emigrant Mountain, on the south side of Big Emigrant Canyon, at about 7,000 feet elevation, taken in some numbers in a shattered column of stone and also in a rock slide. This place is about 20 miles across the mountains northwest from the Cave Creek Station for *O. clappi*.

O. c. emigrans is the dirtiest of the group—in its natural state as black as the soil. It is well distinguished by the sculpture, and would be considered a separate species in a less variable group than *Oreohelix*.

Oreohelix clappi Ferriss.

Oreohelix clappi Ferriss, Nautilus, XVIII, p. 53 (Sept., 1904). Pilsbry, Proc. A. N. S. Phila., 1905, p. 285, pl. 25, figs. 54–56 (shell); pl. 19, fig. 8 (genitalia); pl. 22, fig. 4 (teeth); pl. 23, fig. 26 (jaw).

The shell is moderately depressed, with tubular whorls and deep suture, the altitude about two-thirds the diameter and about equally convex above and below the peripheral angle. The umbilicus at the opening is about one-sixth the diameter and contracts rapidly, only the penultimate whorl visible. Calcareous layer of the shell is brownish white under a thin greenish-yellow cuticle with some darker oblique streaks, which become in mature shells darker and crowded near the aperture. Many possess two indistinct transparent olive spiral bands, one above, the other just below the periphery. In old individuals the cuticle remains only in ragged shreds. The first 1½ embryonic whorls are strongly ribbed radially; these riblets are regular and narrower than their intervals. At the end of the embryonic shell the whorl slightly widens abruptly, with sculpture of rather coarse irregular obliquely radial wrinkles and traces of fine spiral striæ. The last whorl has unequal, irregularly spaced oblique wrinkles, *weak and low at the base*, which is densely covered with minute wavy spiral striæ, obsolete in old individuals. Where the wrinkles pass over the angular periphery they are sometimes somewhat more emphatic, a little pinched up. There are *no spaced circular threads or cuticular fringes on the base.* Whorls 4¾, convex, the last double the width of the preceding. Base very convex. The aperture is very shortly ovate or nearly circular, very oblique, and about one-half the diameter of the shell. The ends of the lips converge. The short parietal callus is a thin transparent film, or in old shells the peristome is continuous, as a raised parietal ledge. Old age is expressed by a deeper descent of the last whorl and closer approach of the lip margins, as usual in the genus *Oreohelix*.

Seven fully adult shells of the original lot measure:

Alt.	10,	diam.	15	mm.
"	9,	"	14.3	"
"	8.7,	"	14.5	"
"	9,	"	14.3	"
"	8.5,	"	14.3	"
"	9.5,	"	14.9	"
"	8.9,	"	14	"

This exact form has been found only at the type locality on the south side of Cave Creek below the place marked Camp on the map, p. 107, where it was taken in 1904, deeply imbedded in rotten shale near the water's edge. About 30 specimens.

In its native state *O. clappi* is covered with humus, perhaps attached by mucus. But few specimens were found except in the type Station. Its habit of burying deeply in the soil probably accounts for its rarity.

Elsewhere in Cave Creek Canyon a slightly different form (see below) was found in 1906 at Stations 9, 11, 12, near 13, 14 and in the ravine west of Reed's Mountain. These stations are all near the bottom of the canyon. It was not found higher up. Here it occurs with *Sonorella, Ashmunella chiricahuana, A. ferrissi* and *A. angulata.*

2. Lower Cave Creek Form.—The shells taken in 1906 at Stations 9, 11, 12 and near 13, 14, Cave Creek, are slightly more angular at the periphery than the types, and the growth-wrinkles bear short cuticular lamellæ where they pass over the peripheral angle in fresh and unrubbed individuals not fully mature. Often, but not always, there are three circular rows of inconspicuous granules at wide, equal intervals on the base, a weak or vanishing development of the basal sculpture of *O. c. emigrans.* The two brown bands (one at the outer third of the upper surface of the last whorl, the other below and near to the peripheral angle) are usually more distinct than in the type lot of *clappi.* A small series of fully adult shells from Station 12 measure:

Alt.	9,	diam.	15.5	mm.
"	8.8,	"	14.5	"
"	8.5,	"	14.4	"
"	8.8,	"	14.8	"
"	9,	"	14.3	"
"	9.2,	"	15.3	"
"	8.7,	"	14.3	"

3. Onion Creek Form.—This form resembles the second form from Cave Creek and *O. c. emigrans* in shape. Compared with *O. clappi* the whorls are flatter, less convex, sutures not so deep. The last whorl invariably falls to the aperture further below the angle of the preceding whorl, and the peripheral angle continues strong as far as the lip-edge.

Cuticle thin, persistent, not ragged or broken, light greenish olive, *lustreless*, with occasional dark oblique lines, which, near the aperture, become crowded. It is seldom banded spirally and then the bands are indistinct, obscure brown and transparent. The growth-striæ are sharper, more distinct than in Cave Creek *clappi*. It is very densely and distinctly striated, spirally. Oblique waved riblets and traces of spiral wreaths on the base, as in *O. c. emigrans*, are shown in young shells, and sometimes upon the penultimate whorl of the mature shell within the aperture, but seldom persistent upon the exterior. There are nearly 5 whorls. The aperture is pear-shaped, its upper margin nearly straight (consequent upon the flatness of the whorls);

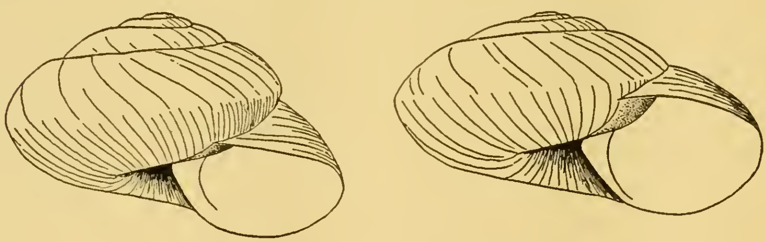

Fig. 8.—*Oreohelix clappi*, lower Cave Creek, Station 12.

not arched, as in typical *O. clappi*. The smaller shells measure about 8.8 × 15 mm.; the largest in about one hundred specimens measure:

Alt.	10½,	diam.	17½	mm.
"	10½,	"	17	"
"	10½,	"	17	"
"	10,	"	17	"
"	10½,	"	16	"

Found at the head of the main fork of Onion Creek, a branch of Turkey Creek, on the north side of the range. It was found in a shattered column of quartzite in company with *Ashmunella, Sonorella, Succinea avara* and two rattle-snakes, *Crotalus pricei* and *C. lepidus*. *Oreohelix chiricahuana* dwelt in the limestone over the ridge, less than a half mile distant. The station is about 4 miles from the locality of *O. clappi* and 16 from that of *O. c. emigrans*, and upon a direct line between the two. This is the greenest in color of the group, the texture of the cuticle is the most harsh and it is the largest in diameter.

4. Form from Rucker Canyon.—The sculpture in this form is weak, the oblique wrinkles smooth, in part effaced, and lower on the base; spiral striation weak or subobsolete, hardly noticeable above. *Cuticle glossy,* persistent, varying from rather bright green or greenish-yellow to brownish-olive, the two brown bands distinct. There are sometimes two fainter bands, one above, the other on the base. The last whorl is only very obtusely angular, the angle, well rounded, usually falls less in front than in the Onion Creek lot. The aperture is conspicuously longer than in typical *O. clappi;* upper margin decidedly arched. In old shells the lip-ends approach closely, but are not connected as in the typical *O. clappi,* the callus between them remaining thin and transparent.

Up to 3½ whorls the young carry five strong cuticular fringes below, one at the periphery and one above. The cuticle in larger shells is smooth.

The largest in 45 measured:

Alt.	10,	diam.	16½	mm.
"	10,	"	16½	"
"	10,	"	16½	"
"	9½,	"	15½	"
"	9,	"	15½	"

This is the handsomest of the group in color and, with the exception of *O. c. cataracta,* the smoothest, the base being polished with somewhat of a varnish-like gloss. The last whorl is even more rounded peripherally than in typical *O. clappi.* In 1908 it was found in a deep gulch, the "box" of Rucker Canyon, at about 8,000 feet elevation, on both sides of the stream in sliding rock, where the atmosphere was as moist as the stations on Cave Creek, about 12 miles distant. It is a near neighbor with *O. barbata,* a small form of the latter being plentiful at the twin caverns in the box, while *O. clappi* was found half a mile farther down the stream.

5. Shake Gulch Form.—The shell is sharply angular peripherally, the angle becoming obtuse near the lip; whorls flattened above; cuticle dull, lusterless, persistent, obscure olive at the base, the upper surface with a russet suffusion, peristome black-bordered. There are one or two faint bands. The surface is obliquely, rather obtusely, wrinkled, the base distinctly striate spirally, growth-lines low, not waved. The sculpture of the embryonic shell is very weak, and

seems closer than usual. Unfortunately, no young examples were taken.

This form is usually more depressed than that from Onion Creek, with less sharp oblique sculpture. It resembles the remote Onion Creek colony in the lusterless cuticle. Fourteen of about 20 shells taken measure:

Alt.	9,	diam.	15.5	mm.	(4 specimens)
"	9,	"	15.7	"	
"	9,	"	14.7	"	
"	10,	"	14.5	"	(senile form).
"	9.5,	"	16.7	"	
"	9,	"	14.5	"	
"	10,	"	17	"	
"	9.5.	"	17	"	
"	9.5,	"	16.5	"	
"	9.75,	"	16	"	
"	9.5,	"	16	"	

Shake Gulch, where these shells were found, is on the southwest side of the range at about 5,500 feet elevation about 12 miles from the Rucker "box."[19] They live in a rock slide near the stream.

6. Horse-shoe Canyon Form.—Similar to the preceding except that the peripheral angle is less acute; between the Shake Gulch and Rucker lots in form. Fragments of a *long cuticular fringe remain in places in the suture* from the third whorl to near the aperture, but there are no spiral series of granules or cuticular prominences on the base, thereby differing from *O. c. emigrans*, and like the forms geographically nearest. Only two collected, both adult, measuring alt. 9, diam. 16 mm.

Found in Horse-shoe Canyon about ten miles from the mouth, in slide rock, on the opposite side of the main fork from the Red Box, at about 7,000 feet elevation. Both shells taken were freshly dead.

Oreohelix clappi cataracta n. subsp.

The shell is *depressed*, nearly lens-shaped; periphery strongly angular, bright olive green, thin, *polished*, translucent, occasionally marked with two transparent bands; 4½ whorls, the last wider than in *clappi*, with the periphery near the flattened top, base strongly convex. Aperture nearly all below the periphery. Parietal callus short,

---

[19] Shake Gulch is so named from the circumstance that "shakes" (split shingles) are there made from the cypress.

merely a thin film on the penultimate whorl. Cuticle smooth and without "fringes" in young or old, very delicately striated spirally; sculpture of the embryonic whorl delicate, usually worn off.

Probably only the first of those measured is mature:

Alt.	6.1,	diam.	13.8	mm.
"	6½,	"	12	"
"	6,	"	12	"
"	6½,	"	11	"
"	·5,	"	11	"

Found at the Cave Creek Falls in broken rock sprayed by the falls, and near the water's edge, in company with a very small form of

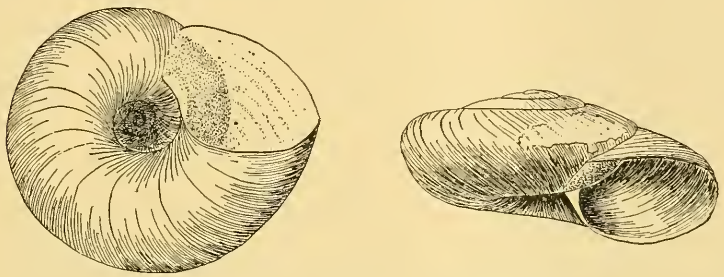

Fig. 9.—*Oreohelix clappi cataracta* P. and F.

Ashmunella chiricahuana. It was also found occasionally among the rocks higher up the slide with *O. barbata* and *Ashmunella angulata.* About 25 were found in two visits to the stations. None were alive, but some perfectly fresh. It is probably a deep burrower. This is the only station where *O. barbata* and *O. clappi* were found together.

O. c. cataracta is quite a distinct race. The green, polished base reminds one of *Omphalina.* It is the smoothest and most depressed form of *O. clappi.*

Oreohelix chiricahuana Pilsbry. Fig. 10.

Proc. A. N. S. Phila., 1905, p. 283, pl. XI, figs. 1–3 (shell), pl. XIX, fig. 4 (genitalia), pl. XXIII, fig. 24 (jaw).

The range or this species extends from Emigrant Canyon to Limestone Mountain, a distance of about 50 miles. Its range is markedly discontinuous towards the north and south ends, but from White Tail to Cave Creek Canyons the colonies are not widely separated. It is always found on limestone, never where the country rock is metamorphic or igneous.

The several races differ as follows:

a.—Sculpture of sharp fine striæ along the lines of growth, conspicuous on the base, where there are also spiral striæ and some widely spaced larger spirals.

b.—Shell smaller, diameter about 11 mm., whorls $4\frac{1}{2}$ to 5; peripheral keel well expressed .... *O. chiricahuana.*

b[1].—Shell larger, diameter about 14 mm., whorls $5\frac{1}{4}$; peripheral keel strongly projecting, the whorl hollowed above and below it .... *O. c. percarinata*

a[1].—Sculpture obsolete, the oblique striæ course and blunt, the base especially much smoother; spiral sculpture weak or wanting; diameter usually 12 to 15 mm., whorls $5\frac{1}{3}$ to $5\frac{1}{2}$.......... *O. c. obsoleta.*

The type locality is on the slope with southern exposure below the cave in Cave Creek Canyon, Station 8 on map, p. 107. The dry ravine has steep sides of steeply dipping, more or less calcareous shale and earth formed by its decomposition. The dead shells are profusely scattered; living ones are under dead mescal (*Agave*), sotol (*Dasylirion*) and bear-grass, with *Thysanophora horni*, *Succinea avara*, *Vitrea*

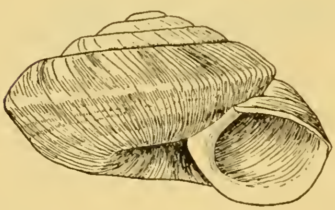

Fig. 10.—*O. chiricahuana*, Cave Creek, Station 8.

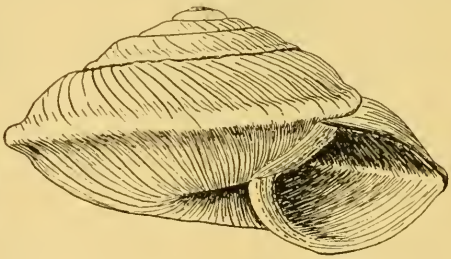

Fig. 11—*O. c. percarinata* P. and F., Cross J Mountain

indentata and *Holospira*. The colony here is about 250 yards long and perhaps 100 wide in the widest place. The shells are very uniform in size:

Alt.	6	6.8	6.5	6.5	6.8	6.8 mm.
Diam.	11.1	11	11	11	10.5	11.5 mm.

The shells are white, with the earlier whorls flesh-tinted, a faint fleshy-corneous band at the outer third of the top of the last whorl, which has two grayish or fleshy corneous bands on the outer half of the base or a general fleshy corneous suffusion there. A scalariform mutation rarely occurs.

From the cave we found large colonies at intervals westward nearly to the western rim of the valley, at Stations 5, 6 and 7 on map, p. 107. At Station 5, on a steep north slope along the creek, under rocks, about 3 miles west of the cave, the shells are similar but larger, 12 to 13 mm. in diameter.

At Station 6, about half way up the north side of the limestone ridge, the shells were like those from the cave in size, but somewhat whiter, more calcareous. Near and at the top of the ridge, along the southern side, east and west of station 7, *O. chiricahuana* is widely distributed. The shells here are like those from Station 6, but smaller, the largest 10 mm. in diameter. This colony is probably 1,500 feet higher than the cave. The smaller size of the shells from Station 7 may probably be correlated with a dryer and hotter habitat. How far down the south slope it extends we did not learn. We found *O. chiricahuana* nowhere else in Cave Creek Canyon, nor has the typical form been encountered elsewhere.

Oreohelix chiricahuana percarinata n. subsp. Fig. 11.

The shell is larger than typical *O. chiricahuana*, whitish, clouded and suffused with flesh color, depressed, with *a compressed, projecting peripheral keel*, the last whorl excavated, concave above and below the keel, elsewhere strongly convex. Striation oblique, rather coarse and quite irregular above, sharper and strongly arcuate below. Spiral

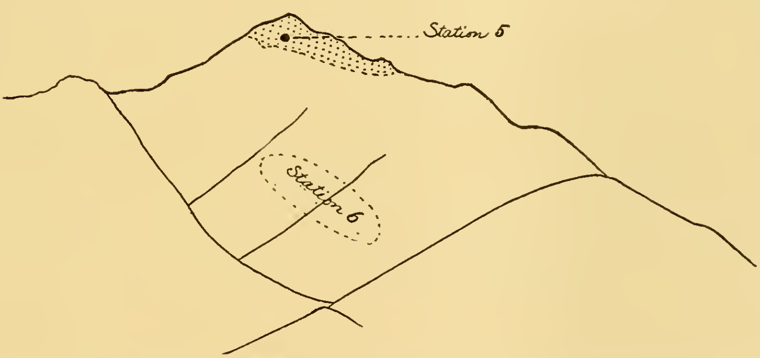

Fig. 12.—Summit Cross of J Mountain, seen from the mouth of Big Emigrant Canyon, at X on map, p. 121. Entire range of *O. c. percarinata* shaded. At Station 5 and over much of the slope around Station 6, *Sonorella optata* was found. High granitic spur on left.

threads few and fine or wanting on the upper surface; on the base there are two to four major spirals at wide intervals, with fine spiral threads over the whole base. The last whorl rarely falls far below the carina at the aperture. Alt. 8, diam. 14 mm.; whorls $5\frac{1}{4}$.

Summit of Cross J Mountain near the mouth of Big Emigrant Canyon, Station 5 on map, p. 121. November 12, 1906. This locality is farther north than any other known colony of *Oreohelix* in the Chiricahua range. The Oreohelices were found around the summit, which is probably about 7,500 feet elevation, and along the ridge northward, down about 500 feet, but not in the valley (Station 6), where *Sonorella* lives. This slope of the mountain is limestone, becoming cherty above, but the summit is angular, friable quartzite (?), among the fragments of which the Oreohelices live. None were found on the ridge running toward the mouth of the canyon, which is composed of a disintegrating, coarse-grained granitic rock. There is little vegetation of any kind on the upper part of Cross J Mountain. The station is rocky, barren and exposed. The snails are moderately abundant, though living ones are hard to get.

Paradise Canyon. On the south side, about two miles below the town of Paradise, *Oreohelix* was found in some abundance, but owing to the snow which covered the ground at the time we camped there (November 20) but few living examples were taken. The form is almost identical with that of Cross J Mountain, the adult differing only in having the radial striation on the base a little more regular, and the major spirals, of which there are three or four, often somewhat stronger, though in some shells they are hardly noticeable. In young and half-grown shells a thin cuticular thread runs along the summit of each of the striæ, and at the intersections of the major spirals these threads rise in short triangular processes. This feature was not observed in the shells from Cross J Mountain.

Another similar lot was taken on the northern slope of the canyon. These places are probably not far from the 6,000 feet contour, being thus much lower than Cross J Mountain.

The separation of these colonies from the Cross J Mountain colony of *O. c. percarinata* probably indicates independent evolution of the same characteristics, since an area occupied by *O. chiricahuana obsoleta* lies between Big Emigrant and Paradise Canyons.

Oreohelix chiricahuana obsoleta n. subsp. Fig. 13.

In White Tail Canyon, this form of *O. chiricahuana* was taken at Stations 1, 2, 3, 6, 7, 8, 12, 14—all on the southern side except 3, which is just over the crest of the ridge on the Pinery side. The sculpture is rather rude and blunt, the striation less sharp than in the Cave Creek form, being effaced or subobsolete especially on the base where spiral lines are wanting or rarely weakly indicated, while Cave Creek *chiricahuana* has sharp, subregular striation and distinct spirals. Two or three inner whorls are brown, the rest being white with some faint gray streaks and scattered dots. Whorls $5\frac{1}{3}$ to $5\frac{1}{2}$ ($4\frac{1}{2}$ in typical *chiricahuana*), the last carinated as in *chiricahuana*. The shape varies from typical to decidedly more elevated, and the size everywhere exceeds that of Cave Creek shells. A series from the typical Station 14, where it is abundant, measures:

Alt.	9.7	9	9.5	9	9.5 mm.
Diam.	15	15	14	14.2	14.2 mm.
Whorls.	5⅓	5⅓	5⅓	....	....
Alt.	10	9.2	9.8	9	8.7 mm.
Diam.	14.2	14	13.5	13	12 [illegible] mm.
Whorls.	....	....	5½	5½	5⅓

In these shells the peripheral angle is about as in Cave Creek types, but the base is smoother, the striation nearly effaced, and spiral striæ are wanting or very rarely a few may be faintly seen under the keel. Shells from Stations 1, 2, 6, 7, 8, 12 agree with those from 14. These stations are on rather steep slopes with generally northern exposure, and from somewhat over 6,000 to about 7,000 feet elevation. The distribution over this area is nearly or quite continuous.

At Station 3, just over the crest of the ridge, on the Pinery Canyon side, probably a little over 7,000 feet elevation, the shells are smaller, 11.8 to 13 mm. diameter; otherwise similar. This station is very high and exposed, on a sunny slope, hence extremely dry and arid; but the following record shows that mere elevation is not a factor of importance. On the south side of White Tail Creek, only

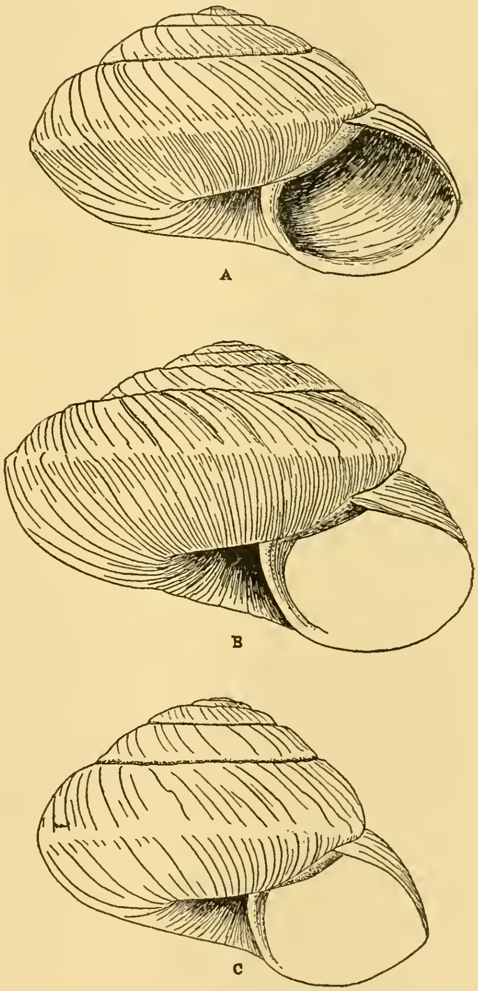

Fig. 13.—*O. c. obsoleta* P. and F. A, White Tail, Station 14; B, C, Limestone Mountain. Drawn to same scale as figs. 10 and 11.

a few feet above the bed of the canyon, at and below the mouth of Indian Creek, the shells are equally small, 12 to 13 mm. in diameter. The station is deficient in herbage, more barren than higher up the slopes.

In the Box Canyon of White Tail we found a colony which differed from all other lots of the White Tail region in sculpture, the striation being distinct and rather sharp on the base, as in typical *chiricahuana*, and with very weak traces of fine spiral lines. The peripheral keel projects more, approaching the shape of the race from Big Emigrant Canyon; otherwise the shape, size and number of whorls is as in *O. c. obsoleta*. The conditions at this station were unfortunately not noted particularly.

No specimens of this shell were taken by Ferriss and Daniels in 1907, as they did not explore the limestone ridges. In 1908 Ferriss and Pomeroy found it again in Hand's Pass, over the range from White Tail, in the head of Pinery Canyon.

The embryonic shell is strongly, regularly ribbed. The shell has 5¼ whorls, rounded, arcuate, keel nearly obsolete near the aperture in mature shells; aperture nearly round, the angle formed by the peripheral keel hardly perceptible.

Alt.	10½	10¼	10¼	10	8¾
Diam.	16	14½	14½	15½	14

They were found for several miles upon both sides of the trail in the scattered stone upon the hillsides and around the cliffs.

In the head of Mackey's Wash, sloping to the north, a few were found, but no aged shells. The major spirals upon the under surface are represented by very low, obtuse ridges. The keel becomes very obtuse on the last whorl near the aperture. *O. c. obsoleta* was also found in the head of Onion Creek (between Paradise and Jhu Canyons).

In 1907 Mr. Ferriss passed over the wide part of the range from Paradise to the mouth of Rucker Canyon and Shake Gulch, some 25 miles from the Cave Creek Station, and here again *O. c. obsoleta* (fig. 13 *b, c*) was found in a foothill known as Limestone Mountain, about ten miles in length and some 7,000 or 7,500 feet above the sea. These are the largest specimens so far found, thick and rounded, opaque white or pink-white and very little clouded. The wrinkles were coarse but obtuse upon the upper surface, the base smooth, without a trace of spiral lines.

Alt.	11	10¼	11	12	9
Diam.	16¼	16	15½	15½	15
Whorls	5½				

In "Canyon No. 3" (not knowing a better name) the shells were sometimes specked with transparent dots.

Alt	$11\frac{1}{4}$	$11\frac{3}{4}$	$11\frac{1}{4}$	$10\frac{1}{4}$	10
Diam	$16\frac{1}{2}$	$16\frac{1}{4}$	16	16	$15\frac{1}{2}$

Limestone Mountain is thickly covered with juniper, mountain mahogany and other trees and shrubbery, for it is in a U. S. Forestry Preserve. The shells were found in the upper part of the mesa before the rough ground was reached, in company with *Holospira*, but small in size. As the hill became higher the shells were larger and more numerous. Here also was found a toothed form of *Ashmunella* and also Pupæ and other of the smaller species. The mountain is composed entirely of limestone, upon the northern slope at least. Rocky cliffs and talus gave the snails ample shelter. Between this station and the Cave Creek Station, about 25 miles distant, there are no limestone exposures and no *Oreohelix chiricahuana*.

Oreohelix barbata Pils. Pl. VI, Figs. 1–3.

Oreohelix barbata Pils., Proc. A. N. S. Phila., 1905, p. 280, pl. 25, figs. 57, 58 (shells); pl. 19, figs. 5 (genitalia); pl. 22, fig. 6 (teeth).

Twenty colonies of this species have been found, all between the head of the southeast fork of Pinery Canyon and the Rucker "box," at elevations of not less than 7,000 feet, and within a distance of twelve miles in length and two to three miles in width. They dwell upon all sides of these high peaks in the rock slides or talus, and among the rocks upon the slopes of the gulches and ravines. Ferriss and Daniels found the most robust specimens living under from two to three feet of rock well covered over with sod, with the most perfect specimens of *Ashmunella chiricahuana*, a toothed *Ashmunella*, *Sonorella virilis* and the little mountain rattle-snake, *Crotalus pricei*. In Cave Creek Canyon they often occur under one or two feet of rock.

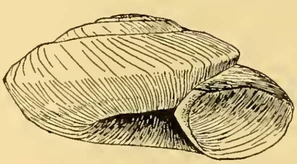

Fig. 14.—*O. barbata*, denuded shell from Cave Creek, Station 4.

In their own territory *Ashmunella*, *Sonorella* and the other forms of *Oreohelix* are usually to be found wherever the conditions are favorable; but it is not so with *O. clappi* and *O. barbata*. These snails are found only by chance, in isolated colonies, and these colonies are usually divided into families, the old pair and their spring crop of all sizes when not fully matured live together.

Every colony as a rule has some peculiarity. *O. barbata* ranges in color from pale greenish to dark reddish brown, some with wide indistinct red bands. Many lose their fringes and part of the cuticle before maturity. In one colony the shells were entirely naked. The rows of cuticular fringes vary in number from five to ten. In size, the shells are from 14½ mm. diameter down to 10 mm. in the race *minima*. Elevation above the sea apparently does not control size. The smaller forms usually dwell at 10,000 feet, and the largest at 7,000, but a pigmy form was found at the lowest altitude, and the most robust at about 8,500 feet.

The deflection or dropping of the last whorl at the aperture is not uniform or consistent in any colony, but it has significance in connection with the proportion of individuals so modified. In some colonies, as that in Cave Creek, the last whorl as a general rule drops very little, while in Barfoot Park it usually descends deeply.

In Cave Creek Canyon this species is confined to the border and slope of the western escarpment. Ferriss (1904) took the types in the talus half a mile below the falls of Cave Creek. These have 4⅓ whorls, and are pale greenish; the cuticular laminæ light russet. There are four to six, usually five, circular wreaths of triangular cuticular scales, one small one being midway between periphery and suture, but often wanting, one at periphery, and three or four on the base.

The last whorl is strongly angular throughout, and usually does not descend very deeply in front. Parietal callus thin and moderately long.

Alt. 7, diam. 13.5 mm., not including cuticular processes.
" 5, " 12 mm.

In 1906 we found almost similar specimens at Station 4 (marked by two dots on the map, p. 107), darker in color, with sometimes as many as eight cuticular wreaths, sharply carinated or angular at the periphery. These were on a well-shaded northern slope, under rocks in a coarse talus. This place is two or three hundred feet above the bed of the "wash" and about one hundred below the cliffs, just opposite a little grove of aspens among the oak scrub, which form a conspicuous landmark near the head of the "wash," from their rarity in this canyon. The snails here had been preyed upon by the mice.

In Turkey Creek near the head of one of the eastern branches at an elevation of about 8,500 feet, Ferriss and Daniels took fully developed examples in 1907 (pl. VI, figs. 1, 2, 3). The shells are strongly angular to the aperture, and measure 13 to 14½ mm. diameter, with 4½ to 4¾ whorls. They have 7 beautifully developed wreaths, in the best preserved individuals. The last whorl drops fully 2 mm. at the aperture. They were found in a talus upon an eastern slope of a steep mountain side, and possessed the best developed, longest and most persistent cuticular wreaths.

A second colony in the head of one of the eastern forks of Turkey Creek, found in 1908, approaches more closely the Barfoot Park series. The shell is greenish under a pale brownish cuticle with a red band; five short cuticular wreaths; last whorl drops 1 mm.; margins of aperture connected by thick callus. Diam. 12, alt. 7 mm.

These snails live in numerous colonies around the region of the Falls of Cave Creek and the heads of the branches northward as far as Turkey Creek. As the original photographic figures do not show the shape clearly, a new figure has been drawn (fig. 14) of a shell denuded of cuticular fringes, from Cave Creek, Station 4.

Blunt-edged Variety.—In Barfoot Park, Rustler's Park, at about 9,000 feet, a slide at the head of Turkey Creek, Ash fork of Cave Creek, Snow-shed Mountain at the head of Cave Creek, and the head of Rock Creek, a form occurs in which the shell is smaller than typical *O. barbata* and in fully adult shells the last whorl often descends the full width of the former whorl: the periphery also is somewhat less sharply angular, and becomes almost rounded near the aperture.

Alt. 5.5, diam. 11.3 mm., Station, Barfoot Park.
" 6, " 11 " " " "

This is distinctly a decadent form, as denoted by the tendency of adult shells to assume the old-age feature of a very deeply descending last whorl. In Barfoot Park it lives in a deep slide of igneous rock having a southern exposure. In Rustler's Park in a few stones on the hillside.

On the Ash fork of Cave Creek a colony has 4½ whorls, the shell is white under the cuticle, which is dark reddish brown above, lighter brown below; occasionally with five cuticular fringes; last whorl drops 1 mm. Diam. 12, alt. 6½ mm., aperture 4¼ mm.

A colony at the spring branch of Rucker Canyon, north side and near the head, Station 10*a*, resembles the above closely (pl. VI, figs. 4, 5). The umbilicus is a little more open, cuticle dark reddish brown, banded with red above; six cuticular fringes. Diam. 12½, alt. 6 mm. It is strongly angular to the aperture, and the last whorl falls much more in front than is usual in Cave Creek shells.

In a slide of rock on the north side at the head of Raspberry Gulch (a tributary of Rucker Creek, which it enters at the Box Canyon) a colony had only 4 whorls. The umbilicus measured 3½ mm. wide. Cuticle dark reddish brown, with a short fringe on the periphery; last whorl drops 1½ mm. Diam. 12, alt. 6½.

On the west slope of Snow-shed Mountain, at the head of Cave Creek, almost one continuous talus, was a colony similar to the preceding. Shell transparent when young, occasionally with 5 short fringes. Diam. only $10\frac{1}{2}$, alt. $5\frac{3}{4}$ mm.

In a dry talus fully exposed to the sun and sloping to the south on the head of Rock Creek was a colony heavily covered at maturity with 9 or 10 black fringes, periphery rounded as in the Rustler Park and Barfoot Park specimens; aperture $4\frac{1}{2}$ mm. Margins connected by a thick callus; umbilicus varies from 3 to $3\frac{1}{2}$. Diam. 11, alt. $6\frac{1}{4}$.

The five colonies above were found by Ferriss in 1908.

In 1907 Ferriss and Daniels found a small heavily fringed form in the talus of a gulch in the head of the southeast fork of Pinery Canyon, that in fringes resembles the type of *barbata*.

Like the above it had from 9 to 10 long fringes. The last whorl dropped but one mm. Diam. 11, alt. 6, aperture 4 mm.

Oreohelix barbata minima n. subsp. Pl. VI, figs. 6, 7.

At the head of Rucker Canyon (Station $11\frac{1}{2}$A) and in the Rucker Box, Ferriss and Daniels found colonies in 1907 that were still further depauperate than the above. Ferriss relocated the latter colony in 1908. These shells possess $4\frac{1}{4}$ to $4\frac{1}{2}$ whorls, the last whorl regularly angular, the angle weakening near the aperture in old shells. Toward the end the whorl falls deeply at maturity. There are from 6 to 7 spiral fringes in the best preserved examples, but adults generally are denuded or show only traces of the spiral wreaths. The margins of the lip converge and form a perfect union in maturity, being joined by a very short parietal callus, and the aperture is sometimes raised above and free from the penultimate whorl.

The shells from the head of Rucker are uniform brown in color and measure:

Alt. 5, diam. 10.3, umbilicus 3, diam. aperture 3.5 mm.; whorls $4\frac{1}{2}$
" 5, " 10, " 3.1 " " 3.25 " " $4\frac{1}{3}$

Those from Rucker Box are light brown, sometimes albinistic, light green.

Six specimens from the Box of Rucker Canyon, type locality, measure:

Alt.	5.8	5.25	6	5.25	5.25	5
Diam.	10	10.5	10	10	10	10

This is the most decadent race, being reduced in size in addition to the deeply descending last whorl and in old shells the nearly or quite free peristome. Colonies of larger forms of *O. barbata* occur at greater elevations than the Rucker Box (about 7,000 feet), so that the degeneration is probably due to other local causes.

Fig. 15.—*O. b. minima* P. and F., Rucker Canyon, Station 11½*a*.

Genus **ASHMUNELLA** Pils. and Ckll.

A study of the genitalia of Chiricahuan Ashmunellas leads to the conclusion that all the species of that range are of common ancestry, and more closely related *inter se* than any are to New Mexican or Huachucan species. In other words, the specific differentiation has been mainly subsequent to the isolation of this fauna.

In both Chiricahuan and Huachucan species the penis is bipartite, consisting of an upper and a lower portion separated by a submedian constriction. In the Huachucan series the *upper segment is enlarged* like the lower (see plate XX, Proc. A. N. S. Phila., 1909). In Chiricahuan forms the upper segment of the penis is *very narrow*, hardly larger than the epiphallus, but its distal end is invariably a little swollen, and contracts abruptly where it passes into the epiphallus[20]. The penis retractor is extremely short in Chiricahuan species, longer in Huachucan. The spermatheca is more or less varicose in Huachucan species, but this is hardly apparent in Chiricahuan forms. The vagina in the Chiricahuan series is swollen and muscular in its upper part, smaller with thinner walls below. In other respects the organs are alike in the two series. These considerations lead to the conclusion that the whole Chiricahuan series of *Ashmunella* constitutes one phylum, the Huachucan series another. Doubtless the two phyla were of common ancestry; but their evolution on the two parallel mountain ranges has been independent. The extraordinary resemblances between some Chiricahuan and Huachucan species, which led us in 1905 to

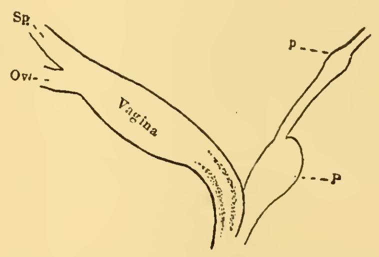

Fig. 16.—Terminal ducts of genitalia of *Ashmunella p. albicauda*, Station 4, White Tail Canyon. *Sp*, base of spermathecal duct; *Ovi*, base of oviduct; *P*, lower, swollen portion of penis; *p*, upper end of penis.

[20] The slender upper continuation of the penis was not always recognized in our former (1905) work on Chiricahuan snails, although once understood it is clear enough.

unite some of them specifically,[21] are wholly due to evolution along parallel lines in the two stocks. This orthogenetic evolution has resulted in the most extraordinary parallelism. By degeneration of the teeth of the aperture, wholly toothless forms have arisen as terminal evolution products in both phyla; and these are so similar in shell-characters that they are indistinguishable. Other forms in both phyla have evolved a V-shaped parietal tooth, like that of *Polygyra*.

While the shell is extremely conservative in *Sonorella*, in the related genus *Ashmunella* it appears to be the most plastic part of the organism. As in *Polygyra* and many other molluscan groups in which complex hard parts have been evolved, many races and species are characterized by varying degrees of degeneration of the teeth of the aperture. In the current phraseology, this may be due to the action of an inhibiting factor, earlier or later checking the development of teeth. This seems to have taken place independently in most of the centres of *Ashmunella* evolution. Toothless apertures are no doubt primitive in the Belogenous Helices, so that secondarily simplified forms, such as *A. varicifera* and *A. chiricahuana*, have completed an evolution cycle, returning to the primitive simplicity of aperture. Whether such forms can give rise to new series having dentate apertures remains uncertain.

Key to Chiricahuan Ashmunellas.

I.—Aperture toothless or with very small vestiges of teeth only.
- *a.*—Shell chestnut brown, glossy, the lip narrow, without traces of teeth.......... *A. chiricahuana.*
- *a*¹.—Shell light brown without much luster; usually with a callous ledge within the outer lip, or other weak vestiges of teeth. *A. esuritor.*
  - *b.*—Penis normal.
  - *b*¹.—No penis; vagina long, much swollen above.. *A. metamorphosa.*

II.—Aperture obstructed by three or four large teeth.
- *a.*—Very acutely carinate, the carina projecting above the suture; whorls of the spire flat.......... *A. ferrissi.*
- *a*¹.—Carina not projecting at sutures or wanting.
  - *b.*—Surface papillose or scaly; shell thin, strongly carinate. *A. lepiderma.*
  - *b*¹.—Surface not scaly or conspicuously papillose.
    - *c.*—Basal tooth single, bifid, or with two basal teeth nearer together than the outer one is to the outer lip tooth.
      - *d.*—Periphery obtusely angular in front, becoming rounded; young with a slight lip-rib only.......... *A. duplicidens.*
      - *d*¹.—Periphery strongly angular or carinate.

[21] In 1905 we considered the Chiricahuan *Ashmunella proxima* to be a subspecies of the Huachucan *A. levettei*. The Huachucan *A. varicifera* we thought identical with the Chiricahuan *A. chiricahuana*.

e.—Whorls fully 6; lip narrow, convex, not forming a projecting angle above........................*A. p. fissidens.*

e[1].—Whorls 5½; lip wide, angulated above; young forming a very heavy lip-rib............................*A. p. albicauda.*

c[1].—Three lip teeth separated by nearly equal spaces.

d.—Corneous or light brown; whorls of the spire convex; outer basal tooth not greatly compressed.

e.—Corneous; basal teeth subequal and well separated. *A. proxima.*

e[1].—Basal teeth somewhat united, the inner often reduced. young shells having a very heavy lip-rib. *A. p. emigrans.*

d[1].—Shell dark brown; whorls of the spire flattened; outer basal tooth strongly compressed, entering.*A. angulata.*

The genitalia are very similar in all Chiricahuan species examined—so similar that we omit detailed descriptions and merely add here a table of measurements in mm. of the organs in examples of the several species.

Species and locality.	Penis.	Epiphallus.	Vagina.	Sperma-theca.	Diameter of shell.	Figure of genitalia.
A. ferrissi:						
Cave Creek, 94,515................	4.5	25	4	19.5	12	pl. X, f. 7
A. angulata:						
Cave Creek, 87,020................	4	31	4	27	11	pl. X, f. 6
A. lepiderma:						
White Tail Canyon................	5	25	4	17	12	
" " "	5	27	4	21	11.5	
" " "	4.5	23.5	6	23.5	11	
A. duplicidens:						
Morse Canyon.........................	6	39	4	18	13.2	pl. X, f. 8
A. fissidens emigrans:						
99,604....................................	6	32	3.5	24	13	pl. X, f. 9
A. fissidens albicauda:						
White Tail................................	5	29	4.5	24	12	
A. chiricahuana						
Head of Cave..........................	9	70	6.5	58	19.5	pl. X, f. 4
Cave Creek Falls....................	5.5	33	8	33	15	pl. X, f. 1
A. esuritor:						
Barfoot Park, 94,432............	7	51	6	35	15–16.5	pl. X, f. 2
" " "	8	40	7	42	"	
" " "	8	42	6.5	42	"	pl. X, f. 5
Topotype, 92,205....................	5	34	4	....	15	pl. X, f. 3

Group of Ashmunella proxima.

From Old Fort Bowie these forms extend southeastward to the end of the Chiricahua range. Northward beyond the depression at the Fort, in the Dos Cabezas end of the range, no *Ashmunella* has been found. The mountains here are apparently too barren and dry for *Ashmunella,* though they support the more hardy Sonorellas.

The colonies seem to be small and widely separated in the area northwestward of White Tail Canyon, but much of that country remains to be explored, especially between Big Emigrant and White Tail Canyons, as well as the entire region of the southwestern watershed.

A. ferrissi and *A. angulata* are distinct from the others by their flattened whorls and conspicuously compressed outer basal tooth. The other species are intimately related, and their variations make a complexly branching form-chain. An adequate study of the material in hand, some thousands of shells, would require more ample time than we can give. Since not half of the territory is adequately covered by our series, we must leave full consideration of the subject for another occasion.

Our knowledge of the forms from Rucker and Horseshoe Canyons and the region around them is still very defective. The forms seem to be related somewhat, as shown in the following diagram:

```
                             proxima
                             |   |   |
                    emigrans |   |   | lepiderma
                             |   |   |
pomeroyi, albicauda—fissidens
                                 |
                                 |
                            duplicidens
```

If a single basal tooth is primitive, then *A. duplicidens* is the least evolved member of the series and of the whole Chiricahuan group of Ashmunellas. Then *A. proxima* and *lepiderma* would be the most evolved. All of the forms with more or less concrescent basal teeth are extremely variable in the degree of union of these teeth. Every colony of *fissidens, emigrans, albicauda, pomeroyi* and *duplicidens* shows great individual variation in this respect. There seems to be complete intergradation between the separated basal teeth of *proxima* and the united teeth or single tooth of *fissidens* and *duplicidens.*

Ashmunella lepiderma n. sp. Pl. VII, figs. 1–7.

Shell umbilicate, the umbilicus about one-fifth the total diameter of the shell, much depressed, biconvex, acutely carinated peripherally, thin, corneous-brown. The surface is lusterless, sculptured with fine, unequal wrinkle-striæ, and covered with a network of cuticular scales or processes (readily removed by cleaning). There are 5½ whorls, the first one corneous and glossy, the first three convex; subsequent whorls convex above, impressed above the lower suture; last whorl is distinctly impressed above the projecting peripheral keel, the base convex; in front it descends slightly or not at all to the aperture, and is narrowly, rather deeply, guttered close behind the lip on the base. The aperture is lunate, contracted by four teeth: a wide one within the outer lip, two contiguous tubercles in the basal lip, and an oblique straight parietal tooth. Parietal callus thin and transparent.

Alt.	4.8,	diam.	11.7	mm.
"	4.2,	"	11.2	"
"	5,	"	11	"
"	5.5,	"	12.2	"

White Tail Canyon, *on the northern side only*, at Stations 10, 11, 16, 17, etc., in "slides" of igenous rock (rhyolite); type locality, Station 11, in a slide of angular rhyolite, coming down to the trail in the bed of the canyon, with *Sonorella micra*. See map on p. 75.

Genitalia are of the type usual in the *fissidens* group. The epiphallus and spermatheca are a little shorter, proportionately, than in *A. p. albicauda* or *emigrans*. Measurements of the organs of three individuals may be found in the table on p. 97. The mantle within the last whorl is cream-white with a few inconspicuous gray dots; collar pale slate-tinted.

This species, of which several hundred specimens were taken, inhabits suitable rock-slides over the whole northern side of White Tail Canyon. At Station 11 it occurs close to the bottom of the canyon, and only a short distance from where *A. fissidens* is found on the opposite side. The slopes of this side of the canyon are steep, interrupted by cliffs, and the heights are difficult of access. At Station 16 there are extensive rock slides sloping northward towards the mesa, and perhaps 1,500 feet higher than Station 11. Here it passes over the ridge and inhabits the opposite slope. While belonging to the *fissidens* group, this species is very distinct by its sculpture of cuticular scales, the strong carination, thin texture, etc. The young shells form only a weak callous rib within the lip at resting periods.

At all the stations there is considerable variation in size and, as in all Chiricahua Ashmunellas, the height of the spire varies a good deal among individuals of any colony. At Station 17 the shells average smaller than in other places, about 4 x 10.3 mm.; but a few are as large as 11.5 mm. diameter and many as small as 9.5 mm. The scale-like sculpture is especially well developed in shells from this station. In some colonies the cuticular scales are minute, sparse or even wanting in adult shells.

At Hand's Pass, at the head of Jhu Canyon, this species reappears. The surface is regularly very minutely pustulate, some perfectly fresh shells having minute cuticular appendages on the pustules in places. There are also some cuticular spiral hair-lines on the base. Alt. 5, diam. 12 mm., whorls 6. This colony is separated from the type locality by the whole southern slope of White Tail Canyon, where *lepiderma* certainly does not occur. We have considered the possibility that the Hand's Pass form may be an independent convergent modification of the *proxima* stock; but in the absence of alcoholic material permitting a full comparison this hypothesis must remain in abeyance.

Ashmunella proxima Pils. Fig. 17.

Ashmunella levettei proxima Pils., Proc. A. N. S. Phila., 1905, p. 242.

This species was described from "Sawmill Canyon," otherwise known as Rigg's or Pine Canyon, where the senior author collected it in 1904. We did not find it there in 1906, but our search was impeded by snow. We found it near Fort Bowie in company with *Sonorella bowiensis*. The exact locality is a little thicket of long-leaved scrub oaks, just below a low rock-wall, somewhat more than half-way up "Quartzite Hill," on the side facing Dixon's house, shown at (1) in the sketch on p. 67. This is about a mile from Old Fort Bowie.

Similar shells were also taken at Crook's Peak (Ferriss and Daniels) in 1907; only two specimens.

In ranking *A. proxima* as a subspecies of *A. levettei*, a wrong estimate was made of its affinities. It is related to *A. fissidens* and *duplicidens*, but differs from both by having two distinctly separated teeth on the basal lip. *A. levettei angigyra* stands very near *proxima* in shell-characters, but the lower end of the tooth within the outer lip *runs inward* in *angigyra*, while in *proxima* the free edge of this tooth runs parallel with the peristome. In *angigyra* the outer-basal and outer lip tooth are usually closer together than are the two basal teeth. This is not the case in *proxima*, in which the three teeth are about equally spaced. In soft anatomy the two are quite distinct. *A. l. angigyra* has a far longer penis of different shape and a shorter epiphallus and vagina than *A. proxima*; moreover, *angigyra* has a radula with more teeth, and there are more ribs on the jaw. The shell is corneous-brown, sub-acutely angular at the periphery, the angle weakening on the last part of the whorl, behind the lip, where the surface is more strongly striate. Spire convex. There are $6\frac{1}{4}$ to $6\frac{1}{2}$ very slowly widening, slightly convex whorls, the last descending somewhat in front. The aperture has a rather long, concave-topped tooth within the outer lip, its face concave. The basal lip has two tubercular teeth, a little compressed laterally, the inner one smaller. These teeth divide the lower border of the aperture into three *nearly equal bays*. The parietal tooth is straight or slightly bent inward at the axial end; never V-shaped, as it frequently is in *A. fissidens*. Parietal callus thin. The umbilicus is rather wide, contained $4\frac{3}{4}$ times in the diameter of the shell. The surface is rather dull, finely striate, the striæ appearing more or less

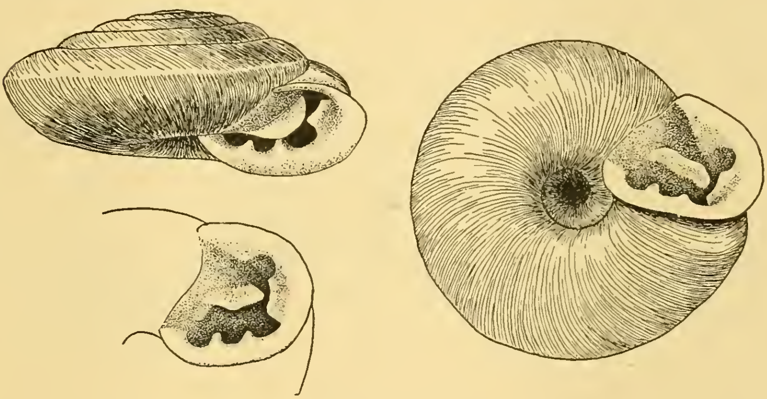

Fig. 17.—*Ashmunella proxima*, Quartzite Peak, Station 1.

irregular or interrupted under a strong lens. The size varies little from 12 mm. diameter.

In perfectly fresh young shells a delicate pattern of minute low granules on the upper surface may be seen with some difficulty. Some very weak traces of spiral striæ may sometimes be made out on the base. The young shells have a callous rib within the lip, at resting stages, but it is apparently not formed as frequently as in *A. fissidens*.

The genitalia were figured in 1905, pl. 21, fig. 24. Having again examined the individual dissected, we note that the penis was incorrectly drawn. The swollen basal half is everted (as in pl. 21, fig. 23), hence does not show in the figure. The slender upper portion of the penis is shown, its distal end indicated by a slight node, only indistinctly drawn in my figure. With these corrections, it will be seen that the organs are like those of *emigrans*, *fissidens* and *albicauda*.

The mantle within the last whorl is white, with the anterior vessels of the lung faintly traced in gray and having gray pigment along the periphery.

Southern forms resembling A. proxima.—Raspberry Gulch. A few specimens in poor condition are intermediate between *proxima* and *fissidens* as to the basal teeth, but the umbilicus is much narrower than in either, and the peripheral angulation is less pronounced, thus approaching *A. duplicidens*. There are over 6 whorls. Other southern localities for forms of *A. proxima* are Rucker Canyon and "Turtle Head," a station between Crook's Peak and the mouth of Rucker.

A. fissidens should by rights be subordinated to *proxima* as a subspecies, on account of the various intermediate forms; yet the status of the races can be more clearly expressed by the artificial device of making it a "species."

Ashmunella proxima emigrans n. subsp. Fig. 18.

On Big Emigrant Mountain, Big Emigrant Canyon, a race was found having some characters of *A. fissidens*. The shell is somewhat larger

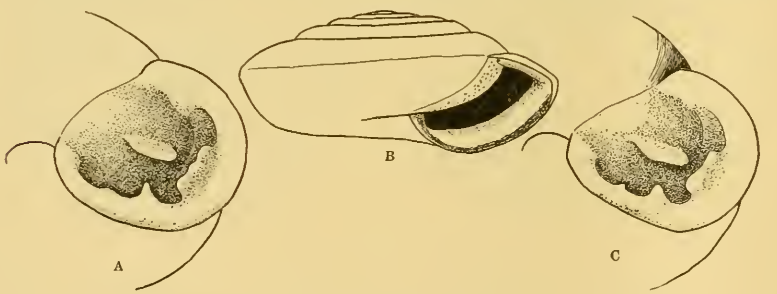

Fig. 18.—*A. p. emigrans*. A, C, apertures of adult shells. B, young shell 11 mm. diam. Big Emigrant Canyon.

than *proxima*, more robust, with slightly less than 6 whorls. The two basal teeth are less separated, somewhat united by a callus at their bases, and the inner one is generally smaller, frequently very small. There is often the weak trace of an upper branch, making the parietal tooth V-shaped. Fine spirals may be seen on the base of the shell. The young shell forms a very strong callous rib within the lip, as in *A. fissidens*. The umbilicus is narrow, contained five times in the diameter of the shell. Alt. 5.8, diam. 13.2 mm.

This shell is like *A. fissidens* except in the single character of having the basal teeth more widely separated. As in that species, the inner of the two basal teeth is quite variable in size. It is a race intermediate in character between *fissidens* and *proxima*.

Genitalia (pl. X, fig. 9) not materially differing from *A. p. albicauda*. The swollen basal portion of the penis is less than half the total length. The penial retractor is less than one millimeter long.

Ashmunella fissidens Pils.

Proc. A. N. S. Phila., 1905, p. 243.

This species was described from "dead" and discolored specimens, thought to be from Cave Creek Canyon, collected by one of us (Mr. Ferriss) in the course of a flying trip through the mountains in the winter of 1904. In 1906 we collected extensively in Cave Creek; a year later Messrs. Ferriss and Daniels did additional work there, but nothing was seen of *A. fissidens*. The location of the type colony, therefore, remains uncertain. It is likely that the shells were picked up in White Tail Canyon, also hurriedly traversed in 1904. While the prevalent form in White Tail differs from *fissidens* in several respects, yet near the head of the canyon some exactly similar shells were found by us in 1906. A lot from near the head of the left branch (going up) (near Jim Artel's old camp) is typical *fissidens;* and we suggest that this be regarded as the type locality in case true *fissidens* is not hereafter found in Cave Creek.

In these shells the lip is not produced forward in an angle near the upper insertion, and the upper angle is not filled with a callus; the lip is narrow with rounded face; there is no upper branch developed on the parietal wall, unless very weakly in some old shells; there are fully 6 whorls; the young develop only a weak lip-rib at resting stages.

Certain forms from much further south, in Shake Gulch, the foot of Bonito Canyon and Limestone Mountain, seem to be referable to *A. fissidens*; but they are less angular, becoming rounded behind the lip, and the umbilicus is decidedly smaller. More material is needed to fix their status.

Ashmunella fissidens albicauda n. subsp. Fig. 19.

The upper end of the parietal wall stands more or less free and the lip, near its upper insertion, runs forward in an angle; the posterior angle of the aperture is heavily calloused, and the parietal tooth is usually V-shaped by development of a weak upper branch. The young shells form a very thick and heavy callus within the lip at resting stages (fig. 19D).

Adult shells are invariably acutely angular in front, the angle weakening and almost disappearing on the latter part of the whorl. Behind the aperture the striation is stronger and sometimes amounts to an irregular costulation. There is an angular gutter behind the basal lip, and the reddish-brown color gives place there to a wide buff stripe which borders the lip. The whole base has a sculpture of extremely minute *spiral lines* in fresh examples; and under the microscope a very minute spiral lineolation is seen between these spiral lines, which are readily visible with a hand lens. The upper surface also shows very faint spiral lines in places, and there is often some

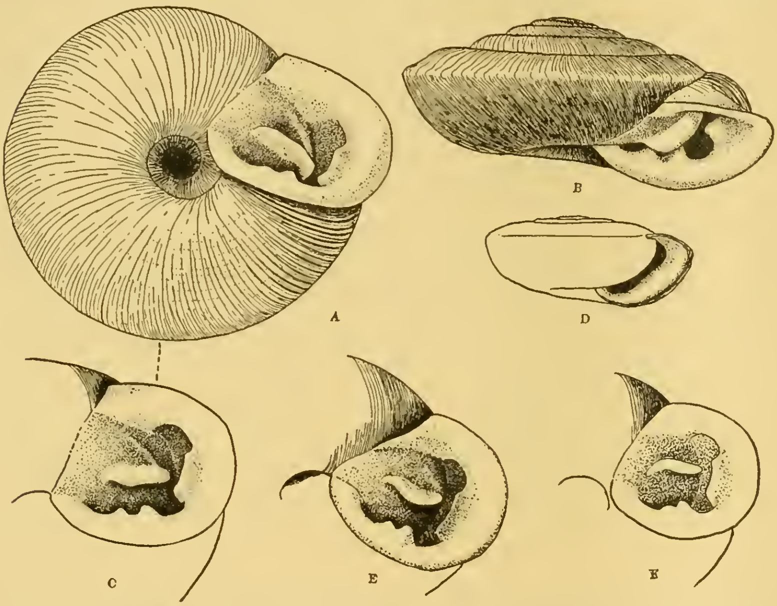

Fig. 19.—*Ashmunella f. albicauda* P. and F. A–C, from Box of White Tail (diam. 13.3 mm.); D, Station 14 (diam. 7 mm.); E, Station 2 (diam. 12 mm.); F, Station 14.

interruption of the growth striæ, giving a slight appearance of punctation. Seven specimens from Station 14 measure:

Alt	5	5.5	4.8	4.7	5.2	4.8	5	mm.
Diam	12.5	12.5	12	11.5	11.5	11.3	11.3	"
Whorls	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	

While variable in size and elevation of the spire, which may be nearly flat or low-conic, and in the shape of the basal teeth, the variations do not seem to differ in the several colonies.

Terminal ducts of the genitalia are figured on p. 95, fig. 16, and the measurements are given in the table, p. 97. The epiphallus in the individual measured (No. 97,939, Station 4, in White Tail Canyon) is shorter than in *A. p. emigrans* or *A. duplicidens*, but this may be an individual character.

A. f. albicauda is found in White Tail Canyon almost everywhere *on the southern side*, but not on the opposite slope of the canyon. Specimens were taken at Stations 1 to 5, 9, 12, 14, on the south side of the Box Canyon and on the south side below Indian Creek, ranging from about 20 feet above the creek bed (at the last place) to about 7,500 feet elevation on the rim southward, where indeed it was taken at Station 3, which lies across the acute divide and on the Pinery side. Not one single specimen was found on the north side of the canyon, where *A. lepiderma* replaces it, coming down to the bottom of the canyon.

The range of *A. fissidens* in the Pinery and Pinery Canyon is unknown. The great Pinery Valley lay before us in splendid panorama from the ridge south of White Tail Canyon and again from the ridge north of Barfoot Park. Probably its ravines are inhabited by *fissidens* and perhaps forms connecting that with *A. proxima*. It may be noted that the large *Sonorella* of White Tail Canyon is a race of *S. virilis*, of Barfoot Park, etc.

At all stations in White Tail Canyon where many shells were taken, the same variations in height of spire noted under *A. duplicidens* were noticed. Otherwise there is variation in the size of the outer lip-tooth and especially in that of the inner tubercle of the basal tooth. The parietal tooth may be either straight at its axial end or abruptly curved inward, and, when turned inward, a low ridge usually runs to the outer end of the lip, making the parietal tooth V-shaped.

Ashmunella fissidens pomeroyi n. subsp. Fig. 20.

In Hand's Pass, head of Jhu Canyon, Ferriss and Pomeroy collected

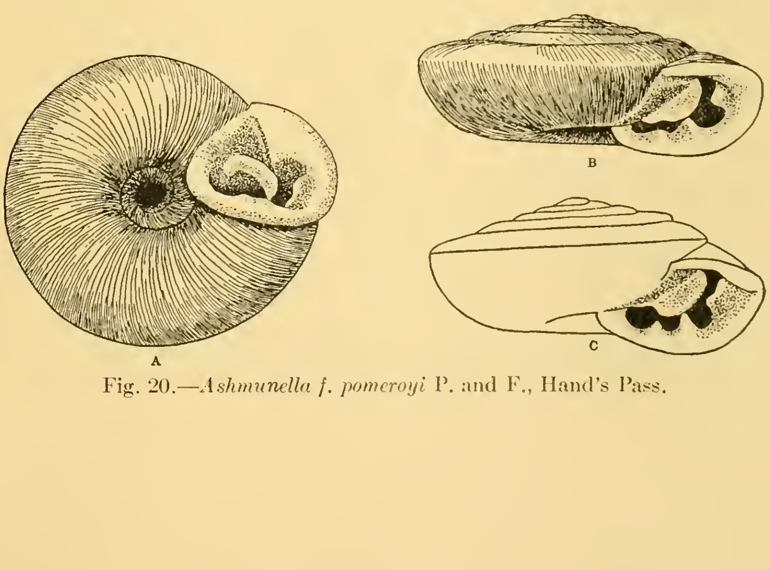

Fig. 20.—*Ashmunella f. pomeroyi* P. and F., Hand's Pass.

in 1908. The shells are similar to those of White Tail Canyon in general appearance, but differ in certain particulars, constituting a minor race. They are in the average smaller, diam. 8½ to 11½ mm., rarely 13 mm., with 5½ whorls; the umbilicus is noticeably wider; the lip is heavy and wide. The basal teeth vary from completely united to distinctly bifid, as in White Tail *fissidens*, or rarely they are almost separated. In most examples these teeth are more united than in White Tail specimens. The shape of the parietal tooth also varies from V-shaped to simple. All of the shells are more angular and more depressed than *A. duplicidens*.

Ashmunella duplicidens Pils. Pl. VIII, figs. 1–8.

Proc. A. N. S. Phila. 1905, p. 244.

After the first 1½ whorls the next four whorls more or less appear minutely punctate in the best preserved examples, though in most only an indistinctly interrupted condition of the striæ can be made out. Under the compound microscope some very fine close spiral striation is seen on the base. The basal tooth is ordinarily doubled as in figs 5 and 8; but sometimes is simple, the inner tubercle being represented only by a sloping callus, as in figs. 1–3, 6, 17.

Immature shells form only a thin narrow rib within the lip at resting stages, and have a wider, somewhat less angular, aperture than *A. fissidens*. This thin lip-rib is subsequently wholly, or almost wholly, absorbed, so that adult shells do not show whitish varix-streaks.

Figs. 3 and 7 show the extremes of elevation and depression of the spire. All of these figures are from topotypes, from Station 1 in Barfoot Park—an extensive slide of coarse rock on a southern exposure. It is an abundant species in this place.

In 1907 Mr. Ferriss found *A. duplicidens* in the head of Morse Canyon, large shells, 13 to 14 mm. diam., with over 6 whorls; in Rucker Canyon, 7,000 to 8,000 feet; and on Rucker Peak, where they are also rather large. Small shells, 10.5 to 11.5 mm. diam., were taken at the Box of Rucker. A specimen from Crook's Peak measures 14 mm. diam.

Large and well-developed *duplicidens* was found in Cave Creek Canyon on the first branch west of the Falls fork of Cave Creek, diam. 14 to 15 mm., and at the Falls.

The genitalia of a specimen from the head of Morse Canyon are figured, pl. X, fig. 8. The penis tapers more gradually than in allied forms, the distinction between its swollen basal half and the slender distal portion being obscure. This was also the case in the individual figured in 1905 from the type lot, but in that preparation the enlarged basal portion of the penis was everted, hence does not show at all in the figure. The lung is 18 mm. long, kidney 7.5 mm., pericardium 3.5 mm. The mantle within the last whorl is cream-colored with sparse black maculation. Earlier whorls have copious black pigmentation along the top of the whorls.

Fig. 21.—Principal collecting stations in Cave Creek and the Parks at its head. Stations marked A were explored in 1907–8 by Ferriss, the others in 1906 by Ferriss and Pilsbry.

The specimens figured (topotypes) measure: Alt. 6, diam. 13 mm., whorls $6\frac{3}{4}$; alt. 6, diam. 12.2 mm., whorls $6\frac{1}{2}$. The smallest specimen seen is from Rucker Canyon, 7,000 feet, measuring alt. 4.9, diam. 10.5 mm., whorls $5\frac{1}{2}$.

A. duplicidens stands very close to *A. fissidens*, but it differs by the more obtuse, though bluntly angular, last whorl, and by the young shells, which form only a very thin, narrow rib within the lip in resting stages, while in *fissidens* a very strong and heavy callus is deposited. The basal teeth are more united than in typical *fissidens*.

A. duplicidens, fissidens and *proxima* are terms of one series of forms differing chiefly, so far as the adult shells are concerned, in the degree of separation of the basal tooth, which in *duplicidens* is a single more or less bifid prominence, while in *proxima* there are two distinct teeth. When the canyons opening westward, between Rucker and Ft. Bowie, have supplied series of shells as copious as those we have obtained in the eastward canyons, another chapter may be added to the history of this group.

Ashmunella angulata Pils.

Proc. A. N. S. Phila., 1905, p. 244.

In the south fork of Cave Creek we found this species abundantly. This is the type locality and here it attains the largest size. A few dead ones were picked up on a mountain-side southeast of Paradise, towards Cave Creek, and at Station 12, in Cave Creek. It reappears at the head of the canyon at the Falls, and at Stations 3 and 4 and in the head of Turkey Creek. At these places the shells are smaller.

In 1907 Ferriss and Daniels took some specimens in Barfoot Park, Station 1*a*. They are much less angular at the periphery than the Cave Creek form. In 1908 it was taken in Horseshoe Canyon at the "Red Box" (10 miles up the canyon) and at "5-mile camp"; also in Rock Creek, at the head of Raspberry Gulch and in the Spring Branch of Rucker Canyon. These localities greatly extend the range of the species. The compressed outer basal tooth and less convex whorls readily separate *A. angulata* from *A. proxima*. Young shells deposit a lip-callus at resting periods. It is thick in the middle, tapering at the ends, as figured in our former paper, pl. XI, fig. 11.

Our former figure of the genitalia of *A. angulata* (1905, pl. 21, fig. 26) is not satisfactory in one point, the slight enlargement marking the upper end of the penis being omitted. This enlargement is rather small yet distinct in the individual figured, which has been re-examined, and is present in all the specimens opened (seven) from several stations.

A new figure is given, pl. X, fig. 6, representing a specimen from Cave Creek near Reed's Mountain, No. 87,020. The penial retractor muscle is longer than in *A. proxima* and its allies.

Ashmunella ferrissi Pils. Fig. 22.

A. ferrissi Pils. Proc. A. N. S. Phila., 1905, p. 247, pl. 16, figs. 108–110, 113.

The type locality is in the talus at the foot of Reed's Mountain, at Station 11, about a half mile below Reed's house, where it is found with *A. chiricahuana, Sonorella virilis*, etc. Additional specimens were taken here in 1906. The figures represent an elevated and a depressed specimen.

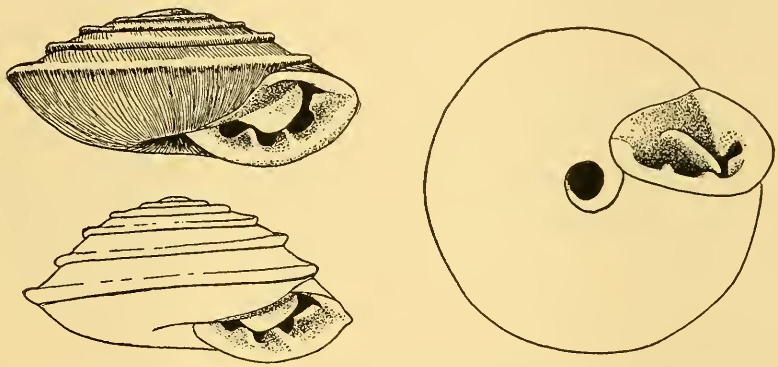

Fig. 22.—*Ashmunella ferrissi*, Cave Creek, Station 11 (topotypes).

The embryonic shell seems to comprise the first $1\frac{3}{4}$ whorls. The initial half whorl is smooth and glossy; then growth-striæ begin below the suture, gradually extending over the whole width of the whorl. The third and fourth whorls are very minutely indistinctly marked with subregularly arranged points, as though hairy in the immature stage, though none taken retain any hairs. The rest of the whorls are finely striate. The base also is marked with very fine, unequal growth-striæ, and under a strong lens shows faint, extremely fine and close spiral striæ. These are also faintly visible in places on the upper surface. The carina first appears above the suture at the end of the second whorl in some examples, in others at the end of the third.

There is considerable variation in size and degree of elevation. Three of the specimens taken in 1906 at the type locality measure:

Alt. 6.2, diam. 12.5 mm.
" 5.2, " 11.8 "
" 5.6, " 10.6 "

The punctation of the early neanic whorls, not noticed when the species was first described, shows that *A. ferrissi* is related to *A. angulata*, a much more widely spread species.

Genitalia as usual in the group. Basal half of the penis is swollen. As in *A. angulata*, the retractor muscle of the penis is longer than in *A. duplicidens, proxima*, etc. The mantle within the last whorl is white (pl. X, fig. 7).

Group of Ashmunella chiricahuana.

This group is distinguished by the very long spermatheca and epiphallus and the open aperture, which is either toothless or provided with minute vestigeal teeth which do not sensibly obstruct the opening.

A. chiricahuana has never been found to have any trace of teeth. It varies in size and degree of elevation of the aperture. *A. esuritor* frequently retains minute vestiges of teeth, but they are variable and often hardly noticeable. It is less evolved than *A. chiricahuana* in retaining this functionless reminiscence of the toothed ancestral form. The series is exactly parallel to the *A. levettei-varicifera* series in the Huachucas, but there the degeneration of teeth has been more recent and all stages of the process still exist.

Ashmunella chiricahuana (Dall). Fig. 23.

Proc. A. N. S. Phila., 1905, p. 250.

This fine *Ashmunella* is widely distributed in Cave Creek Canyon, living on reasonably moist north slopes where there is good rock shelter, with *Sonorella*. In 1906 we took specimens at Stations 3, 4, 5, 11, and in the ravines west of Reed's Mountain between that and Station 10. In 1907 and 1908 the following localities were added by Mr. Ferriss: Cave Creek Falls, head of Cave Creek near Long Park, Long Park at 8,000 feet. The types were from the adjacent Fly's Park (No. 124,481 U. S. N. M.). The figures published by Dr. Dall represent *A. varicifera*, a Huachucan species, and we have therefore given new illustrations.

The color varies from light brownish-corneous to light chestnut, and occasionally albinos are found. The surface is very glossy. Young specimens form a strong wide white rib within the lip when a resting stage occurs. This persists as a yellow blotch or stripe in the adult stage.

Some specimens, as those from Cave Creek, Station 5, and the head of Cave Creek, show traces of punctation on the intermediate whorls not visible in most others.

The chief variation, aside from tint, is in the elevation of the spire.

Two examples, extremes of a continuous series, are figured to illustrate this (fig. 23 *c*, *d*), from about the middle of the amphitheatre west of Reed's Mountain. This variation is not peculiar to any special colonies, though greater in some lots than others.

At the Cave Creek Falls there is a small form. Three specimens measure as follows:

Alt	8	7	6.7 mm.
Diam	16	16	13.5 "
Whorls	$5\frac{1}{2}$	$5\frac{2}{3}$	$5\frac{1}{3}$

The genitalia of two individuals are figured. Pl. X, fig. 4, is from one of the very large shells of the head of Cave Creek at about 8,000

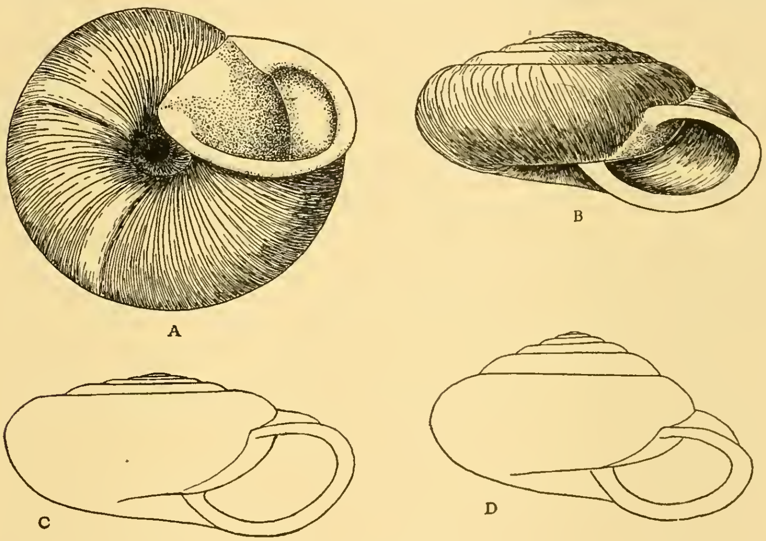

Fig. 23.—*A. chiricahuana* (Dall). A, B, Cave Creek Canyon; C, D, amphitheatre of Cave Creek.

feet elevation, near Long Park, diam. 19.5 mm. The ducts are very long in these large snails. Both penis and spermatheca adhere to the uterus throughout part of their length, the penis looping under the spermatheca. The vagina is stout down to its base. Pl. X, fig. 1, was drawn from one of the very small shells of the Cave Creek Falls, diam. 13.5 to 16 mm. The ducts are shorter and the base of the vagina is thin-walled. The penial retractor is longer in this species than in the toothed species, but not so long as in the Huachucan Ashmunellas.

The collar and foot are slate-colored; mantle-lining of the last whorl cream-white, not maculate.

In a former paper[21] we mentioned a form of *Ashmunella* from Miller Canyon, Huachucas, which, so far as the shell is concerned, agrees exactly with *A. chiricahuana.*

Specimens collected in 1907 have now been dissected. The Huachucan form proves to be practically identical with *A. levettei* in the soft anatomy, and abundantly distinct from *A. chiricahuana* in the proportions of the organs, especially of the spermatheca and its duct, as will be seen by the following table:

	A. chiricahuana, Chiricahua Mts.	Huachuca Mt. form.
Length of vagina	9 mm.	7.2 mm.
" " spermatheca and duct	56 "	26 "
" " penis	4.5 "	7.3 "
" " epiphallus and flagellum	68.5 "	40 "

The spermatheca in the Huachucan form has the long, cylindric, weakly sacculate shape of that of *A. levettei,* wholly unlike that of *A. chiricahuana.* This form has been fully described and figured in a former paper. It is undoubtedly the shell indicated as *A. chiricahuana* var. *varicifera* Ancey, and will now be called *Ashmunella varicifera.*

Ashmunella esuritor Pils. Pl. IX, figs. 1–8.

Proc. A. N. S. Phila., 1905, p. 249, pl. 13, figs. 23–26 (shell); pl. 21, figs. 30, 25 (genitalia).

The type locality is not in Barfoot Park proper, but in a small park of yellow pine on the road from Paradise, about a mile before it crosses the ridge or divide going to Barfoot. This is the first grove of yellow pine on the road up. The type locality is a small conical pile of earth and rocks about ten feet to the left of the road.[22] It was covered with snow at the time of our visit, but a small series of living specimens was taken, No. 92,205 A. N. S. P. About a mile below this place, toward Paradise, where a few yellow pines first appear among the oak scrub, we found a few examples. It will probably be found in many other suitable places in this immediate vicinity, reached by the road from Paradise to Barfoot Park. Our work in this place was impeded by a heavy snowfall, which lay knee-deep among the pines.

In the topotypes (No. 92,205) the diameter varies from 14.5 to 16 mm., whorls 6 to 6½. The degree of elevation of the spire is quite

[21] Mollusca of the Southwestern States I, *Proc. A. N. S. Phila.,* 1905, pp. 242, 251, pl. XV, figs. 94, 95.

[22] We would ask future collectors to preserve this small type colony by taking only a moderate number of specimens there.

variable, as in all the related species. Two of this lot are figured, pl. IX, figs. 1, 2, 4, 5. In one or two shells there is the minute vestige of a parietal tooth (figs. 4, 5). The soft parts were partially spoiled when studied, but I have figured the terminal ducts of the genitalia, pl. X, fig. 3. The spermatheca was broken. Other organs agree with the type figured in 1905.

The genitalia of two specimens are figured, pl. X, figs. 2, 5. The penis and vagina conform in shape to the usual Chiricahuan type. The retractor muscle of the penis is well-developed, but short, about 2 mm. long. The epiphallus is very long. Measurements of the organs may be found on p. 97. The penis and epiphallus are decidedly longer in three specimens of this lot dissected than in the type or topotype of *esuritor*. The spermatheca of the types of *esuritor* is unusually swollen distally, as correctly represented in the figure published in 1905.

Additional specimens (pl. IX, figs. 6, 7, 8) from the east side of Barfoot Park, Station 1*a*, were taken by Mr. Ferriss in 1907. The penultimate and two preceding whorls have the fine striæ interrupted irregularly, in places forming minute granules, and there is besides some indistinct appearance of punctation on the spire. There are very fine spiral lines on the base. There is a wide prominence, hardly to be called a tooth, within the outer lip in most examples, but in some this is very low or wanting, and in none quite so prominent as in the type of *A. metamorphosa*. Edentulous specimens resemble *A. chiricahuana* closely, but they differ from that species by the slightly more depressed shape, by having a rather deep, narrow gutter behind the lip (almost wanting in *A. chiricahuana*), by the smaller aperture in shells of the same diameter, and by having the umbilicus wider within, though not at its mouth. Three adults, No. 94,432, measure:

Alt.	8	7.3	6.7	mm.
Diam.	17	16.3	15	"
Whorls	$6\frac{1}{2}$	$5\frac{3}{4}$	6	

In 1906 we dug out a small series of dead shells (No. 97,930) from under the snow and rocks in the head of Pine Canyon,[23] perhaps fifteen minutes walk down from Barfoot Park. The callous "tooth" within the outer lip is either weak or wanting in these examples, and four out of ten adults taken show the weak trace of a parietal tooth. The most

[23] This canyon, which runs westward from Barfoot Park, is sometimes called Riggs' Canyon, or Saw-mill Canyon. At its head a saw-mill stood, but it was removed in the spring of 1907.

elevated shell of this lot is drawn in pl. IX, fig. 3, Alt. 9, diam. 17 mm., with $6\frac{1}{2}$ whorls.

The specimens measure:

Alt	8.3	7	8	9	7.5	mm.
Diam.	17.2	17	16.5	17	16	"
Whorls	6	$6\frac{1}{4}$	$6\frac{1}{4}$	$6\frac{1}{2}$	....	
Alt	8	7.5	8	7.5	7	mm.
Diam	16.4	16.5	16	15.5	15	"
Whorls	6	$6\frac{1}{3}$	$6\frac{1}{2}$	6	$5\frac{3}{4}$	

A single shell from Onion Creek has a distinct callous prominence within the outer lip and a low tooth in the basal lip. Anatomically it resembles the topotypes of *A. esuritor* so far as can be made out, the soft parts being mutilated in pulling. The mantle is white within the last whorl.

Group of A. metamorphosa.

Ashmunella metamorphosa Pils. Pl. IX, fig. 9.

Proc. A. N. S. Phila., 1905, p. 252, pl. 16, fig. 115 (shell); pl. 22, fig. 8 (radula); pl. 23, fig. 16 (jaw); pl. 21, fig. 27 (genitalia).

With one exception the original figures of this species, cited above, were taken from one specimen. Fig. 114 of plate XVI (1905) represents another shell, probably not conspecific. It is now proposed to restrict the type of *A. metamorphosa* to the broken shell represented on pl. XVI, fig. 115, the anatomy of which was figured. This is No. 88885 A. N. S. P.

This shell (pl. IX, fig. 9) resembles *A. esuritor* in contour. There is a deep furrow behind the narrowly reflexed basal and outer lips. The outer lip bears a long low callus on its inner edge. Above this callus it is brown, elsewhere white. Whorls 6. The surface is not well preserved and shows no minute sculpture, being somewhat worn. Alt. 8.8, diam. probably about 17 mm. It is a fully adult, but not old, individual. In pl. IX, fig. 9, the aperture of the type specimen of *A. metamorphosa* is drawn, the former photographic figure being unsatisfactory.

Barfoot Park, collected by James H. Ferriss, February, 1904.

We have nothing to add to the description and figures of genitalia jaw and teeth given in 1905. Having again examined the genitalia of the type, we see nothing to indicate that it is abnormal. The possibility that it is the ♀ phase of a proterandrous form has been considered, but the absence of such a condition in the other species of the genus makes against such hypothesis. If normal, the genitalia of this snail indicate one of the most distinct Chiricahuan species, a penis and its retractor being absent, as in some slugs.

The lot originally referred to this species consisted of three specimens, two being included in Mus. No. 88,886. The soft parts of one of these were mutilated and not preserved. The other one has been dissected and proves to be *A. esuritor*. When we were in Barfoot Park near the end of November, 1906, snow lay almost knee-deep among the big pine trees and living snails were hard to find. Some dead shells (No. 97,930), taken in the head of Pine Canyon, may be *metamorphosa*, but we refer them for the present to *A. esuritor*. No shells known to have the anatomical peculiarities of *A. metamorphosa* have been taken since 1904.

We have found no character in the shell to certainly distinguish *A. metamorphosa* from *A. esuritor*. The latter varies from forms with a nearly simple lip, like *A. chiricahuana*, to those with various callous vestiges of teeth, as shown on the plate, figures 1 to 8. Further collections of specimens in the flesh are needed.

Thysanophora hornii (Gabb).

Helix hornii Gabb, Amer. jour. of Conch., II, 1866, p. 330, pl. 21, fig. 5 (bad).
Thysanophora hornii Gabb, Pilsbry, Nautilus XI, 1898, p. 105; XIII, Jan., 1900, p. 98; Proc. A. N. S. Phila., 1903, p. 763; 1896, p. 126; Hinkley, Nautilus XXI, 1907, p. 172 (Tampico); Dall, Proc. U. S. Nat. Mus., XIX, 1896, p. 336.
Not *Patula horni* Gabb, W. G. Binney, Man. Amer. Land Shells, Bull. 28, U. S. N. M., 1885, p. 169.

Chiricahua Mountains: near Dos Cabezas cave; near Lawhorn's ranch, mouth of Big Emigrant Canyon; White Tail Canyon above Stations 4 and 11, rare; Cave Creek Canyon on the slope below the cave, at Station 6, and about a half mile up the South Fork.

Thysanophora ingersolli (Bland). Fig. 24, A, B, C.

Helix ingersolli Bland, Ann. Lyc. Nat. Hist. of New York, XI, 1874. p. 151, figs.
Microphysa ingersolli Bld., W. G. Binney, Terr. Moll., V, p. 173, fig. 82 (shell); pl. III, fig. V (teeth); Man. Amer. Land Shells, 1885, p. 170, fig. 160.
Thysanophora ingersolli Bld., Dall, Proc. U. S. N. Mus., XIX, p. 366 (Fly Park); Pilsbry, Nautilus XI, p. 105; J. Henderson, The Mollusca of Colorado, Univ. of Colo. Studies IV, No. 3, p. 169.

This species differs from the typical forms of *Thysanophora* by the absence of cuticular laminæ or hairs, the surface being clean and bright, with the appearance of a *Vitrea*. Under very high magnification some spiral striæ are visible on the intermediate whorls, but not on the first. In the typical form, the aperture is narrowly lunate, the spire almost flat, umbilicus nearly one-fourth of the diameter, "Height 2.5, diam. 4 mm." In many Colorado examples the umbilicus is narrower, about one-fifth the diameter of the shell.

The localities for *T. ingersolli* in Colorado have been given by Henderson (*l.c.*). Specimens are in coll. A. N. S. from Field, British Columbia (Stew. Brown). In New Mexico we have seen it from Sapello Canyon at Beulah (Cockerell); Sandia Mountains near Albuquerque (Miss Maud Ellis); Bland (Ashmun); James Canyon, Cloudcroft, Sacramento Mountains (Rehn and Viereck). In Arizona we have it from Bill Williams Mountain near Williams (Ferriss and Pilsbry) and the top of Mt. Mingus, near Jerome (Ashmun). A specimen from this place is drawn in figs. 23, *a*, *b*, *c*, alt. 2, diam. 4.4, width of umbilicus 1.15 mm., whorls 5¼. It does not occur in the Chiricahua Mountains.

Thysanophora ingersolli meridionalis n. subsp. Fig. 24, D, E, F.

Shell with a wider aperture than *T. ingersolli*; whorls not quite as closely coiled, scarcely 5 in a shell of over 5 mm. diam.; umbilicus about one-fourth the total diameter; spire nearly flat. Alt. 2.3, diam. 5.2, width of umbilicus 1.3 mm., whorls 4¾.

Chiricahua Mountains in Bear Park, Long Park, head of Cave Creek,

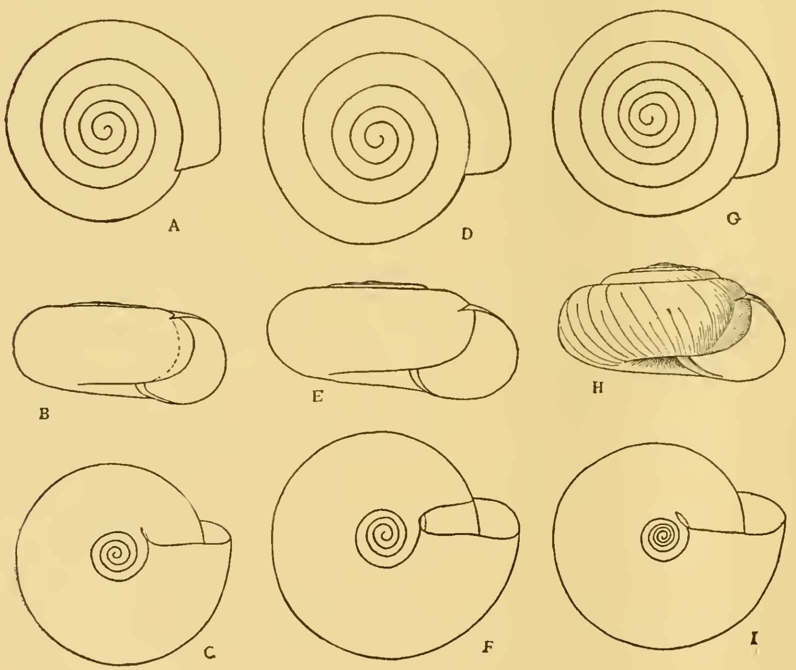

Fig. 24.—A, B, C, *Thysanophora ingersolli* (Bld.), Mt. Mingus, near Jerome, Arizona; D, E, F, *T. i. meridionalis* P. and F., Long Park, Chiricahua Mountains, Arizona; G, H, I, *T. i. convexior* (Anc.), Weston, Oregon.

8,000 feet, Pine Canyon, 7,500 feet, and "Box" of Rucker Canyon. It has been listed by Dall from Fly's Park.

While not strongly differentiated, adult shells of this race are readily distinguishable. The aperture clasps the preceding whorl less deeply than in *ingersolli*. The microscopic spiral striation also is somewhat better developed in the examples compared.

Thysanophora ingersolli convexior (Ancey). Fig. 24, G, H, I.

Microphysa ingersolli var. *convexior* Ancey, Conchol. Exch. II, p. 64, Nov., 1887 (Logan Canyon, Utah).

"Shell a little smaller; spire scarcely planulate, the apex not subimmersed, distinctly convex; whorls 5, not 5½, regularly but less slowly increasing, umbilicus smaller" (Ancey).

This form has not been figured. We have seen no topotypes, but examples from Weston, in eastern Oregon, collected by Henry Hemphill, evidently belong to the same race. One of these is figured (fig. 24, *g*, *h*, *i*). The specimen figured measures, alt. 2.5, diam 4.8, width of umbilicus 1 mm., whorls 5¾. The aperture is a little wider than in typical *ingersolli*.

Family **UROCOPTIDÆ** Pils.

Genus **HOLOSPIRA** von Martens.

All of the Holospiras now known from Arizona belong to a single group of closely related species, characterized by the light brown shell, having a stout lamella on the axis in the penultimate and first part of the last whorl, often in addition a superior or parietal lamella, and sometimes a basal lamella also. In several of the forms the lamellæ vary from one to three, as we have demonstrated by cutting from twenty to fifty individuals of a single colony. In colonies so varying, the number of internal lamellæ is not correllated with age, size or any other external feature of the shells, so far as we can discover, after collecting and examining hundreds of shells from a great number of colonies. The subgeneric divisions (*Eudistemma, Tristemma*) based upon the number of internal lamellæ in shells of this type have, therefore, no basis in nature. While the Arizona species differ somewhat from the Mexican type of the subgenus *Bostrichocentrum* in texture and sculpture, it does not seem that the differences are of subgeneric importance, and for the present we will place them in that group.

The variations in the internal lamellæ recorded below are really less discontinuous than might be supposed by the tables. The axial lamella is invariably present, but it varies in strength and length. The superior lamella may be very strong and over a half whorl long, but in other individuals of the same colony it may be small or barely observable, so that the series from a strong lamella to none is practically a continuous one in some colonies, though usually this lamella is either distinctly developed or wholly wanting. The same statement applies to the basal lamella, except that it is never very large and usually quite small and short when present.

The study of these races is extremely complex, and we have been unable to find time to enter upon it seriously. Any full record of a form should take into account the number of ribs on a whorl or their distance apart, as well as the proportions of the shell, number of whorls, length of cone, and the lamellæ.

(*a*) In many colonies a longer and a shorter form may be selected, with only few intergrading specimens; and there may also be a noticeable difference in sculpture. Such colonies may perhaps be hybrid, composed of two incipient races. (*b*) Different colonies in the same district, often living under apparently identical conditions, and frequently in close proximity, may show differences in size, ribbing or comparative frequency of certain combinations of lamellæ, in fact, incipient racial divergence. The mingling of two or more such colonies by their spread, aided by changing conditions of surface, may have given rise to colonies of the (*a*) type.

In some cases, where the colonies are widely separated, they have apparently evolved into reasonably distinct subspecies, probably in the absence of intermigration. The Cave Creek colonies of *H. chiricahuana* illustrate this.

Holospira arizonensis Stearns. Pl. XI, figs. 1–4.

H. arizonensis Stearns, Proc. U. S. Nat. Mus., XIII, 1890, p. 208, pl. 15, figs. 2, 3 (Cave at Dos Cabezas). Bartsch, Proc. U. S. Nat. Mus., Vol. 31, 1906, p. 134.

This species has hitherto been known by fourteen fragments and one perfect specimen, the type No. 104,392 U. S. N. M. It measures, length 12.8, diam. at 10th whorl 4.2 mm., whorls 12. We did not visit Dos Cabezas Cave, but our guide and driver, Mort Wien, passed there and collected a series of shells from close to, almost in, the mouth of the cave.[24] Fresh shells are pale corneous brown, glossy, bluish and subtransparent in places on the intermediate whorls. First $2\frac{1}{2}$ whorls smooth; following 6 whorls sharply striate, the striation gradually disappearing, so that two or three whorls preceding the last are smoothish. The last whorl is dull, coarsely striate, its outer wall

[24] It is stated that Mr. Vernon Bailey collected the types in the cave. They had doubtless been carried there by wind or mice. This accounts for the broken condition of all but one specimen of the type lot. No Arizonian *Holospira* lives in caves or shaded or damp places. They live in dry and sunny situations.

flattened and tapering to the base, which is a little gibbous and rounded. Its latter part is straightened and runs forward shortly beyond the preceding whorl, the upper wall descending slightly. Otherwise it is not noticeably contracted behind the aperture. The outer lip is narrowly expanded and revolute, and is lined within with a rather thin white callus.

One living specimen in the lot is an albino, pure white with some bluish spots.

The axial lamella is strongly developed; superior lamella variable, but usually strong and extending through the last half of the penultimate whorl. Basal lamella variable, usually wanting, but sometimes strong. Twenty specimens opened give the following data:

Three lamellæ: superior, axial and basal (15%)—

Length	14,	diam.	4	mm.;	whorls	$12\frac{1}{2}$.	
"	14,	"	4	"	"	$12\frac{3}{4}$.	
"	13.5,	"	4	"	"	$12\frac{1}{2}$.	

Two lamellæ: superior and axial (65%)—

Length	14.8,	diam.	4	mm.;	whorls	$13\frac{1}{4}$.
"	14.5,	"	4	"	"	$13\frac{1}{4}$.
"	14,	"	4	"	"	$12\frac{1}{2}$.
"	14,	"	3.9	"	"	$12\frac{1}{2}$.
"	13.9,	"	4	"	"	$12\frac{1}{2}$.
"	13.6,	"	3.9	"	"	$12\frac{3}{4}$.
"	13.3,	"	4	"	"	$12\frac{1}{2}$.
"	13,	"	4	"	"	$11\frac{1}{2}$.
"	12,	"	4	"	"	$11\frac{1}{2}$.
"	12,	"	3.9	"	"	$11\frac{1}{2}$.
"	12,	"	3.9	"	"	$11\frac{1}{2}$.
"	11.5,	"	4	"	"	$11\frac{1}{2}$.
"	11.3,	"	3.9	"	"	$11\frac{1}{2}$.

One lamella: axial (20%)—

Length	12,	diam.	3.8	mm.;	whorls	$11\frac{1}{2}$.
"	11.8,	"	3.8	"	"	$11\frac{1}{2}$.
"	11.3,	"	3.8	"	"	$11\frac{1}{2}$.
"	....	"	4	"	"	.... (spire broken).

The above specimens were taken at random.

Holospira arizonensis emigrans n. subsp. Pl. XI, figs. 5–8.

The shell is in the average more slender than *arizonensis*, with more numerous whorls; striation slightly finer, and often extending weakly upon the smoother lower whorls; the last whorl has a broad contraction behind the lip, preceded by an opaque white, *very coarsely striate*, inflation; base opaque white, projecting more than in the type; callus within the outer lip is very heavy. Color dull corneous brown, like the type.

Head of Big Emigrant Canyon, in the region of piñon pine groves. Type No. 99,701 A. N. S. P. from Station 1; also taken at several stations eastward in the same neighborhood.

The head of Big Emigrant Canyon is cut into numerous small ravines, the northern slopes of which are wooded with piñons. The rock is limestone. Here *Holospira* was found in large numbers. In the type lot 25 specimens, taken wholly at random from a series of some hundreds, were opened and measured.

Three lamellæ: superior, axial and basal (16%)—

Length	13.5,	diam.	4	mm.;	whorls	13⅓.
"	13,	"	3.9	"	"	13½.
"	12.3,	"	3.9	"	"	12½.
"	12,	"	4	"	"	12⅓.

Two lamellæ: superior and axial (24%)—

Length	13.4,	diam.	3.9	mm.;	whorls	13½.
"	13,	"	3.9	"	"	13⅓.
"	13,	"	3.9	"	"	13.
"	13,	"	3.9	"	"	13.
"	12.9,	"	3.8	"	"	13½.
"	12.2,	"	4	"	"	11¾.

One lamella: axial (60%)—

Length	15.1,	diam.	3.9	mm.;	whorls	16.
"	13.9,	"	3.9	"	"	13½.
"	13.9,	"	3.8	"	"	14.
"	13.8,	"	3.8	"	"	14⅓.
"	13.5,	"	3.9	"	"	13⅓.
"	13.1,	"	3.9	"	"	13½.
"	13,	"	3.9	"	"	13⅓.
"	13,	"	4	"	"	12¾.
"	13,	"	3.8	"	"	13⅓.
"	12.5,	"	3.8	"	"	12¾.
"	12.4,	"	4	"	"	12¾.
"	12.3,	"	3.6	"	"	13.
"	12,	"	3.9	"	"	12¾.
"	11.9,	"	3.3	"	"	12½.
"	11,	"	3.9	"	"	11½.

The smallest individual in the lot measures, length 11, diam. 3.4, whorls $12\frac{1}{3}$. It has superior and axial lamellæ.

In another lot from a colony not far from Station 1, in 20 shells opened the proportions are:

Three lamellæ, superior, axial and basal	4	specimens,	20%
Two lamellæ, superior and axial	10	"	50%
One lamella, the axial	6	"	30%

Two other small lots were taken a mile or two southeast from Station 1, the shells resembling the type lot, though perhaps there may be a greater proportion of slender specimens among them.

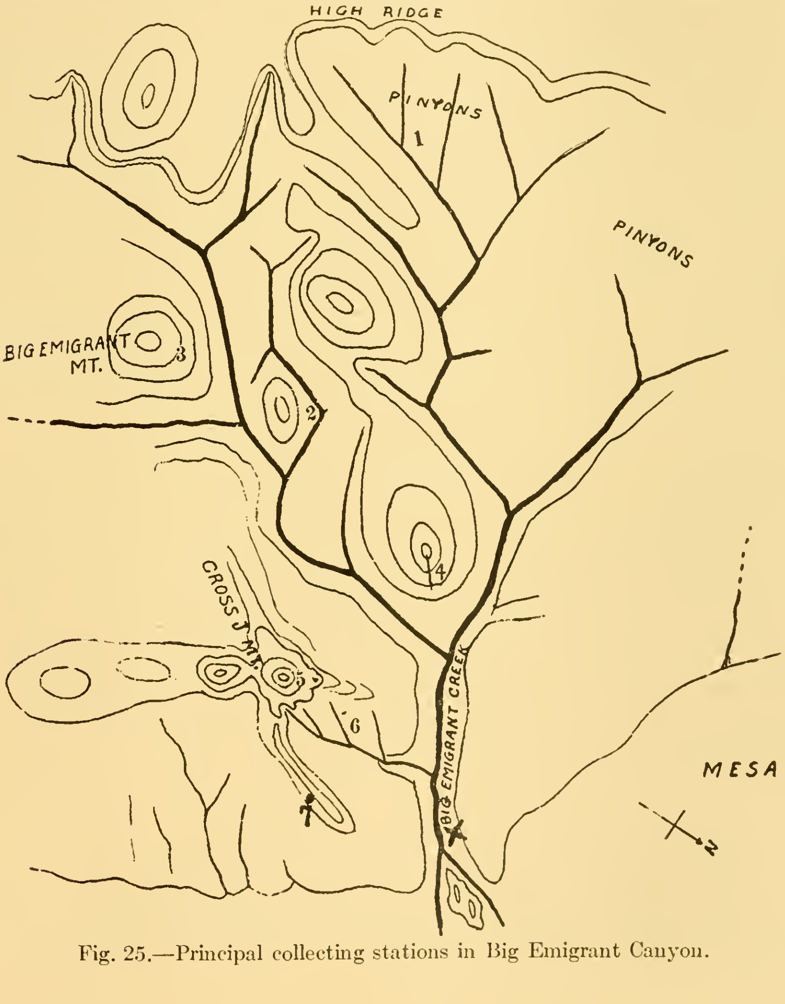

Fig. 25.—Principal collecting stations in Big Emigrant Canyon.

At Station 2, at the bottom of the canyon (middle branch), a few dead specimens sharply, but very finely, striate throughout were found (pl. XI, figs. 9, 10, 11, 12). On the tapering cone and basal whorl the striæ are coarser. At the head of this branch a small series (about 25) of similar shells was found. They are hardly distinguishable from *H. cionella*. *Holospira* colonies are scattered profusely all over the head slopes of Big Emigrant Canyon. We doubt whether more than one specific stock is represented there, though when thoroughly worked several minor races might be mapped out.

Holospira cionella Pils. Pl. XII, figs. 1, 2.

Proc. A. N. S. Phila., 1908, p. 217.

The types of this species came from near Old Fort Bowie. The fort stands on the narrow and low neck which unites the Dos Cabezas range with the Chiricahuas proper. Only the adobe walls now stand; only the cemetery remains to be guarded! The ridge has here a minimum elevation of 5,500 feet. About a mile south Mr. Dixon's place lies in the valley east of two conical peaks, known as Bull Hill and Quartzite Peak, the former of cherty limestone formation. *Holospira cionella* is found on the slope of Bull Hill facing the fort, the exact spot being along a tiny gully which crosses the trail to the fort. This place is indicated on the right at (3) in the photograph reproduced on page 67. It probably has an elevation of 6,000 to 6,200 feet. Another colony is on the lower slope of Quartzite Peak, toward Dixon's house, also indicated in the photograph at (2). Specimens from this place agree most closely with the original types of *cionella*.

The figured types (pl. XII, figs. 1, 2) are cylindric shells, evenly and rather finely but strongly rib striate, the striæ not weaker on the latter whorls; they are coarser on the swelling behind the contraction preceding the lip. Out of 11 shells of the type lot opened, 9 have an axial lamella only; 2 have axial and superior or parietal lamellæ. When originally describing this species only a few specimens were opened, and all happened to have one lamella only. The four specimens figured in 1905 measure as follows (the first three may be considered cotypes):

Length	12,	diam.	3.1	mm.; whorls	$12\frac{1}{2}$.
"	11.3,	"	3.25	" "	12.
"	11,	"	3.25	" "	12.
"	8.7,	"	3	" "	11.

Bull Hill (pl. XII, figs. 4–8). Specimens from the locality facing the Fort are all smaller than the types, though a few individuals of the original lot, such as pl. 27, fig. 31, of our former paper, are entirely similar.

Twenty taken at random measure:

Two lamellæ: axial and parietal—

Length	10,	diam.	3	mm.;	whorls	12.
"	8.9,	"	3.1	"	"	11.
"	8.6,	"	3	"	"	11.
"	8.4,	"	3	"	"	10¾.
"	7.8,	"	3	"	"	10⅓.

One lamella, the axial—

Length	9.8,	diam.	3	mm.;	whorls	11½.
"	9.5,	"	3.1	"	"	11⅓.
"	9.4,	"	3	"	"	10¾.
"	9,	"	3.1	"	"	10½.
"	9,	"	3	"	"	11¾.
"	8.9,	"	3	"	"	10¾.
"	8.8,	"	3	"	"	10¾.
"	8.8,	"	3	"	"	10¾.
"	8.5,	"	3	"	"	10½.
"	8.4,	"	3	"	"	10½.
"	8.4,	"	3	"	"	10½.
"	8,	"	3	"	"	10½.
"	8,	"	3	"	"	10.
"	7.7,	"	3	"	"	9½.
"	7.2,	"	3	"	"	9½.

Goodwin's Canyon, near Lawhorn's ranch, not far south of Nine-mile Water Hole, is the locality of a small series taken by Mort Wien (pl. XII, fig. 3). They are decidedly wider than Fort Bowie *cionella,* and have either two or three lamellæ in the few examples opened. It is apparently a subordinate race of *cionella.* The largest and smallest measure:

Length	11,	diam.	3.5	mm.;	whorls	12⅓.
"	10,	"	3.5	"	"	11½.

Some specimens of similarly wide shape, but with only the axial lamella, in a few opened, were taken by Mort Wien "a half mile from Dos Cabezas Cave."

Holospira cionella intermedia n. subsp. Pl. XIII, figs. 1–14.

The head and southern slope of White Tail Canyon are inhabited by a race closely related to *C. cionella,* but remarkably polymorphic. The internal lamellæ vary from one to three, but in most colonies there are one or two, the former number predominating. The sculpture is always coarse on the cone, but on the cylindric part it may be coarse, partially effaced, or fine, in specimens of the same colony, while in some other colonies one or other of these conditions may be developed separately. The White Tail series deserves far more study than we have been able to find time for.

The shell differs from *H. cionella* by the perceptibly longer taper and coarser striation of the terminal cone, and slightly greater development of the basal crest. In the form selected as type (pl. XIII, fig. 3) the ribs continue throughout, but in many examples of the same lot they weaken more or less on the penultimate and next earlier whorls. The callus within the aperture is very heavy.

Type locality on the south side of the "box" of White Tail Canyon. Types (pl. XIII, fig. 3,) No. 99,684 A. N. S. P. It also was taken at Stations 1, 2, 3, 4, 5, 8, 14; most or all of these colonies being of considerable extent, although the gathering in each case was made in a small area. The highest points are at Stations 1, 3 and 8; the lowest in the Box Canyon and between Stations 14 and 13. See map on p. 75. It was taken also in Jhu Canyon, Turkey Creek and Limestone Mountain. All of these stations are on limestone.

There is variation in sculpture in the type colony, some examples being strongly striate throughout, but in most the striæ are weaker on the penult whorl. Pl. XIII, figs. 3, 4 and 5, represent shells from the type colony. Thirty-seven specimens of this lot opened measure:

(Shells with the ribs weak on penultimate whorl.)

One lamella: axial—

Length	13,	diam.	3.9	mm.
"	11.9,	"	3.7	"
"	11.8,	"	3.4	"
"	11.5,	"	3.8	"
"	11.1,	"	3.2	"
"	11,	"	3.6	"
"	11,	"	3.6	"
"	11,	"	3.4	"
"	10,	"	3.3	"
"	10,	"	3.25	"

Two lamellæ: axial and superior—

Length	12.1,	diam.	3.4	mm.
"	11,	"	3.4	"
"	10,	"	3.4	"

Three lamellæ: axial, superior and basal—

Length 10, diam. 3.4 mm.

(Shells with strong ribs throughout.)

One lamella: axial—

Length 12, diam. 3.3 mm. (Type specimen, pl. XIII, fig. 3).

"	11.2,	"	3.1	"	
"	11,	"	3.4	"	
"	11,	"	3.4	"	
"	11,	"	3.4	"	
"	10.6,	"	3.3	"	
"	10.6,	"	3.3	"	
"	10.5,	"	3.5	"	
"	10.5,	"	3.2	"	
"	10.5,	"	3.7	"	
"	10.4,	"	3.2	"	
"	10.3,	"	3.5	"	
"	10.3,	"	3	"	
"	10,	"	3.3	"	
"	10,	"	3.25	"	
"	10,	"	3.2	"	
"	10,	"	3.3	"	
"	9.3,	"	3.5	"	

Two lamellæ: axial and superior—

Length 11.7, diam. 3.4 mm.

"	11,	"	3.4	"	
"	10.7,	"	3.2	"	
"	10,	"	3.5	"	
"	9,	"	3	"	Specimen figured, pl. XIII, fig. 5.

Station 2.—Similar specimens occurred at higher levels at Station 2. A large proportion of these specimens are ribbed throughout. The lamellæ in 15 shells opened are as follows:

10 shells have 1 lamella, the axial.

5 shells have 2 lamellæ, axial and superior.

Station 3.—Shells were taken under stones on the sunny side of the ridge, and another lot on the summit of the ridge. The majority of the shells are ribbed throughout, but some have the penultimate whorl nearly smooth. Most specimens are 10 to 11 mm. long. In 13 opened:

8 shells have 1 lamella, the axial.

5 shells have 2 lamellæ, axial and superior.

Pl. XIII, figs. 1, 2, Station 4, northwest branch of ravine back of Gardner's Mine, about three-quarters of the distance to summit. Some of the shells have the terminal cone slightly shorter than in the types. Sculpture variable, as shown in the figures. Internal lamellæ 1, 2 or 3. In 20 specimens opened:

10 have 1 lamella, the axial.

8 have 2 lamellæ, axial and superior.

2 have 3 lamellæ, axial, superior and basal.

Below Station 5, pl. XIII, figs. 13, 14. The shells are small and ribbed throughout, rarely over 9 mm. long.

Box Canyon.—In the Box Canyon, at two stations, one some distance below Station 5 (pl. XIII, figs. 6, 7, 8), the other at the mouth of Indian Creek, the shells are long and slender, strongly ribbed throughout. Axial and superior lamellæ are present in a few opened.

Length 13, diam. 3.2 mm.; whorls 14.
" 10, " 3.2 " " 11½.

Station 8.—A small series agrees, at least superficially, with those from Station 14, which lies about 800 feet lower.

Station 14.—The shells do not differ much from the type lot. There is a longer and coarsely ribbed and a shorter, more closely ribbed, form. Of the longer form we opened 10 shells, 1 having three, 4 two, and 5 one lamellæ. In seven of the shorter form opened 1 has two lamellæ, 6 have one lamella.

Forms from head of Onion Creek.—Two forms are represented in the small lot examined. Pl. XIII, fig. 9, shows a slender shell with coarse, very widely spaced ribs: length 12, diam 3.3 mm., whorls 12½. It has one lamella, the axial. Pl. XIII, figs. 10, 11, 12, represents the prevalent form, shorter than the preceding, *very finely and closely ribbed* throughout, or the ribs may be weak or subobsolete on the penultimate next preceding whorls. In five opened, only the axial lamella is present.

Length 10.5, diam. 3.5 mm.; whorls 11½.
" 9.5, " 3.3 " " 10⅓.

Jhu Canyon.—At the head of Jhu Canyon a gathering consists of two forms, similar to pl. XIII, figs. 9–12, from Onion Creek. The larger form is near typical *intermedia*, but the smaller may represent another race of the White Tail type. The material is not sufficient for a definite decision.

Turkey Creek.—On the right (north) side, about two miles below Paradise (pl. XII, figs. 13, 14, 15, 16), *Holospira* apparently referable to *intermedia* was found in two colonies, very variable in size and sculpture. Internal lamellæ one, two or three.

Limestone Mountain.—Although very widely separated from the range of *intermedia*, the shells do not seem separable from that race. Four are figured, pl. XII, figs. 9, 10, 11, 12.

Holospira cionella capillacea n. subsp. Pl. XIII, figs. 15, 16.

Similar to *intermedia* except that the intermediate whorls are very finely, closely striated; only the axial lamella developed, in a few opened. Length 11.7 to 12, diam. 3.5 mm. White Tail Canyon, Station 10, about half way to the summit of the ridge, below cliffs. This colony is the only one found in igneous rock (rhyolite). *Sonorella micra* and *Ashmunella lepiderma* occur in the same vicinity. *Holospira* was very scarce.

Holospira chiricahuana Pilsbry. Pl. XIV, figs. 5–8.

Proc. A. N. S. Phila., 1905, p. 219, pl. 26, fig. 9; pl. 27, figs. 26–29; p. 215, fig. 4.

The type locality of *H. chiricahuana* is on the steep slopes of a small dry ravine or wash tributary to Cave Creek, below and near the entrance of the cave. The slope faces the south and is composed of very steeply dipping friable calcareous shale and earth formed by its decomposition, with sparse vegetation, agave, sotol and bear grass. Dead shells are scattered in profusion, and the living ones lurk under bunches of dead bear grass, etc. The colony is about one-eighth of a mile long and perhaps 100 yards wide. This is also the type locality of *Oreohelix chiricahuana*. Map on p. 107, Station 8.

A majority of the specimens (82 per cent.) have a superior or parietal lamella from $\frac{1}{4}$ to $\frac{1}{2}$ of a whorl long, on the roof of the penultimate whorl near its end, above the aperture or on the front side, but in some (18 per cent.) this is wanting. In those of the type lot formerly opened it was absent or very weak, but in others of the type lot, as well as in many topotypes opened, this lamella is more or less strongly developed. The interior of the outer lip is very heavily thickened with a white callus within.

All forms of *H. chiricahuana* thus far found have the shell strongly ribbed throughout, with no tendency to become smoother on the cylindrical portion.

While in the type form of *H. chiricahuana* the internal lamellæ are inconstant, yet in several other colonies localized in various parts of the Cave Creek Valley the lamellæ seem to be constant, so far as we can judge from the limited material taken. It must be remembered that many other colonies doubtless exist.

The additional locality, "Fort Bowie," given in our original account, was evidently due to some mixture of labels or specimens. Thorough search in 1906 showed that it does not occur there. The large specimen represented in pl. XXVII, fig. 26, of our paper of 1905, was probably not from the type locality, but picked up somewhere else in Cave Creek Valley.

Fifty specimens opened, taken at random from a lot of several hundred topotypes, measure as follows:

Two lamellæ: parietal and axial—

Length.	Diam.	Whorls.	Length.	Diam.	Whorls.
10.8	3.1	$12\frac{1}{3}$	9.2	3	$11\frac{3}{4}$
10.8	3	$12\frac{1}{3}$	9.2	2.9	$11\frac{1}{2}$
10.4	3.1	$12\frac{1}{3}$	9.1	3	$11\frac{3}{4}$
10.3	3	12	9.1	3	$11\frac{1}{3}$
10.1	3	12	9.1	3	$11\frac{1}{2}$
10	3	$12\frac{1}{3}$	9	3	$11\frac{1}{2}$
10	3	12	9	3	$11\frac{1}{2}$
10	3	12	9	3	$11\frac{1}{2}$
10	3	$11\frac{3}{4}$	9	3	$11\frac{1}{2}$
9.9	3.1	12	9	3	$11\frac{1}{2}$
9.9	3	$11\frac{1}{2}$	9	3	$11\frac{1}{2}$
9.8	3	12	9	3	$11\frac{1}{3}$
9.8	3	12	9	3	11
9.7	3.1	$11\frac{1}{2}$	9	3	11
9.6	3	12	9	3	11
9.5	3.1	$11\frac{1}{3}$	8.9	3	11
9.5	3	$11\frac{3}{4}$	8.9	3	11
9.5	3	$11\frac{1}{2}$	8.7	3	$10\frac{3}{4}$
9.5	3	$11\frac{1}{2}$	8.6	2.9	11
9.5	3	$11\frac{1}{2}$	8	2.9	$10\frac{1}{2}$
9.3	3	$11\frac{1}{2}$			

One lamella: the axial—

Length.	Diam.	Whorls.	Length.	Diam.	Whorls.
10.6	3.1	$12\frac{1}{2}$	9	3	11
10	3.1	$11\frac{3}{4}$	9	3	$10\frac{3}{4}$
10	3	12	8.9	3	$11\frac{1}{3}$
9.9	3.1	$11\frac{1}{2}$	8.9	2.9	11
9.5	3	12			

Holospira chiricahuana ternaria n. subsp. Pl. XIV. figs. 1–4.

At the end of the penultimate whorl there are usually three internal lamellæ: parietal, axial and basal. Shell usually larger with more whorls, but otherwise as in the type.

Length 12.2, diam. 3.4 mm.; whorls $13\frac{1}{3}$.
" 11, " 3.2 " " $12\frac{1}{2}$.
" 11.1, " 3.3 " " $12\frac{1}{2}$.
" 10.3, " 3.1 " " $12\frac{1}{3}$.
" 10.8, " 3.1 " " $12\frac{1}{2}$.
" 9.4, " 3.1 " " 11.

Station 6, about half way up the northern slope of a long ridge which projects into Cave Creek Valley from the western border.

Fifty-three specimens were taken from a single small colony. The frozen ground did not encourage a thorough investigation. Out of 20 opened, 17 have three internal lamellæ and three have only one, the axial.

Holospira chiricahuana optima n. subsp. Pl. XIV, figs. 13–15.

The shell is larger and perceptibly more slowly tapering than *H. chiricahuana*, with more whorls, and only one internal lamella, the axial, in 20 specimens opened.

Station 5, at the base of the north slope of the ridge mentioned above, close to the stream, under stones. The larger size of the shells might be thought due to the more humid and shaded situation than that inhabited by the typical form, were it not that *Holospira* prefers hot and arid places and does not exist at all in damp situations. A single colony found. About 75 shells were taken. Thirty-five of them, unselected, measure as follows:

Length.	Diam.	Whorls.	Length.	Diam.	Whorls.
14.3	3.7	$14\frac{3}{4}$	13	3.5	$13\frac{1}{2}$
14	4	$13\frac{3}{4}$	13	3.5	$12\frac{3}{4}$
14	3.9	$13\frac{3}{4}$	13	3.3	$13\frac{1}{2}$
14	3.7	$14\frac{1}{2}$	13	3.3	$13\frac{1}{2}$
13.9	3.7	$13\frac{1}{2}$	13	3.4	$13\frac{1}{2}$
13.9	3.5	$13\frac{3}{4}$	13	3.2	$13\frac{1}{3}$
13.9	3.3	$13\frac{3}{4}$	12.9	3.6	$12\frac{3}{4}$
13.8	3.6	14	12.8	3.5	$13\frac{1}{2}$
13.8	3.3	$14\frac{1}{2}$	12.7	3.3	$13\frac{1}{2}$
13.6	3.3	$14\frac{1}{2}$	12.7	3.3	13
13.5	3.8	14	12.6	3.4	$13\frac{1}{3}$
13.5	3.5	14	12.5	3.5	$13\frac{1}{3}$
13.3	3.8	14	12.1	3.25	13
13.3	3.4	$14\frac{1}{2}$	12	3.7	$12\frac{1}{2}$
13	3.8	$13\frac{1}{4}$	12	3.3	$13\frac{1}{2}$
13	3.8	$13\frac{1}{4}$	11.3	3.5	$12\frac{1}{2}$
13	3.6	$13\frac{3}{4}$	11.2	3.3	$13\frac{1}{4}$
13	3.5	13			

Holospira chiricahuana gracilis n. subsp. Pl. XIV, figs. 9–12.

The shell is more slender and tapers more slowly than the type, and has more whorls. It is more slender than *H. c. optima*. Only the axial lamella developed in 19 out of 20 specimens opened, the other one having a strong parietal lamella also.

Found at Station 10, on the crest of a narrow ridge, a spur from the south wall of Cave Creek Valley, which terminates in a high conical hill standing not far from the creek. This is the only colony of the species found south of Cave Creek, the others being north of the creek. One colony of small extent.

Thirty specimens measure:

Length.	Diam.	Whorls.	Length.	Diam.	Whorls.
11.7	3.1	14	10.9	3	12¾
11.7	3	14	10.9	3	13
11.5	3	14	10.8	3	13
11.5	3	13½	10.7	3	12½
11.5	3	13½	10.5	3	13¼
11.3	3	13½	10.4	3	13
11.2	3	13½	10.3	3	12½
11.1	3.1	13⅓	10.3	2.9	12½
11.1	3	13⅓	10.2	3	12⅓
11	3	13⅓	10.1	3	12½
11	3	13½	10.1	3	12⅓
11	3	12½	10	3	12⅓
11	3	13	10	3	12
11	2.9	13½	9.9	3	12
10.9	3	13	9.9	2.9	12½

LIMACIDÆ.

Agriolimax hemphilli ashmuni Pils. and Van.

Barfoot and Long Parks. The specimens vary from a pale yellowish-gray to the blackish color of the types.

ZONITIDÆ.

Vitrina alaskana Dall.

Long Park, 8,000 feet; Head of Cave Creek, at about the same elevation; Barfoot Park.

Zonitoides arborea (Say).

Head of Cave Creek, 8,000 feet; Long Park, Station 12 A; Rustler Park; Rucker Canyon. It is not commonly diffused, and seems to be absent in the dryer part of the range.

Zonitoides milium meridionalis P. and F.

Quartzite Peak, near Fort Bowie; head of Cave Creek, 8,000 feet;

Rustler and Long Parks; head of Pine Canyon; Rucker Canyon, 7,000 feet.

Zonitoides minuscula alachuana (Dall).

Barfoot Park; Pine Canyon; Spring in lower Rucker Canyon.

Vitrea indentata umbilicata (Ckll.).

Chiricahua Mountains; Buckeye Canyon, in the Dos Cabezas range; Bull Hill and Quartzite Peak, near Fort Bowie; Big Emigrant Canyon at Stations 1, 2, 3, 5, 6; White Tail Canyon at about all the stations east of Stations 4 and 5, at all elevations; Jhu Canyon; Paradise Canyon, on the right side, below the town; Cave Creek Canyon, Stations 4, 6, 8, 11, 12, 13, 14; Barfoot Park; Long Park; Rustler Park; Rucker Canyon; Horseshoe Canyon. Probably occurs wherever snails live in the Chiricahuas.

Genus **EUCONULUS** Reinhardt.

The term *Euconulus* was proposed by Reinhardt in 1883 for the typical group of *Conulus*, in which he included *Kaliella*. *Conulus* being preoccupied, Pilsbry in 1900[27] substituted *Euconulus* for the generic group, with *fulvus* as type. Dall, 1905,[28] has given the generic synonymy and references in full. Mr. J. W. Taylor in his monograph of British land shells (1908) has discussed the varieties of *E. fulvus*. His treatment of *E. chersinus* as a variety of *fulvus* was evidently due to the lack of specimens, for the two forms are much less alike than the several small British species of *Hyalinia* which he distinguishes, and in fact are unusually distinct as species go among the small Zonitidæ. One of the European forms is apparently close to *chersinus;* but an intelligible exposition and revision of the *Euconulus* of Europe remains a desideratum. There is no trustworthy record of *Euconulus fulvus* from Japan, though *E. fulvus alaskensis* may naturally be expected to occur in the Kuril Islands, Yesso and Saghalin.

Euconulus fulvus alaskensis (Pils.).

Conulus fulvus alaskensis Pils., Nautilus, XII, February, 1899, p. 116. *Cf.* Dall, Land and Fresh Water Mollusks, Harriman Alaska Exped., 1905, p. 40, and Pilsbry, Nautilus, XXII, 1908, p. 25.

Chiricahua Mountains: White Tail Canyon, high on the northeastern side below the confluence of Indian Creek; Cave Creek Canyon at Stations 3 and 4 near the northeastern rim; Barfoot, Long and Rustler Parks; head of Pine Canyon, 7,500 feet; Box of Rucker Canyon.

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[27] *Nautilus*, XIV, Nov., 1900, p. 81.
[28] *Harriman Alaska Exped.*, Mollusks, p. 39.

Chiefly or wholly found at high elevations, and very rare in the region north of Cave Creek.

E. fulvus alaskensis differs chiefly from *fulvus* by having about one whorl less in shells of similar size. On the first whorl the radial striæ begin at the first fourth, and are about as close as on the rest of the shell. There are no spiral striæ on the first or later whorls. The last whorl has 90 to 105 striæ in 1 mm. *E. f. alaskensis* was described from Dyea Valley, Alaska. It is also before us from Petropavlovsk, Kamchatka, collected by Dr. William H. Dall. It extends southward in the Rocky Mountains to the Chiricahua and Huachuca ranges, in southern Arizona, chiefly at high elevations.

Fig. 26.—*Euconulus fulvus alaskensis* Pils. A, B, cotype, Dyea Valley, Alaska; C, Head of Cave Creek, Chiricahua Mountains.

Mr. E. G. Vanatta has made a careful study of the American forms of *Euconulus fulvus* in order to determine the status of the Chiricahuan form, using high magnification to bring out the minute sculpture. It appears that all the forms examined have a minute sculpture of excessively close, regular vertical striæ, though in some examples it is less distinct than in others. This sculpture, when strongly developed, lends a silk-like luster to the surface in quite fresh examples.

In *E. fulvus* from the northeastern United States the first whorl has fine spiral striæ and very indistinct traces of vertical (radial) striæ, not seen in some but legible, though weak, in other examples. The upper surface of the last whorl has about 126 vertical striæ in 1 mm., crossed by spiral striæ. There are about 6 whorls (figs. 27, B, C, Herkimer Co., N. Y., No. 59,521 A. N. S. P., alt. 2.4, diam. 3.1 mm. Fig. D, Buckfield, Oxford Co., Maine, No. 87,302 A. N. S. P., alt. 3.5, diam. 3.4 mm.). The largest examples seen are from Buckfield, Me., collected by Mr. J. A. Allen.

An English example (fig. 27A, Burnley, England, R. Walton coll., 75,912 A. N. S. P.) has distinct vertical striæ on the first whorl as well as spirals, and on the last whorl there are 140 vertical striæ in 1 mm., with no noticeable spirals. Alt. 2.4, diam. 2.8 mm.

It seems that there is considerable variation in the minute sculpture of *E. fulvus,* though it appears to be always somewhat coarser than in *E. chersinus* and, in the average at least, finer than in *E. fulvus alaskensis.*

Euconulus chersinus (Say) is, of course, a very distinct species from all of the preceding. No conchologist who actually examines *fulvus* and *chersinus* with an ordinary hand lens could lump them. Mr. Vanatta's study of the microscopic sculpture has shown that there is little real difference between *chersinus* and *polygyratus,* and we are

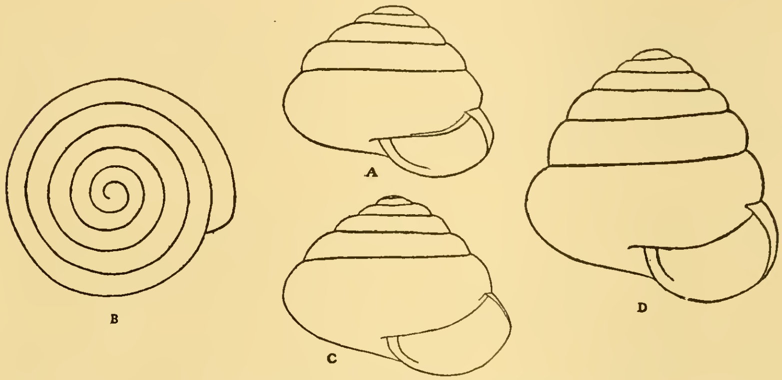


Fig. 27.—*Euconulus fulvus* (Müll.). A, Burnley, England; B, C, Herkimer County, N. Y.; D, Buckfield, Maine.

now disposed to drop the latter as a synonym. *E. chersinus* (*polygyratus*) occurs associated with *fulvus* in some Maine localities. *E. chersinus* has not been found in New Mexico or Arizona.

ENDODONTIDÆ.

Pyramidula (Gonyodiscus) cronkhitei (Newc.).

Foot of talus about half a mile below Reed's place, in Cave Creek Canyon, Station 11; head of cave, 8,000 feet; Barfoot Park; head of Pine Canyon; Long Park, 8,000 feet; "Box" of Rucker Canyon.

Helicodiscus eigenmanni arizonensis Pils. and Ferr.

Quartzite Peak near Fort Bowie; head of west branch of Big Emigrant Canyon and at Station 2; White Tail Canyon at Stations 4, 10, in the Box Canyon, and on both sides below the junction of Indian Creek; Cave Creek Canyon at Stations 4 and 14, 8,000 feet; Rustler's Park; head of Pine Canyon; Shake Gulch, Limestone Mountain.

Radiodiscus millecostatus Pils. and Ferr.

Head of Cave Creek, 8,000 feet, Station 14; Barfoot Park, Station 3;

Pine Canyon, 7,500 feet; Rustler Park; Long Park, 8,000 feet; "Box" in Rucker Canyon.

This species is new to the Chiricahuas. It was originally described from the Huachuca range. It was found in some profusion in Long Park, many specimens exceeding the type in size, the largest 2.3 mm. in diameter.

It is somewhat remarkable that this form, belonging to a southern genus and here at the northern edge of its known range, should be found only at high levels.

Punctum californicum Pils.

P. californicum Pils., Nautilus, XI, April, 1898, p. 134 (Fish Camp, Fresno County, California).

Head of Cave Creek, Station 14, 8,000 feet; Rustler Park; Long Park. Found with *Radiodiscus*.

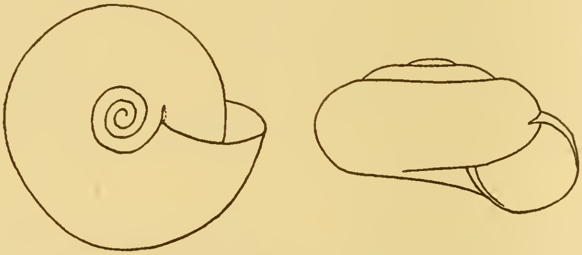


Fig. 28.—*Punctum californicum* Pils., Rustler Park, Chiricahuas.

Only seven examples of this atom of life were found, none of them as large as the California types, and probably not fully mature. The figured example measures alt. .82, diam. 1.35, width of umbilicus .35 mm., whorls $3\frac{1}{4}$. The first $1\frac{1}{4}$ whorls are smooth; then very fine obliquely radial striæ appear. On the last whorl the striation is dense and fine, with thin delicate cuticular laminæ on the striæ, which give fresh shells a satin sheen where the light strikes, the color of the shell being light chestnut. Striæ at nearly regular intervals are slightly more prominent. At the periphery there are about 40 of the more prominent striæ in 1 mm. The umbilicus is one-fourth the total diameter.

An adult shell of the type lot of *P. californicum* measures 1.8 mm. diam., umbilicus .42 mm., therefore, slightly less than one-fourth the diameter. The sculpture is similar to that of Chiricahua *P. californicum*.

This snail is new to Arizona, having been known hitherto only from

Fresno County, California. It is one of the very few forms common to Arizona and the West Coast.

VALLONIIDÆ Pilsbry.

Vallonia perspectiva Sterki.

Summit of Cross J Mountain, Big Emigrant Canyon; Paradise Canyon below Paradise; White Tail Canyon; Spring in lower Rucker Canyon; Limestone Mountain.

FERUSSACIDÆ Bourguignat.

Cochlicopa lubrica (Müll.).

Chiricahua Mountains: Ridge between White Tail Canyon and the Pinery, Station 3; Jhu Canyon; Paradise Canyon; Cave Creek Canyon at Stations 4, 5 and 11 and 14 F, very scarce; Barfoot Park; head of Pine, 7,500 feet; Long Park, 8,000 feet; Box of Rucker Canyon.

PUPILLIDÆ Turton.

Pupilladæ Turton, Manual of the Land and Fresh-water Shells of the British Islands, p. 97 (1831).
Pupillidæ, Pilsbry, Nautilus, XVIII, p. 107 (Jan., 1905).
Pupidæ of authors.

The northern (Canadian) forms of this group approach their southern limit in the ranges of Southern Arizona. *Vertigo* is represented only by a few puny forms at high elevations. The Upper Sonoran Bifidariæ predominate, especially those of the section *Immersidens*.

The family name *Pupillidæ* replaces *Pupidæ* because the generic term *Pupa* was not based upon a member of this family.

Genus PUPILLA 'Leach' Turton.

Pupilla hebes (Ancey).

Box in Rucker Canyon; Spring branch of Rucker. The sinistral form of *P. hebes* (which we will call form *nefas*) was taken in Pine Canyon, 7,500 feet (type loc.), and at the head of Cave Creek, Station 14, at 8,000 feet. No dextral examples were taken at either of these stations.

Genus BIFIDARIA Sterki.

Bifidaria pellucida hordeacella (Pils.).

Summit of Cross J Mountain, Big Emigrant Canyon; Paradise Canyon below Paradise; White Tail Canyon; Cave Creek Canyon on slope below the cave; Shake Gulch, Limestone Mountain.

Bifidaria quadridentata Sterki.

Barfoot Park, one specimen.

Section ALBINULA 'Ckll' Sterki.

Bifidaria pilsbryana Sterki.

Rustler's Park; White Tail Canyon; Pine Canyon, 7,500 feet; Box in Rucker Canyon; Limestone Mountain, in Shake Gulch.

Section IMMERSIDENS Pils. and Van.

In the central sierras, from the Grand Canyon of the Colorado to the Mexican State of Michoacan, a distance of over 1200 miles, the typical (or *procera*) group of Bifidaria gives place to a great extent to a group in which the angular and parietal lamellæ are less united, joined only at the inner end of the angular lamella. The basal fold, when present, is radial, or transverse to the cavity. This group is morphologically in a more primitive stage than the eastern Bifidariæ, in which the angular and parietal lamellæ are more completely concrescent. Some of the species, however, have evolved very complicated apertures. Such forms as *B. perversa* and *B. ashmuni* are to be viewed as highly evolved members of a low group. *Immersidens* stands intermediate between *Bifideria s. str.* and *Sterkia.* In the latter group the angular and parietal lamellæ are not united.

The following forms from Arizona and New Mexico belong here:

Bifidaria perversa Sterki.
" *ashmuni* Sterki.
" *ashmuni minor* Sterki.
" *cochisensis* Pils. and Ferr.
" *cochisensis oligobasodon* Pils. and Ferr.
" *dalliana* Sterki.
" *bilamellata* Sterki and Clapp.

Bifidaria prototypus Pils., from Michoacan, Mexico, also belongs to the group, as a terminal member of a form-chain composed of *ashmuni, cochisensis, oligobasodon, prototypus,* which constitute successively simpler links in the chain. Probably the great unknown mountain region of Northern Mexico will supply other members of the group.

In order to complete the account of *B. ashmuni* and its allies, forms from the Huachuca Mountains and elsewhere have been described and illustrated below.

Key to Species of Immersidens.

a.—Shell sinistral, last whorl straightened and produced forward (fig. 29)......*B. perversa* Sterki.
a[1].—Shell dextral.

b.—Columellar lamella running forward on the parietal wall in the position of an infraparietal lamella; inner end of the parietal lamella curving strongly toward the outer wall.

c.—Length about 2 mm .... *B. ashmuni* Sterki.

c[1].—Length 1.6 to 1.8 mm .... *B. a. minor* Sterki.

b[1].—Columellar lamella normal in position, horizontal and conspicuous in a front view.

c.—Parietal barrier λ-shaped, the inner end curving more or less towards the outer wall.

d.—Basal fold well-developed, radial. *B. cochisensis* P. and F.

d[1].—Basal fold minute; angular lamella reduced. *B. c. oligobasodon* P. and F.

d[2].—Basal fold wanting; angular lamella reduced. *B. prototypus* Pils.

c[1].—Parietal lamella straight or bending slightly toward the columella at its inner end; shell small, rather slender.

d.—Length 2, diam. 0.85 mm., or smaller; nearly cylindric. *B. dalliana* Sterki.

d[1].—Length 2 to 2.4, diam. 0.9; spire tapering more. *B. bilamellata* S. and C.[29]

Bifidaria perversa Sterki. Fig. 29.

Bifidaria perversa Sterki, Nautilus, XII, December, 1898, p. 90 (Nogales).

Found in the Chiricahuas in the Valley of Turkey Creek below Paradise and in White Tail Canyon. Heretofore known only from Nogales and the drift débris of the San Pedro River at Benson, Arizona.

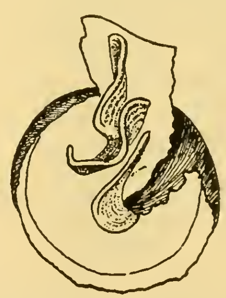


Fig. 29.—*B. perversa*, basal view, most of the basal wall removed to show the angular, parietal and and columellar lamellæ.

Bifidaria ashmuni Sterki. Fig. 30, *a*, *b*, *c*.

Bifidaria ashmuni Sterki, Nautilus, XII, Sept., 1898, p. 49 (Santa Rita Mountains, Arizona; Cook's Peak and Dripping Springs, Organ Mountains, New Mexico).

Bifidaria ashmuni form *minor* Sterki, t.c., Dec., 1898, p. 92 (Nogales, Arizona).

The typical form of *B. ashmuni* is nearly cylindric, tapering but slightly, composed of five strongly convex whorls. The last whorl becomes straightened and slightly sinuous in basal view, and has a more or less conspicuous oblique swelling or crest some distance behind the aperture. This crest is not always so strong, as shown in fig. 30 *c* (a specimen from Page's Ranch, Oak Creek, in central Arizona). The

[29] *Bifidaria bilamellata* Sterki and Clapp, *Nautilus*, XXII, pl. 8, fig. 7 (March, 1909). Sterki, *Nautilus*, XXII, p. 126 (April, 1909). Yuma County, Arizona.

peristome is well expanded, continuous, and usually stands shortly free from the whorl in front. The parietal lamella is sigmoid, bending far to the right at its inner end. The angular lamella, also sigmoid, runs from the peristome to the parietal lamella, the two lamellæ together forming a figure like the letter λ. The columellar lamella is broad and horizontal far within, but near the aperture *it runs out upon the parietal wall,* where it appears as a more or less elevated cord between the parietal lamella and the columella, occupying, therefore, the place of an infraparietal lamella. These lamellæ are well shown in fig. 30 *b,* a basal view in which the base of the shell has been removed. The upper palatal fold is short, situated some distance within the mouth, but visible from in front. The lower palatal is long, entering, and so deeply immersed that it is not visible in a front view, being concealed behind the massive parietal barrier. There is a radially placed basal fold, scarcely or not visible in a front view. Length about 2, diam. 1 mm.

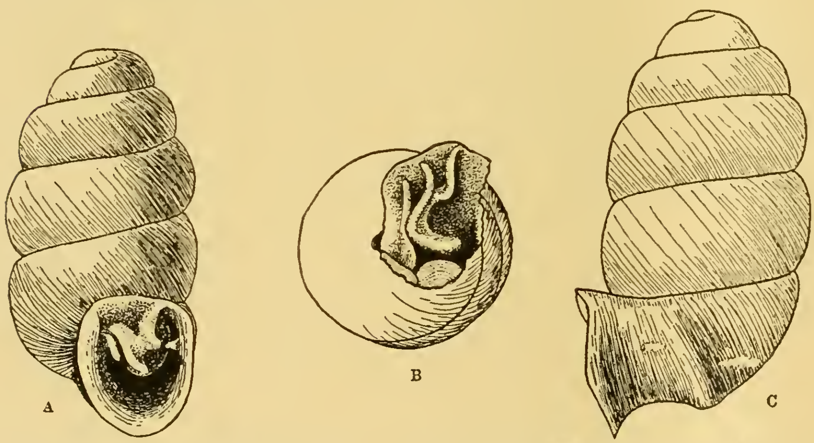


Fig. 30.—*Bifidaria ashmuni* Sterki. A, B, Florida Mountains, New Mexico; C, Page's Ranch, Oak Creek, Central Arizona.

Arizona: Coconino Co., Grand Canyon, on the Bright Angel trail about 100 feet below the rim (Ferriss and Pilsbry); Yavapai Co., Verde River, Walnut Gulch, Mescal Gulch and Kirwagen's ranch, all near Jerome, and along Oak Creek at Owensby's and Page's ranch; along the Santa Fe R. R. at Holbrook, Navajo Co., and Navajo Springs, Apache Co. (Ashmun); Cochise Co., in the Chiricahua range in White Tail Canyon below the mouth of Indian Creek and on Limestone Mountain (Ferriss and Pilsbry); Ash Canon, Huachuca range (Ferriss and Daniels); Nogales, S. Cruz Co. (Ashmun). New Mexico: Valencia Co., along the Santa Fe R. R., at Grants (Ferriss and Pilsbry) and San Rafael (Ashmun); Mountain Station, Oscura Mountains, Socorro Co., and White Oaks, Lincoln Co., in Central New Mexico (Ashmun); Cook's Peak (U. S. N. M.); Dripping Spring, Organ Mountains (Cockerell); Florida Mountains, Luna Co. (Ferriss and Pilsbry).

B. ashmuni is distinguished by the strong development of the angulo-parietal lamella, which bends far to the right at its inner end, the very deep immersion of the lower palatal and basal folds, the *continuation of the columellar lamella upon the parietal wall, alongside the parietal lamella,* and the longer, usually more gibbous, "neck" of the last whorl.

Fig. 31.—*Bifidaria ashmuni minor* Sterki, Nogales, Arizona.

B. ashmuni minor Sterki (fig. 31) is a small race, length about 1.6 mm., with 4 to 4½ whorls, found at Nogales, Arizona, and also on the Mexican side of the international boundary. The aperture is substantially like that of *ashmuni.*

Bifidaria cochisensis n. sp. Figs. 32, 33.

The shell is slightly tapering cylindric, like *B. ashmuni,* but the last whorl is less protracted and the crest or wave behind the aperture is very low, often not noticeable. The peristome is continuous as a slightly raised thread across the parietal wall (or in a less developed form it is rather widely interrupted above). Lamellæ *weaker* than in typical *B. ashmuni,* especially the angular lamella, which is straighter; *parietal lamella less curved at its inner end.* Columellar lamella wide and horizontal, *not continued upon the parietal wall.* Basal and lower palatal folds less deeply immersed than in *B. ashmuni,* readily visible in the mouth, the basal fold small.

Length 2.5, diam. 1.1 mm.		Cotypes, Tanner Canyon, fig. 32.
" 2.2, " 1.1 "		
" 2.15, " 1.1 "		Santa Rita Mountains, fig. 33.

Southeastern Arizona: Chiricahua Mountains, White Tail Canyon; Summit of Cross J Mountain, Big Emigrant Canyon (Ferriss and Pilsbry). Huachuca Mountains, Tanner Canyon, 6,000 feet (Ferriss, type loc.). Santa Rita Mountains (Ashmun).

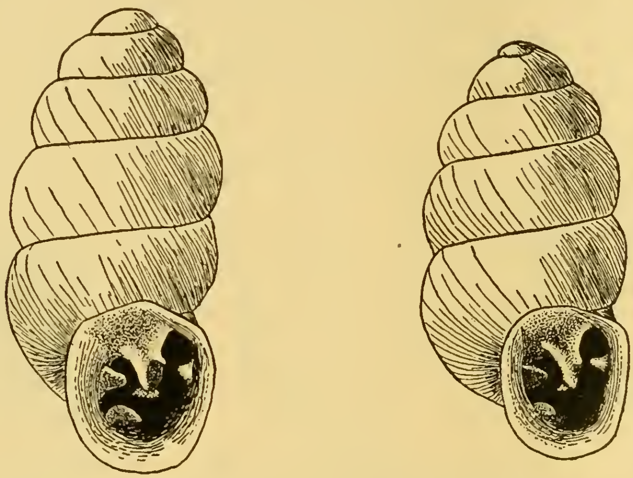


Fig. 32.—*Bifidaria cochisensis* P. and F. Types from Tanner Canyon, Huachuca Mountains.

The absence of a forward continuation of the columellar lamella on the parietal wall, between the parietal lamella and the columellar wall, is the most prominent feature of this species, though it has several other constant, if less conspicuous, differential characters. It is decidedly less aberrant than *B. ashmuni*, the lamellæ and folds, as well as the less protracted last whorl, approaching the normal *Bifidaria* type.

A modification of *B. cochisensis* also occurs in the Huachucas at Tanner Canyon and in the Chiricahua range on Limestone Mountain. The shell is smaller than usual in *cochisensis*, about 1.9 or 2 mm. long. The teeth are much weaker, especially the angular lamella. The inner end of the parietal lamella is not much curved and is readily visible in an obliquely basal view in the aperture. The basal and palatal folds are less deeply placed, the lower palatal being visible *below* the apex of the parietal barrier in a front view. The basal fold is very small. The upper margin of the peristome is adnate for some distance. In this form, or race, if such it proves to be, *B. ashmuni cochisensis* makes its nearest approach to *B. dalliana* and to the following race.

Possibly Dr. Sterki at the time of his original description had *cochisensis* before him, together with typical *ashmuni*, since he mentions specimens from the Santa Rita Mountains. We have examined a lot collected by Mr. Ashmun at that place and find them all to be *cochisensis*. The terms of Sterki's original description apply only to the form herein defined as *ashmuni*, for he mentions the crest

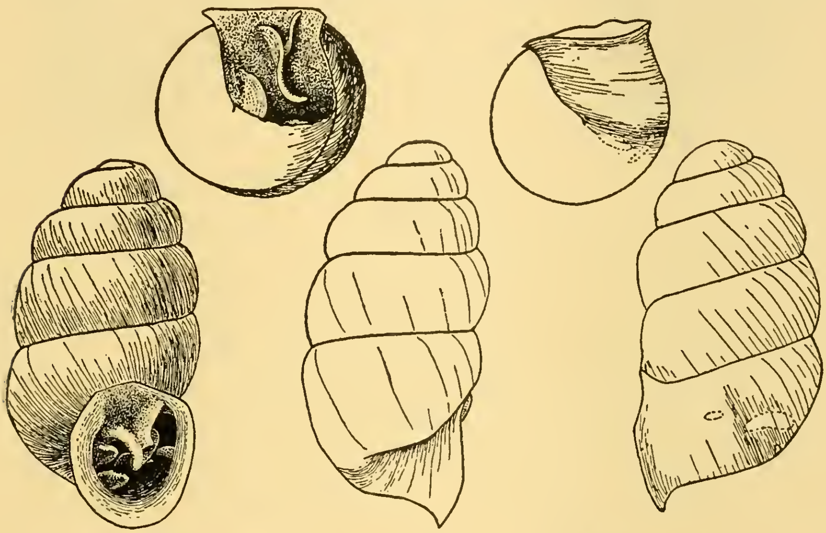


Fig. 33.—*Bifidaria cochisensis* P. and F. Santa Rita Mountains, Arizona.

"forming a projecting angle at the base" and the columellar lamella "ascending to the body-whorl between the parietal and columella." Careful examination of a series of several thousand examples, supplying data for the present account, has shown no intergrading forms between *ashmuni* and *cochisensis*, yet careful cleaning of the aperture is necessary for their discrimination.

Bifidaria cochisensis oligobasodon n. subsp. Fig. 34, *a*, *b*, *c*.

The shell is externally similar to *B. cochisensis*, but differs by the reduction of all the teeth. The parietal barrier is simplified (fig. 34 *b*), and the basal fold is reduced to a minute tubercle or a mere vestige, or in a few apparently mature shells it seems to be wholly lost. Parietal margin adnate.

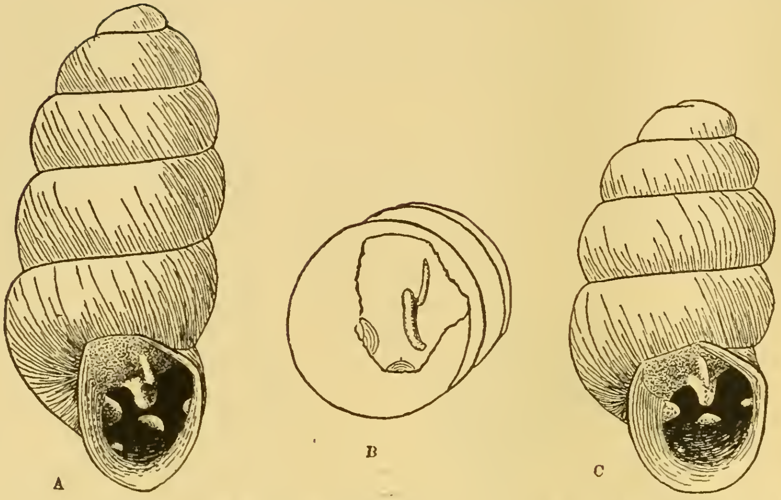


Fig. 34.—*Bifidaria cochisensis oligobasodon* P. and F. Ash Canyon, Huachuca Mountains.

Length 2.6, diam. 1.1 mm.
" 2.1, " 1 "

Ash Canyon, Huachuca range. Types No. 97,444 A. N. S. P., cotypes in Ferriss coll.

This form would be considered specifically distinct from *cochisensis* were it not approached by a small form of that species from Tanner Canyon, which has weaker teeth than the larger typical *cochisensis*. *B. c. oligobasodon* stands very near *B. prototypus* Pils.[30] (fig. 35),

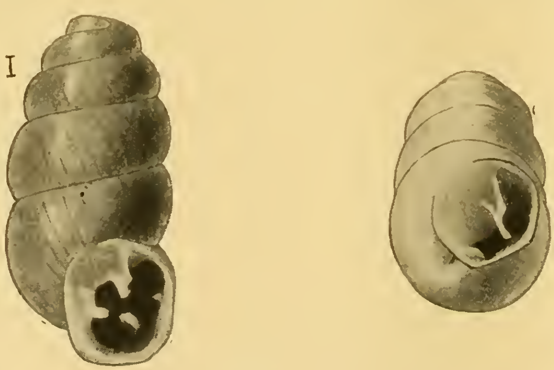


Fig. 35.—*Bifidaria prototypus* Pils.

[30] *Proc. A. N. S. Phila.*, 1899, p. 400.

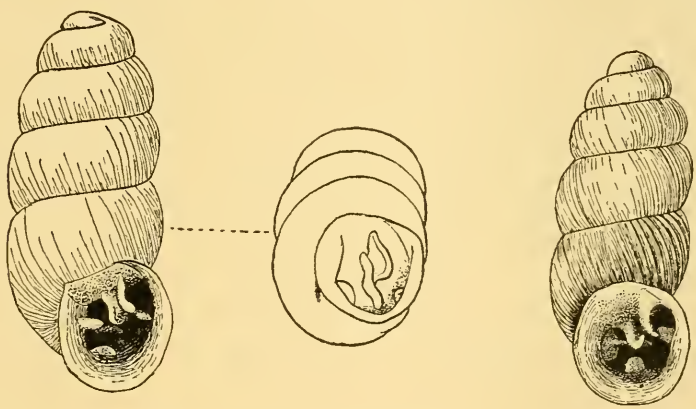
described from the State of Michoacan, Mexico, figured here for comparison. In a long series of *prototypus* no specimen with even a vestigeal basal tooth was found. In view, therefore, of the very wide separation of the two forms geographically, it may be best to treat them as specifically diverse.

Bifidaria dalliana Sterki. Fig. 36.

Bifidaria dalliana Sterki, Nautilus, XII, p. 91, Dec., 1898. Pilsbry and Vanatta, Proc. A. N. S. Phila., 1900, p. 593, pl. 22, fig. 8.

Chiricahua Mountains: Quartzite Peak near Fort Bowie; White Tail Canyon in several places (Ferriss and Pilsbry); Limestone Mountain and Shake Gulch (Ferriss).

Other Arizona localities in collection A. N. S. P. are Nogales (type loc.), Santa Rita Mountains, Montezuma's Well, Salt River near Tempe, Kirwagen's ranch near Jerome; all collected by Mr. Ashmun.



A B

Fig. 36.—A. *Bifidaria dalliana* Sterki, front and obliquely basal views of a specimen from White Tail Canyon below the junction of Indian Creek, Chiricahua Mountains. B, *B. bilamellata* S. and C, type.

B. dalliana is related to *B. cochisensis*, but differs by being conspicuously more slender, resembling *B. p. hordeacella* in shape, but it diverges more fundamentally by the parietal lamella, the inner end of which turns slightly *toward the columella,* while in *B. ashmuni, cochisensis* and *perversa* the inner end bends towards the outer wall.

In the Chiricahuas the specimens are often longer than the types, one figured here measuring 2 mm. long, .85 wide.

Bifidaria bilamellata Sterki and Clapp stands very close to *B. dalliana,* but it differs by having a perceptibly more tapering spire, which is somewhat longer, and the columellar lamella has a vertical callus at its inner end (weaker or wanting in *dalliana*). The parietal lamellæ are substantially alike in the two species. For comparison we reproduce here the type figure of *B. bilamellata* (fig. 36 B).

Subgenus **CHÆNAXIS** Pils. and Ferr.

Bifidaria tuba Pilsbry and Ferriss.

A few examples were taken by Mort Wien about half a mile from Dos Cabezas Cave, where it occurred with *Holospira*. This extends the known range of the species eastward.

Genus **VERTIGO** Müller.

Vertigo is a distinctly boreal element, confined in the Chiricahuas, so far as our observations show, to high levels. The species are identical with alpine forms of Colorado and Utah.

Vertigo columbiana utahensis Sterki.

Head of Cave Creek, 8,000 feet, one example.

Vertigo milium Gld.

Head of Pine Canyon, one specimen.

Vertigo modesta parietalis Anc.

Head of Cave Creek, 8,000 feet; Long Park.

Vertigo coloradoensis basidens Pils. and Van.

Rustler's Park.

SUCCINEIDÆ.

Succinea avara Say.

Chiricahua Mountains: Cave Creek Canyon on the slope below the cave and at Station 6.

BASOMMATOPHORA.

No fresh-water snails were taken in the streams of the Chiricahuas, but Pilsbry found two species in the *ciénega* about midway between the Chiricahua and the Peloncillo or Stein's Peak ranges: *Lymnæa cockerelli* Pils. and Ferr. and *Physa virgata* Gld. Both are widely if sparsely distributed in Arizona and New Mexico.

It is said that sometimes blind fish are washed out of the swollen springs in the ciénega when the snow melts on the mountains.

PELECYPODA.

Pisidium abditum huachucanum Pils.

Spring branch, head of Rucker Canyon, many young specimens only; Box in Rucker Canyon.

Explanation of Plates I–XIV.

Figures 35 and 36 B were drawn by Helen Winchester; the other figures were drawn or photographed by H. A. Pilsbry.

Plate I—Figs. 1, 2, 3—*Sonorella bicipitis* n. sp. Types from Station 1, Buckeye Canyon, No. 94,328 A. N. S. P.

Figs. 4, 5—*S. bicipitis.* Nine-mile Water Hole. Nos. 94,324 and 89,908 A. N. S. P.

Figs. 6, 7, 8, 9—*Sonorella optata* n. sp. Types from head of Big Emigrant Canyon. No. 94,319 A. N. S. P.

Fig. 10—*S. optata*—Cleft in summit between forks of Big Emigrant Canyon. No. 94,321 A. N. S. P.

Figs. 11, 12, 18, 19—*S. optata.* West side of Big Emigrant Mountain. No. 94,320 A. N. S. P.

Figs. 13, 14, 15, 16—*Sonorella bowiensis* Pils. Topotypes, from Quartzite Peak, near Fort Bowie. No. 94,327 A. N. S. P.

Fig. 17—*S. optata*, small form. Head of Big Emigrant Canyon. No. 99,789 A. N. S. P.

Plate II—Figs. 1, 2, 3—*Sonorella virilis* Pils. Cave Creek, Station 11 (topotypes of var. *circumstriata*). No. 94,332 A. N. S. P.

Figs. 4, 5—*S. virilis.* Two miles up the south fork of Cave Creek. No. 94,335 A. N. S. P.

Fig. 6—*S. virilis.* Spring Branch near Rucker Camp, head of Rucker Canyon. No. 97,563 A. N. S. P.

Figs. 7, 8, 9—*Sonorella virilis leucura* n. subsp. White Tail Canyon, Station 14. No. 99,682 A. N. S. P.

Figs. 10, 11—*Sonorella micra* n. sp. Station 10, White Tail Canyon. No. 94,334 A. N. S. P.

Fig. 12—*S. micra.* Station 17, White Tail Canyon. No. 94,330 A. N. S. P.

Figs. 13–18—*Sonorella binneyi* n. sp. Horseshoe Canyon.

Plate III—Fig. 1—*Sonorella bicipitis* Pils and Ferr. Genitalia of specimen from Buckeye Canyon. Station 3. × 3. No. 94,326.

Fig. 2—*S. bicipitis.* Genitalia of specimen from Nine-mile Water Hole. No. 94,324. × 3.

Fig. 3—Side of the head of same specimen.

Fig. 4—*S. bicipitis.* Penis opened to show the papilla. Buckeye Canyon. Station 4. No. 94,325.

Fig. 5—*Sonorella binneyi* Pils and Ferr. Genitalia of No. 97,414. Horseshoe Canyon.

Fig. 6—*S. bicipitis.* Sole of specimen from Nine-mile Water Hole. No. 94,324.

Fig. 7—*S. bicipitis.* Genitalia of specimen from Buckeye Canyon, Station 1. × 3. No. 94,328 (type lot).

Plate IV—Fig. 1—*Sonorella optata* Pils and Ferr. Genitalia of No. 94,322. Big Emigrant Mountain, × 3, with details of penis, papilla and the vestigeal flagellum (*fl.*).

Fig. 2—*S. optata.* West Side of Big Emigrant Canyon. No. 94,320. × 4.

Fig. 3—*S. optata.* Big Emigrant Canyon, Station 1. No. 94,319. × 4.

Fig. 4—*S. optata.* Cleft in Big Emigrant Canyon. No. 94,321. × 4.

Fig. 5—*S. optata.* Genitilia of young snail. No. 94,323. × 14. Outline of penis papilla shown by broken line.

Fig. 6—*Sonorella bowiensis* Pils. Genitalia of a topotype. × 3. No. 94,327.

Fig. 7—*S. optata.* Genitalia of a nearly mature snail. No. 94,323. × 4. Cross J. Mountain.

Plate V—Fig. 1—*Sonorella micra* Pils and Ferr. Genitalia. × 4. No. 94,334. From Station 10, White Tail Canyon. The penis is extended, its papilla projecting.

Fig. 2—*S. micra.* Detail of same specimen showing the epiphallus extended.
Fig. 3—*S. micra.* No 94,330. × 4. Penis normally retracted, with detail of end of the papilla.
Fig. 4—*S. virilis* Pils. Specimen from Station 11, Cave Creek Canyon. × 2. No. 94,332.
Fig. 5—*Sonorella virilis leucura* Pils. and Ferr. × 2. White Tail Canyon, Station 4. No. 94,331. The twisted condition of the penis is an accidental or individual peculiarity of this specimen.
Fig. 6—*S. virilis.* × 2. Cave Creek, Station 13. No. 94,335. With detail of opposite side of the vagina

Plate VI—Figs. 1, 2, 3—*Oreohelix barbata* Pils. An adult and two immature individuals from the head of Turkey Creek.
Fig. 4—*O. barbata.* Less fully scaled form with blunt periphery. Head of Rucker Canyon, Station 10A.
Figs. 5, 6, 7—*O. barbata minima* Pils. and Ferr. Rucker Canyon, Station 11½A.

Plate VII—Figs. 1, 2, 3, 4—*Ashmunella lepiderma* n. sp. White Tail Canyon, Station 11.
Figs. 5, 6, 7—*A. lepiderma.* Station 17.

Plate VIII—Figs. 1–8—*Ashmunella duplicidens* Pils.

Plate IX—Figs. 1, 2—*Ashmunella esuritor* Pils. Near Barfoot Park, Station 2. No. 92,205. Elevated specimen.
Figs. 3—Pine Canyon, No. 97,930. Elevated specimen.
Figs. 4, 5—Near Barfoot Park. No. 92,205. Depressed specimen.
Figs. 6, 7, 8—East side of Barfoot Park. No. 94,432. Diameter 16½ mm.
Fig. 9—*Ashmunella metamorphosa* Pils. Aperture of type specimen. No. 88,885.

Plate X—Fig. 1—*Ashmunella chiricahuana* (Dall). Falls of Cave Creek. No. 97,427 A. N. S. P.
Fig. 2—*Ashmunella esuritor* Pils. E. side Barfoot Park. No. 94,432.
Fig. 3—*Ashmunella esuritor.* Topotype. No. 92,205.
Fig. 4—*Ashmunella chiricahuana* (Dall). Head of Cave Creek, near Long Park. No. 94,430.
Fig. 5—*Ashmunella esuritor* Pils. E. side Barfoot Park. No. 94,432.
Fig. 6—*Ashmunella angulata* Pils. Cave Creek Canyon. No. 87,020.
Fig. 7—*Ashmunella ferrissi* Pils. Topotype. No. 97,925.
Fig. 8—*Ashmunella duplicidens* Pils. Head of Morse Canyon.
Fig. 9—*Ashmunella proxima emigrans* Pils. Cotype. No. 99,604.

Plate XI—Figs. 1, 2, 3, 4—*Holospira arizonensis* Stearns. Topotypes from Dos Cabezas Cave. No. 99,700 A. N. S. P.
Figs. 5, 6, 7, 8—*H. arizonensis emigrans* n. subsp. Head of West branch of Big Emigrant Canyon. No. 99,701 A. N. S. P.
Figs. 9, 10, 11, 12—*H. arizonensis.* Form from Station 2, Big Emigrant Canyon. No. 99,702 A. N. S. P.

Plate XII—Figs. 1, 2—*Holospira cionella* Pils. Two cotypes. No. 87,117. A. N. S. P.
Fig. 3—*H. cionella.* Form from Goodwin Canyon. No. 99,710 A. N. S. P.
Figs. 4–8—*H. cionella.* Forms from Bull Hill, near Fort Bowie. No. 99,709 A. N. S. P.
Figs. 9, 10, 11, 12—*H. cionella.* Forms from Limestone Mountain. No. 97,424, A. N. S. P.
Figs. 13, 14, 15, 16—*H. cionella.* Forms from below Paradise. No. 99,726 A. N. S. P.

Plate XIII—Figs. 1, 2—*Holospira cionella intermedia* P. and F. White Tail Canyon, Station 4. No. 99,717.

Figs. 3, 4, 5—*Holospira cionella intermedia* P. and F. Types. Box Canyon of White Tail. No. 99,684.

Figs. 6, 7. 8—*Holospira cionella intermedia* P. and F. Types. Box Canyon of White Tail, another colony.

Figss. 9, 10, 11, 12—*Holospira cionella intermedia* P. and F. Two forms from head of Onion Creek. No. 99,724.

Figs. 13, 14—Do. Below Station 5, White Tail Canyon. No. 99,718.

Figs. 15, 16—*H. c. capillacea* P. and F. Southeast side of White Tail, below cliffs half way to summit. No. 99,727.

PLATE XIV—Figs. 1, 2, 3, 4—*Holospira chiricahuana ternaria* n. subsp. Cave Creek, Station 6. No. 99,699 A. N. S. P.

Figs. 5, 6, 7, 8—*Holospira chiricahuana* Pils. Topotypes, cave in Cave Creek. No. 99,696 A. N. S. P.

Figs. 9, 10, 11, 12—*H. chiricahuana gracilis* n. subsp. Cave Creek, Station 10. No. 99,698 A. N. S. P.

Figs. 13, 14, 15—*H. chiricahuana optima* n. subsp. Cave Creek Station 5. No. 99,697 A. N. S. P.

A NEW SPECIES OF MARINULA FROM NEAR THE HEAD OF THE GULF OF CALIFORNIA.

BY HENRY A. PILSBRY.

Marinula rhoadsi n. sp. Fig. 1.

The shell is imperforate, elliptical-ovate, rather solid; spire pale yellowish; the last whorl has a dark band at the shoulder, and is pale yellow above, more or less suffused with brown below the band. Surface smoothish, under the lens showing fine, irregular growth-lines (much more emphatic for a short distance behind the outer lip) and very faint excessively fine spiral striæ. Spire short, conic, attenuate near the apex. Whorls 5¾, slightly convex, the last flattened or a little impressed below the suture. Last whorl oval. Aperture narrow, the outer lip thin, without callus deposit within. Parietal lamella very high and compressed. Two columellar lamellæ, the upper one larger.

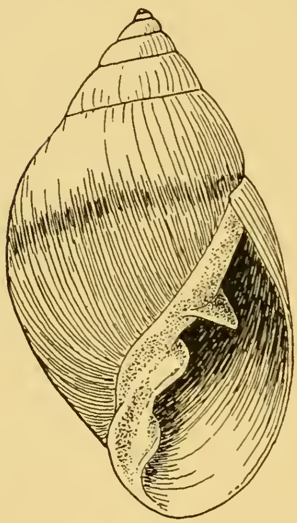


Fig. 1.

Length 10, diam. 5.8 mm.; length of aperture 6.9 mm.

Length 9.8 diam. 5.3 mm.; length of aperture 6.2 mm.

Hardie River, Lower California, near Mt. Cocopah Major, types No. 97,757 A. N. S. P., collected by Mr. S. N. Rhoads, Feb. 22, 1905.

Compared with *Marinula pepita* King this species differs by its much more inflated shape, the more slender spire, more or less attenuate above, the nearly even suture, and the varied coloring. The face of the columella is flat or concave in *M. rhoadsi,* and the parietal lamella emerges further, approaching the edge of the parietal callus. In *M. pepita* the face of the columella is convex and the parietal lamella does not emerge so far.

This species is named for Mr. Samuel N. Rhoads, who made a journey, not without difficulty and danger, down the Colorado River below Yuma, returning along the bases of the arid mountains westward to Calexico, California.

MARCH 1.

MR. FRANK J. KEELEY in the Chair.

Fourteen persons present.

JOHN H. HARSHBERGER, Ph.D., made a communication on the physiognomy of North American vegetation. (No abstract.)

MARCH 15.

MR. CHARLES MORRIS in the Chair.

Nineteen persons present.

The reception of a paper entitled "Spermatogenesis in Lepidoptera," by Margaret Harris Cook, was reported by the Publication Committee.

THOMAS H. MONTGOMERY, Ph.D., made a communication on a study of sexual selection as embodied in his observations on spiders. (No abstract.)

Thamnophis butleri again in Pennsylvania.—MR. HENRY W. FOWLER remarked that on July 3, 1907, he had secured an example of this species at Warren, in Warren County. As it has not before been recorded from this part of the State, this record may prove of interest, though specimens have been secured as far east as Port Allegheny in McKean County, as recorded by Stone, and later by Ruthven. Cope originally obtained Pennsylvanian specimens near Franklin, in Venango County, and described them as *Eutænia brachystoma.*

The following was ordered to be printed:

CRATÆGUS IN PENNSYLVANIA. II.

BY C. S. SARGENT.

Since the publication in the PROCEEDINGS of the Academy for 1905 of my paper on *Cratægus* in Eastern Pennsylvania a further systematic study of the genus in other parts of the State has been made. The results of these studies appear in the following paper. Additional observations have also been made in Delaware, Chester and Monroe Counties by Mr. B. H. Smith, in Bucks County by Dr. C. D. Fretz, and in Berks County by Mr. C. L. Gruber. In Lackawanna County, at Scranton and in its neighborhood, where the genus is largely represented in many distinct forms, important collections have been made by Mr. A. Twining. The region surrounding Orbisonia, in Huntingdon County, has been carefully explored by Mr. B. H. Smith, who has also collected for several seasons near Bedford in Bedford County, near Altoona in Blair County, and at Wilmore and Portage in Cambria County. Prof. O. E. Jennings has placed at my disposal very large collections accompanied by valuable notes made by him and his wife near Pittsburg, in Allegheny County, and in Washington, Westmoreland and Armstrong Counties. Without the assistance and careful observations of all these collectors the publication of this paper would have been impossible.

To Mr. Smith I am under special obligations. He has been my guide and companion during a number of journeys made during the last five years through many of the Cratægus fields of the State; he has enriched his specimens by the most carefully prepared notes and with excellent sketches of the fruit of many species, and he has been a constant and untiring adviser during the preparation of this paper, which has occupied my attention for several years.

The field is by no means exhausted; a large part of the State has never been visited by careful observers of *Cratægus*, and in the regions where the genus has been the most carefully examined, plants occur which are still imperfectly known; and before it is possible to prepare a third paper on the Cratægus of the State, collections must be made over large territories, and these collections, it is to be hoped, will not be long delayed.

Synopsis of Groups.

A.—Nutlets without ventral cavities (Groups Crus-galli–Anomalæ).

B.—Nutlets with longitudinal cavities on their ventral faces (Group Tomentosæ).

Crus-galli.

Leaves subcoriaceous or less commonly thin, obovate to oblong-obovate, acuminate, acute, acuminate or rounded at the apex, usually serrate only above the middle, without lobes except on vigorous shoots, their veins usually thin and often within the parenchyma; petioles short, usually eglandular; flowers in many-flowered glabrous corymbs; fruit subglobose to short-oblong or oval, mostly 1–1.4 cm. in diameter; flesh thin, usually green.

- Anthers rose color or pink.
  - Leaves subcoriaceous, their veins mostly within the parenchyma; stamens 10; anthers dark rose color..................1. *C. crus-galli.*
  - Leaves thin, their veins more or less prominent.
    - Leaves usually rounded at the apex; stamens usually 10; anthers pink; spines few..................2. *C. trahax.*
    - Leaves acuminate at the apex.
      - Stamens 10; calyx-lobes long, slender, entire.
        - Fruit short-oblong; anthers pale pink; branchlets and spines olive green..................3. *C. olivacea.*
        - Fruit narrow-oval; anthers rose color; branchlets and spines bright chestnut brown..................4. *C. accincta.*
      - Stamens 15; calyx-lobes short, glandular-dentate; anthers only faintly tinged with pink; branchlets and spines light brown..................5. *C. phlebodia.*
- Anthers white or pale yellow; stamens 10 or less.
  - Leaves subcoriaceous, rounded or acute at the apex; fruit narrow oblong-obovate to oval; spines dark purple, 2–3 cm. in length. 6. *C. eburnea.*
  - Leaves thin, acute or acuminate at the apex; fruit short-oblong to ovate; spines light reddish brown, 4–5 cm. in length. 7. *C. aliena.*

1. **Cratægus crus-galli** Linnæus.

Spec. 476 (1753); Sargent, Silva N. Am., IV, 91, t. 178; Man., 368, f. 286; Proc. Acad. Nat. Sci. Phila., 1905, 379.

Rich hillsides, Bedford, Bedford County, B. H. Smith and C. S. Sargent (No. 302), September 30, 1905, May 25, 1908; B. H. Smith, September 16, 1908; also from Canada to North Carolina.

The number 302 from Bedford represents a number of large shrubs with erect branches forming narrow irregular heads. This habit is quite unlike that of the typical form of *Cratægus crus-galli* but in other respects they are similar to that species as it grows in eastern Pennsylvania.

2. **Cratægus trahax** Ashe.

Jour. Elisha Mitchell Sci. Soc., XIX, pt. I, 27 (1903); Gruber, Proc. Berks County Nat. Sci. Club, I, 21 (Cratægus in Berks County, II).
Cratœgus crus-galli Sargent, Proc. Acad. Nat. Sci. Phila., 1905, 579 (in part) (not Linnæus).

Glabrous with the exception of the hairs on the upper side of the midribs. *Leaves* oblong-obovate, rounded or rarely acute at the broad apex, gradually narrowed to the cuneate base, and finely serrate above the middle, with incurved glandular teeth; nearly fully grown when the flowers open from the 20th to the 27th of May and then thin, yellow-green, sparingly villose along the upper side of the midribs, with mostly persistent hairs and paler below, and at maturity thin, dark yellow-green and very lustrous on the upper surface, pale yellow-green on the lower surface, 4–5.5 cm. long and 2–2.5 cm. wide, with thin midribs and slender more or less prominent primary veins; petioles stout, slightly wing-margined nearly to the base, 6–7 mm. in length; leaves on vigorous shoots usually acute or acuminate, coarsely serrate, often 7–8 cm. long and 3.5–4 cm. wide, with thick midribs and prominent primary veins. *Flowers* 1.3–1.8 cm. in diameter, on long slender pedicels, in wide usually 10–15- but occasionally 30-flowered corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire or occasionally slightly glandular near the base, reflexed after anthesis; stamens 5–15, usually 10; anthers pink; styles 1 or rarely 2. *Fruit* ripening early in October and usually remaining until November on the branches, on long slender drooping pedicels, in few-fruited clusters, subglobose to short-oblong, maroon or dark crimson, often blotched with dark green at the apex, dull, slightly pruinose, 1–1.3 cm. long and 8–13 mm. wide; calyx little enlarged, with a broad obconic cavity, and erect and slightly incurved persistent lobes; flesh bitter, greenish yellow; nutlet usually 1, narrowed and rounded at the apex, broader and rounded at the base, slightly ridged, 6–7 mm. long and 4–5 mm. in diameter.

A tree 4 or 5 m. high, with a short trunk 2–3 dm. in diameter, covered with dark gray bark, numerous large horizontal ascending or drooping branches forming a broad rounded head, and slender only slightly zigzag branchlets light orange-brown and marked by large pale lenticels when they first appear, becoming light reddish brown in their first season and dull gray the following year, and unarmed or armed with occasional stout spines 3–3.5 cm. long.

Bluffs along Tulpehocken Creek, North Heidelberg Township, Berks County; common; C. L. Gruber, (No. 105) May 27, August 2 and

September 16, 1905; (No. 45) May 29, August 1 and September 25, 1905, May 25 and 26, 1906.

From *Cratægus crus-galli* Linnæus this plant differs in its thinner leaves with more prominent veins, in the pink, not dark rose-colored, anthers and in the size and shape of the fruit. Mr. Gruber, who has watched carefully during several seasons the trees of these two forms growing near together, is convinced that *Cratægus trahax* should be specifically distinguished. A plant in an old hedge on Island Road, West Philadelphia, B. H. Smith (No. 221), June 3, 1903, probably belongs to this species.

3. **Cratægus olivacea** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* oblong-obovate, acuminate at the ends or sometimes acute at the apex, and sharply often doubly serrate above the middle, with straight glandular teeth; about half-grown when the flowers open late in May and then thin, dark yellow-green, smooth, lustrous and glabrous above with the exception of occasional hairs on the midribs, and pale and glabrous below, and at maturity thin but firm in texture, dark green and lustrous on the upper surface, light yellow-green on the lower surface, 5.5–7 cm. long and 3–3.5 cm. wide, with stout midribs and thin very prominent primary veins; petioles stout, wing-margined often to the middle, glandular, with minute often persistent glands 2–2.2 cm. in length; leaves on vigorous shoots thicker, more coarsely serrate, occasionally slightly lobed toward the apex, 7–10 cm. long and 3.5–4 cm. wide. *Flowers* on long slender pedicels, in wide, lax, mostly 14–20-flowered, corymbs, with linear glandular bracts and bractlets fading brown and generally deciduous before the flowers open, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, entire, reflexed after anthesis; stamens 10; anthers pale pink; styles 2. *Fruit* ripening the end of September, on long slender drooping red pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends or slightly narrowed at the base, dull red, marked by numerous large dark dots, 1–1.2 cm. long and 8–10 mm. in diameter; calyx little enlarged, with a wide shallow cavity, and small spreading and appressed lobes; flesh thin, green, dry and hard; nutlets 2, broad and rounded at the apex, narrow and rounded at the base, ridged on the back with a high broad grooved ridge 6–7 mm. long and 4–4.5 mm. wide.

A tree 7–9 m. high, with a tall trunk sometimes 3 dm. in diameter, covered with dark fissured and scaly bark, large wide-spreading branches forming a symmetrical round-topped head, and slender nearly straight branchlets dark green more or less tinged with red and marked by pale lenticels when they first appear, becoming dark olive green in their first season and dull reddish brown the following year, and armed with numerous slender straight olive green, ultimately dark brown, spines 3–3.5 cm. long.

Deep bottom lands, on the Little Juniata River, near Elizabeth Furnace, East Altoona, Blair County, B. H. Smith, (No. 280 type) May 22, 1905, B. H. Smith and C. S. Sargent, September 27, 1905.

Distinct in the olive green color of the branchlets and spines.

4. **Cratægus accincta** n. sp.

Glabrous. *Leaves* oblong-ovate, acute or acuminate or rarely rounded and short-pointed at the apex, gradually narrowed to the long slender entire base, and finely serrate above the middle, with straight glandular teeth; about half-grown when the flowers open at the end of May and then very thin, dull bluish green above and paler below, and at maturity thin, dark green, 4.5–5 cm. long and 1.5–2 cm. wide, with thin prominent midribs and thin primary veins; petioles slender, narrowly wing-margined to below the middle, often rose-color in the autumn, 4–8 cm. in length; leaves on vigorous shoots obovate, acuminate and long-pointed at the apex, coarsely doubly serrate, and often 6 cm. long and 3.5–4 cm. wide, with stout broadly winged petioles. *Flowers* 1–1.2 cm. in diameter, on long slender pedicels, in broad, lax, 15–20-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire, reflexed after anthesis; stamens 7–10, mostly 10; anthers rose color; styles 1 or rarely 2. *Fruit* ripening in October, on long slender pedicels, in drooping many-fruited clusters, narrow-oval, scarlet, lustrous, marked by long pale lenticels, 1.2–1.4 cm. long and 7–8 cm. in diameter; calyx little enlarged, with a narrow deep cavity pointed in the bottom, and spreading and appressed persistent lobes; flesh thin, yellow, dry and mealy; nutlet, rounded at the apex, gradually narrowed to the rounded base, slightly and irregularly ridged, 8–9 mm. long and 4–4.5 mm. in diameter, or when 2 gradually narrowed and rounded at the ends, more prominently ridged on the back and 3–4 mm. wide.

A tree 7–8 m. high, with a trunk sometimes 2 dm. in diameter covered with light gray scaly bark, spreading branches forming a round-topped head, and slender slightly zigzag branchlets light orange-green when they first appear, becoming light chestnut brown and lustrous in their first season and dull red-brown the following year, and armed with very numerous slender, straight or slightly curved chestnut brown spines 2.5–5 cm. long.

McKees Rocks, Allegheny County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 24 type) September 28, 1905. O. E. Jennings, May 24, 1906.

5. **Cratægus phlebodia** n. sp.

Glabrous. *Leaves* narrowly obovate, acuminate gradually contracted to the long slender concave-cuneate base, and finely often doubly serrate, with straight or incurved glandular teeth; more than half-grown when the flowers open late in May and then thin, yellow-green, smooth and lustrous above, pale below, and at maturity thin, dark yellow-green on the upper surface, paler on the lower surface, 3.5–5 cm. long and 2–2.2 cm. wide, with thin very prominent midribs and primary veins; petioles slender, narrowly wing-margined to below the middle, 8–10 mm. in length. *Flowers* 1.8–2 cm. in diameter, on long slender glabrous pedicels, in mostly 10–18-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short, slender, acuminate, minutely glandular-dentate near the middle, reflexed after anthesis; stamens 15–20; filaments persistent on the ripe fruit; anthers faintly tinged with pink; styles 1–3. *Fruit* ripening the end of September, on slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, dull scarlet, blotched with green at the apex, marked by large pale dots, 1–1.2 cm. long and nearly as broad; calyx little enlarged, with a narrow deep cavity pointed in the bottom, and small spreading often deciduous lobes; flesh thin, yellow-green, dry and hard; nutlets 1–3, full and rounded at the ends or sometimes acute at the base, ridged on the back,with a high broad ridge, 7.5–8 mm. long and 4–4.5 mm. wide, or, when 1, 5–5.5 mm. in diameter.

A tree sometimes 5–6 m. high, with a trunk 2.5–3 dm. in diameter covered with pale scaly bark, large erect and spreading branches forming an oblong round-topped head, and slender only slightly zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light orange-brown in their first season and pale gray-brown the following year, and armed with many slender straight or slightly curved light brown spines 4–5 cm. long, and very numerous and compound on old stems and branches.

Border of oak woods, near Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 295 type) September 30, 1905; B. H. Smith, May 18, 1906; Orbisonia, Huntingdon County, B. H. Smith, (No. 316) May 20, 1906, October, 1907.

The flowers of number 295, from Orbisonia, have usually only 6–10 stamens. In other respects the two plants appear to be very much alike.

6. **Cratægus eburnea** Ashe.

Ann. Carnegie Mus., I, pt. III, 393 (1902).

Glabrous. *Leaves* oblong-obovate, rounded or acute at the apex, gradually narrowed to the concave-cuneate entire base, and finely often doubly serrate above, with straight or incurved glandular teeth; about half-grown when the flowers open in the first week of June and then thin, dark yellow-green, smooth and lustrous above and paler below, and at maturity subcoriaceous, dark yellow-green and very lustrous on the upper surface, paler on the lower surface, 4.5–5 cm. long, 2.5–3 cm. wide, with thin prominent midribs and primary veins; petioles stout, narrowly wing-margined nearly to the base, occasionally glandular early in the season, with deciduous glands, 6–8 mm. in length. *Flowers* about 1.4 cm. in diameter, on slender pedicels in broad many-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire, reflexed after anthesis; stamens 8–10; anthers white; styles 1 or 2. *Fruit* ripening in October, on long drooping pedicels, in few-fruited clusters, oblong-obovate to oval, narrowed and rounded at the apex, more gradually narrowed and pointed at the base, dark red, 1.3–1.4 cm. long and 9–10 mm. in diameter; calyx little enlarged, with a deep narrow cavity pointed in the bottom, and slender reflexed persistent lobes; flesh thin, yellow-green, dry and hard; nutlets 1 or 2, obtuse at the apex, slightly narrowed at the base, ridged on the back, with a low narrow ridge, 7–8 mm. long and about 3 mm. wide, or when 1 about 1.5 mm. in diameter.

A tree sometimes 7–8 m. high, with a short trunk 2–2.5 dm. in diameter covered with light gray bark broken into rectangular scales, stout wide-spreading branches forming a broad round-topped head, and slender straight or slightly zigzag branchlets dark orange-green and marked by small pale lenticels when they first appear, becoming dark purple and lustrous in their first season and dark brown the following year, and armed with slender straight or slightly curved purple spines 2–3 cm. long, and occasionally persistent and becoming much elongated and branched on old stems.

Darlington Hollow, Sharpsburg, Allegheny County, J. A. Shafer, (No. 22, the type tree) June 8 and October, 1901, May 28, 1902, O. E. Jennings, (No. 98) June 16, 1908.

This is one of the largest and most abundant species in the neighborhood of Pittsburg.

7. **Cratægus aliena** n. sp.

Glabrous with the exception of the hairs on the young leaves. *Leaves* oblong-obovate, acute or acuminate, gradually narrowed to the concave-cuneate entire base, and sharply often doubly serrate usually only above the middle, with straight glandular teeth; nearly half-grown when the flowers open from the middle to the 20th of May and then thin, dull yellow-green, smooth and glabrous above with the exception of a few hairs on the upper side of the midribs and paler below, and at maturity thin but firm in texture, dark green and very lustrous on the upper surface, pale yellow-green on the lower surface, 4–5 cm. long and 2–2.5 cm. wide, with thin prominent midribs and primary veins; petioles stout, narrowly wing-margined nearly to the base, occasionally glandular early in the season, rose color in the autumn, 7–8 mm. in length; leaves on vigorous shoots subcoriaceous, abruptly long-pointed at the apex, more coarsely serrate, occasionally slightly lobed, often 5–6 cm. long and 4–5 cm. wide. *Flowers* 1.2–1.4 cm. in diameter, on long slender pedicels, in broad mostly 12–15-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender acuminate, entire or minutely dentate, reflexed after anthesis; stamens 10; anthers light cream color; styles 1 or 2, usually 2. *Fruit* ripening early in October, on long drooping red pedicels, in few-fruited clusters, short-oblong to slightly obovate, crimson, lustrous, marked by large pale dots, 1–1.2 cm. long and 9–10 mm. in diameter; calyx little enlarged, with a narrow deep cavity pointed in the bottom, and small spreading often deciduous lobes; flesh thin and hard; nutlets 1 or 2, gradually narrowed and rounded at the ends, ridged on the back, with a high broad slightly grooved ridge, 7.5–8 mm. long and 4–4.4 mm. wide, or when 1, 6–6.5 mm. in diameter.

A tree 5 or 6 m. high, with a tall trunk 1.5–2 dm. in diameter and covered with dark scaly bark, small spreading branches forming a wide round-topped symmetrical head, and stout only slightly zigzag branchlets light orange-green and marked by pale lenticels when they first appear, becoming light reddish brown in their first season and gray tinged with red the following year, and armed with numerous stout nearly straight light red-brown spines 4–5 cm. long.

Hillsides, valley of Blacklog Creek, near Orbisonia, Huntingdon County, B. H. Smith, (No. 309, type) May 19 and October 9, 1906, October 8, 1907.

2. Punctatæ.

Leaves thin to subcoriaceous, obovate-cuneate, usually more or less lobed above the middle; petioles short; anthers rose-colored or pink (sometimes pale yellow in one variety of No. 1); fruit subglobose to ellipsoidal or oval, usually more or less flattened at the ends, punctate, up to 3 cm. in diameter; flesh dry and mealy; nutlets 2–5, prominently ridged on the back.

Stamens usually 20.

Anthers rose color or yellow; leaves, corymbs and calyx more or less densly villose....................1. *C. punctata.*

Anthers pink; calyx glabrous.

Leaves oblong-obovate; pedicels glabrous..............2. *C. calvescens.*

Leaves broad-obovate to orbicular-obovate or elliptical; pedicels slightly villose....................3. *C. recedens.*

Stamens 8–14; anthers pink; leaves oblong-obovate, only slightly lobed.

Flowers on stout slightly villose pedicels, in 7- or 8-flowered corymbs; anthers pale pink; fruit subglobose to short-oblong. 4. *C. porrecta.*

Flowers on slender glabrous pedicels, in 14–20-flowered corymbs; anthers light rose pink; fruit ellipsoidal to oval...5. *C. præstans.*

1. **Cratægus punctata** Jacquin.

Hort. Vind., I, 10, t. 28 (1770); Sargent, Silva N. Am., IV, 103, t. 184; Man., 389, f. 308; Proc. Acad. Nat. Sci. Phila., 1905, 583; Gruber, Bull. Torrey Bot. Club, XXXII, 389.

Cratægus punctata mutabilis Gruber, Bull. Torrey Bot. Club, XXXII, 390 (1905).

Cratægus Moselemensis Gruber, Bull. Torrey Bot. Club, XXXII, 391 (1905).

Cratægus Moselemensis corrugata Gruber, Bull. Torrey Bot. Club, XXII, 391 (1905).

Cratægus Triosteum Gruber, Bull. Torrey Bot. Club, XXXII, 392 (1905).

Orbisonia, Huntingdon County, B. H. Smith (No. 307), May 19, 1906; Valley of the Conemaugh between Portage and Wilmore, Cambria County, B. H. Smith, (No. 272, with small green fruit) May 21, 1905, B. H. Smith and C. S. Sargent, September 26, 1905; valley of the Little Juniata River below Altoona, Blair County, B. H. Smith, (Nos. 259 and 261) May 20, 1905; near Carnot, back of Stoops' Ferry, Allegheny County, O. E. Jennings and B. H. Smith, (No. 89) October 6, 1907; near Linesville, Crawford Vounty, O. E. Jennings, (Nos. 80 and 81) June 12 and October 9, 1907, (No. 90) October 9, 1907, May 28, 1908; Lincoln Heights, Scranton, Lackawanna County, A. Twining, (Nos. 7 and 8) June 8, 1907; Campbell's Ledge, Luzerne County, A. Twining, May 30, 1907.

Cratægus punctata is one of the most generally and widely distributed species of northeastern North America. It varies greatly in the size of the leaves, the amount of pubescence on the leaves, corymbs and young branches, and in the size and color of the fruit, which varies from dark red to light yellow and green. The most distinct of these varieties has yellow anthers and yellow fruit often with a reddish cheek. This has sometimes been considered a species, but individuals occur on which flowers with rose-colored and with yellow anthers, and with red and yellow fruits, may occasionally be found. The yellow fruited form is

Cratægus punctata var. **aurea** Aiton, Hort. Kew., II, 170 (1789).

> *Cratægus crocata* Ashe, Ann. Carnegie Mus. I, pt. 3, 389 (1902); Gruber, Berks County Nat. Sci. Club, II, 21 (Cratægus in Berks County); Bull. Torrey Bot. Club, XXXII, 390.
> *Cratægus cydonia* Gruber, Bull. Torrey Bot. Club, XXXII, 390 (1905).

O'Hara Township, Allegheny County, J. A. Shafer, (No. 25) May 20 and October 10, 1902; W. Scott Farm, Moon Township west of Carnot, Allegheny County, J. A. Shafer, June 3 and October 26, 1902; Wildwood Park, Allegheny County, O. E. Jennings, (No. 92) October 14, 1907; not rare in the eastern part of the State, and most abundant in the region adjacent to Lakes Ontario and Erie.

A form densely hoary-tomentose on the under surface of the leaves and on the corymbs is

Cratægus punctata var. **canescens** Britton.

> Bull. Torrey Bot. Club, XX, 231 (1894); Sargent, Man., 389; Proc. Acad. Nat. Sci. Phila., 1905, 583.

In Pennsylvania this form has been noticed only in Durham, Bucks County, and near Stroudsburg, in Monroe County.

A form with remarkably small leaves, flowers and fruits may be called

Cratægus punctata var. **microphylla** n. var.

Leaves obovate, acute, prominently veined, 2–2.5 cm. long and 1–1.2 cm. wide. *Flowers* in compact few-flowered corymbs, 1–1.4, mostly 1.2 cm. in diameter; stamens 18–20; anthers rose color. *Fruit* on short pedicels, depressed-globose, dark red, 8–10 mm. long and 10–12 mm. wide.

In a moist pasture, Linesville, Crawford County, O. E. Jennings, (No. 83 type) June 12 and October 9, 1907.

2. **Cratægus calvescens** n. sp.

Glabrous with the exception of the hairs on the upper side of the young leaves and petioles and on the calyx-lobes. *Leaves* oblong-obovate, acute, broad and rounded or acuminate and usually abruptly short-pointed at the apex, gradually narrowed to the concave-cuneate entire base, and coarsely often doubly serrate above the middle, with straight glandular teeth; half-grown when the flowers open early in June and then thin, yellow-green, smooth, lustrous and slightly hairy on the midribs above and paler below, and at maturity thin but firm in texture, glabrous, dark yellow-green on the upper surface, paler on the lower surface, 4–6 cm. long and 2.5–3 cm. wide, with thin prominent midribs, and slender conspicuous veins extending very obliquely toward the apex of the leaf; petioles stout, narrowly wing-margined to below the middle, sparingly villose on the upper side while young, soon becoming glabrous, 1–1.5 cm. in length; leaves on vigorous shoots abruptly pointed and acuminate at the apex, more coarsely serrate, usually slightly and irregularly lobed and often 6–7 cm. long and 4.5–5 cm. wide. *Flowers* 2–2.2 cm. in diameter, on long stout pedicels, in broad lax mostly 10–18-, usually 12–15-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, irregularly glandular-serrate near the middle, glabrous on the outer surface, slightly villose on the inner surface, reflexed after anthesis; stamens 12–20, usually 20; anthers pink; styles 2–4, usually 3. *Fruit* ripening early in October, on long drooping pedicels, in lax 2–7-flowered corymbs, subglobose, truncate at the apex, rounded at the base, dark red, marked by large dark dots, more or less pruinose, becoming lustrous, 1.5 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading and appressed usually persistent lobes; flesh yellow-green, hard and bitter; nutlets usually 3, slightly narrowed and rounded at the ends, usually ridged on the back, with a high narrow ridge, 8–9 mm. long and 5–5.5 mm. wide.

A tree 6–7 m. high, with a tall trunk covered with gray scaly bark, and often 2.5 dm. in diameter, large wide-spreading branches forming a round-topped symmetrical head, and stout nearly straight branchlets, pale orange-green when they first appear, becoming light orange-brown and lustrous in their first season and dark gray-brown the following year, and armed with numerous stout nearly straight purple ultimately dark brown spines 3.5–5 cm. long.

Stony ridges and slopes; common; Riverview Park, Allegheny, Allegheny County, O. E. Jennings and Grace E. Kinzer, (No. 29 type) October 2, 1905, May 24, 1906, O. E. Jennings, June 8 and October 14, 1907, (No. 66) O. E. Jennings, October 8, 1906, June 2, 1907, (No. 26) O. E. Jennings, October 14, 1907, (No. 27) O. E. Jennings, October 14, 1907; Nine-mile Run, near Pittsburg, Allegheny County, O. E. Jennings, (No. 39) October 9, 1905 (No. 44) October 10, 1909, O. E. Jennings and B. H. Smith, (No. 88) October 5, 1907; Idlepark. Westmoreland County, (No. 86) O. E. Jennings, September 21, 1907; rich hillsides, Bedford, Bedford County, B. H. Smith and C. S. Sargent, (No. 301) September 30, 1905, B. H. Smith, May 18, 1906.

The leaves of the Bedford County plant are usually acuminate, or they are acute and do not show on the specimens collected by Mr. Smith any tendency to become broad and rounded at the apex—a form which is not uncommon on trees in the neighborhood of Pittsburg. The young leaves of the Bedford County plants are slightly more hairy along the upper side of the midribs, and the spines are rather lighter colored. Otherwise they appear identical with the type of the species.

3. **Cratægus recedens** n. sp.

Leaves broad obovate to orbicular-obovate or rarely elliptical, acute or acuminate and often abruptly pointed at the apex, gradually narrowed to the cuneate or rarely rounded entire often unsymmetrical base, sharply doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 4 or 5 pairs of slender acuminate spreading lobes; more than half grown when the flowers open about the 20th of May and then thin, yellow-green, roughened above by numerous white hairs and sparingly villose on the midribs and veins below, and at maturity thin, dull deep yellow-green, smooth and glabrous or occasionally scabrate above and pale and still slightly villose below on the thin prominent midribs and 6 or 7 pairs of thin primary veins extending obliquely toward the apex of the leaf, 4.5–5.5 cm. long and 3.5–4.5 cm. wide; petioles slender, wing-margined at the apex, villose early in the season, becoming nearly glabrous, 1.5–3 cm. in length; leaves on vigorous shoots more coarsely serrate and more deeply lobed and often 7–8 cm. long and broad. *Flowers* 1.8–2.2 cm. in diameter, on long stout slightly hairy pedicels, in broad 5–15-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, glabrous, the lobes gradually narrowed from wide bases, long, acuminate, minutely glandular-serrate below the middle or entire, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 18–20; anthers pink; styles 3–5. *Fruit* ripening early in October, on slender glabrous or slightly hairy erect or spreading pedicels, in few-fruited clusters, nearly globose, sometimes slightly tapering toward the base, dark red more or less blotched with green or russet green, hardly punctate, glabrous or rarely puberulous, 1.1–1.5 cm. in diameter; calyx prominent, with a long tube, a wide deep cup-shaped cavity, and elongated reflexed persistent lobes hairy on the upper surface;

flesh yellowish green, firm and bitter; nutlets 3–5, rounded at the broad base, narrow and, when 5, acute at the apex, rounded and ridged on the back, with a broad grooved ridge, 7–7.5 mm. long and 4–4.5 mm. wide.

A tree 6–7 m. high, with a short trunk sometimes 1.6 dm. in diameter and covered with gray scaly bark, long slender horizontal or drooping branches, stout nearly straight branchlets dark orange-green, slightly pubescent and marked by small pale lenticels when they first appear, becoming light orange-brown in their first season and dull reddish brown and glabrous the following year, and armed with numerous slender nearly straight chestnut brown shining spines 3–5 cm. long, persistent and becoming compound and sometimes 10 cm. in length on old stems and branches.

Borders of woods at Indian Dale, near Kutztown, Berks County, C. L. Gruber, (No. 227 type) August 4 and October 2, 1905, May 19 and 22, 1906.

Very distinct from *C. punctata* Jacquin in the shape of the thin nearly glabrous leaves with much more slender veins, in the glabrous calyx-tube and only slightly hairy corymbs, and in its smaller globose hardly punctate fruit which is rounded and not truncate at the ends.

4. **Cratægus porrecta** Ashe.

Ann. Carnegie Mus., I, pt. III, 391 (1903).

Leaves oblong-obovate, acute or acuminate and often abruptly pointed at the apex, gradually narrowed to the long concave-cuneate entire base, coarsely doubly serrate usually only above the middle, with large straight glandular teeth, and often slightly divided toward the apex into 4 or 5 pairs of narrow acuminate lobes; nearly fully grown when the flowers open early in May and then dark yellow-green, smooth, lustrous and glabrous with the exception of a few hairs on the midribs above, and paler and sparingly villose on the midribs below, and at maturity thin but firm in texture, dark yellow-green on the upper surface, paler on the lower surface, 6–8 cm. long and 3.5–4 cm. wide, with thick midribs and thin prominent primary veins; petioles stout, narrowly wing-margined nearly to the base, slightly hairy on the upper side while young, soon becoming glabrous, occasionally glandular, 1–1.5 cm. in length. *Flowers* 1.5–1.7 cm. in diameter, on long stout slightly villose pedicels, in small compact mostly 7- or 8-flowered corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, slightly villose, the lobes long, slender, acuminate, entire or occasionally minutely dentate near the middle, glabrous, reflexed after anthesis; stamens 8–14; anthers pale pink; styles 2 or 3. *Fruit* on long drooping pedicels, in few-fruited clusters, subglobose to short-oblong, flattened at the ends, russet-green to dark purplish red, pruinose, becoming lustrous, 1.1–1.4 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading often deciduous lobes; flesh thin, light yellow-green, hard and bitter; nutlets 2 or 3, obtuse at the ends, irregularly grooved, often pentagonal, 9–10 mm. long and 5–6 mm. wide.

A tree sometimes 5 m. high, with a trunk 2–2.5 dm. in diameter and covered with dark gray bark separating in large flakes, large wide-spreading horizontal branches forming a flat-topped head, and stout nearly straight glabrous branchlets, light orange-green more or less tinged with red when they first appear, becoming dark chestnut-brown and lustrous in their first season and darker-colored the following year, and armed with numerous slender straight chestnut brown spines 3.5–5 cm. long, persistent, abundant and often 1.5 dm. long on old stems.

Ravines, Schenley Park, Allegheny County, J. A. Shafer, (No. 7 type) May and October, 1902, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 7) September 28, 1905, O. E. Jennings, October 18, 1907, June 10, 1908; common on dry hills in the neighborhood of Pittsburg.

5. **Cratægus præstans** n sp.

Glabrous. *Leaves* slightly obovate, acute and sometimes pointed at the apex, gradually narrowed to the long slender entire base and finely often doubly serrate above the middle, with straight glandular teeth; more than half grown when the flowers open at the end of May and then thin, dark yellow-green and lustrous above and paler below, and at maturity thin, dark green, 5–6 cm. long and 2–2.5 cm. wide, with thin midribs and primary veins; petioles slender, narrowly wing-margined to below the middle, 2–2.5 cm. in length; leaves on vigorous shoots coarsely serrate, occasionally slightly lobed above the middle, often 7–8 cm. long and 3.5–4 cm. wide. *Flowers* 1.2–1.8 cm. in diameter, on long slender pedicels, in wide lax 12–20-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire, reflexed after anthesis; stamens 11–14; anthers light rose pink; styles 2 or 3. *Fruit* ripening late in September, on long slender pedicels, in drooping few-fruited clusters, short-oblong to oval, obtuse at the apex, the rounded base often decurrent on the petiole, dark red, slightly pruinose, marked by minute dark dots; calyx little enlarged, with a short tube, a narrow deep cavity pointed in the bottom, and reflexed closely appressed lobes; flesh thin, yellow-green, hard, juicy, bitter and acidulous; nutlets, usually 2, acute at the apex, obtuse and rounded at the base, ridged on the back, with a broad slightly grooved ridge, 10–11 mm. long and 5–6 mm. wide.

A tree 4–5 m. high, with a short trunk 1–1.5 dm. in diameter covered with dark scaly bark, small spreading branches forming an open irregular head, and stout only slightly zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut brown to bronze green and lustrous in their first season, and dark gray-brown the following year, and armed with stout straight or slightly curved chestnut brown spines 3.5–4 cm. long.

Nine Mile Run, near Pittsburg, Allegheny County, O. E. Jennings, (No. 78 type) May 27, 1907, O. E. and Grace K. Jennings, September 13, 1909.

3. Pruinosæ.

Leaves thick, generally broad at the base; petioles long, usually slender; flowers large, in glabrous or hairy corymbs; stamens 5–20; anthers rose color or white. Fruit short-oblong, ovate or obovate, often broader than high, frequently conspicuously angled, green or red, generally pruinose, ripening late; flesh dry and hard, the mature calyx prominent, raised on a short tube; nutlets 3–5.

- Anthers rose color or pink.
  - Stamens 20.
    - Leaves smooth on the upper surface.
      - Leaves blue-green.
        - Fruit not mammillate.
          - Leaves rounded or abruptly cuneate at the base.
            - Leaves ovate to oblong-ovate; fruit depressed-ovate, conspicuously 5-angled; flesh tinged with red. 1. *C. angulata.*
            - Leaves oblong-ovate; fruit obovate, not conspicuously angled....2. *C. viatica.*
          - Leaves concave-cuneate at the base; fruit subglobose to short-oblong, 5-angled....3. *C. wilmorensis.*
        - Fruit mamillate below the middle, conspicuously 5-angled. 4. *C. arcana.*
      - Leaves yellow-green.
        - Flowers in 8–12-flowered corymbs; fruit oval to pyriform-oval....5. *C. crawfordiana.*
        - Flowers in 4–7-flowered corymbs.
          - Anthers pink; fruit obovate, deep orange-red. 6. *C. gaudens.*
          - Anthers dark rose color; fruit short-oblong, green. 7. *C. bellatula.*
    - Leaves scabrate on the upper surface.

Leaves yellow-green, oblong-ovate; fruit depressed-globose, not pentagonal..8. *C. amplifica.*
Leaves blue-green, ovate; fruit subglobose to ovoid-globose, pentagonal..9. *C. denudata.*
Stamens 15–20.
Leaves smooth.
Fruit obovate.
Flowers not more than 1.8 cm. in diameter; fruit on long drooping pedicels....................................10. *C. leiophylla.*
Flowers more than 2 cm. in diameter; fruit on erect or spreading pedicels..............................11. *C. dunmorensis.*
Fruit subglobose to slightly obovate, on slender drooping pedicels..12. *C. adrena.*
Leaves scabrate on the upper surface; fruit short-oblong, on erect or spreading pedicels....................................13. *C. torta.*
Stamens 10 or less.
Mature leaves glabrous.
Fruit subglobose.
Leaves blue-green.
Leaves oblong-ovate; rounded or rarely abruptly cuneate at the base; fruit on short stout pedicels, green flushed with dark red, not pruinose.........14. *C. relicta.*
Leaves ovate, concave-cuneate or rarely rounded at the base; fruit on long slender pedicels, purple-red, pruinose..15. *C. erubescens.*
Leaves yellow-green, oblong-ovate, very deeply lobed.
16. *C. divisifolia.*
Mature leaves more or less scabrate above, broadly ovate, thin, yellow-green; fruit green, becoming red..........17. *C. edurescens.*
Anthers pale yellow or white; stamens 20.
Mature leaves glabrous.
Leaves broad at the base.
Leaves rounded or truncate at the base.
Leaves thin; flowers less than 2 cm. in diameter; branchlets only slightly zigzag; spines few, short and stout.
18. *C. latifrons.*
Leaves thick; flowers 2 cm. or more in diameter; branchlets very zigzag; spines numerous, long and slender.
19. *C. tribulosa.*
Leaves abruptly cuneate or rounded at the base.
Fruit subglobose.
Leaves ovate to oval, blue-green; fruit not more than 1 cm. in diameter, on slender drooping pedicels.
20. *C. incompta.*
Leaves broadly ovate, yellow-green; fruit up to 1.3 cm. in diameter, on short stout erect pedicels.
21. *C. Shaferi.*
Fruit short-oblong to slightly obovate; leaves only 3–4 cm. long; branchlets very slender, contorted.
22. *C. bedfordensis.*

Fruit obovate; leaves more than 5 cm. long, branchlets stouter, not contorted..........................23. *C. conjuncta.*
Leaves narrowed at the base; fruit subglobose to slightly obovate..24. *C. duracina.*
Mature leaves scabrate; fruit obovate..........................25. *C. lecta.*

1. **Cratægus angulata** n. sp.

Glabrous with the exception of a few hairs on the upper surface of the young leaves. *Leaves* ovate to oblong-ovate, acuminate, rounded or abruptly cuneate at the base, finally often doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate lateral lobes; more than half grown when the flowers open at the end of May and then thin, light yellow-green, slightly hairy above especially along the midribs and veins and rather paler below, and at maturity thin, dark blue-green, smooth and lustrous on the upper surface, pale bluish green on the lower surface, 4.5–6 cm. long and 3.5–4 cm. wide, with thin midribs and primary veins; petioles slender, occasionally glandular, with small mostly deciduous glands, 2–2.5 cm. in length; leaves on vigorous shoots thicker, usually rounded or truncate at the broad base, more coarsely serrate, deeply lobed and often 6–7 cm. long and wide. *Flowers* 2.6 cm. in diameter, on long slender pedicels, in compact mostly 5–8-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, slender, acuminate, finely glandular-serrate near the middle or almost entire, reflexed after anthesis; stamens 18–20; anthers rose color; styles 4 or 5. *Fruit* ripening at the end of October, on slender pedicels, in pendant usually 3–5-fruited clusters, depressed-ovate, conspicuously pentagonal, flattened at the apex, obtusely tapering at the base, light greenish yellow, finally dark purplish red at least on one cheek, marked by large dark dots, pruinose, becoming lustrous, 1–1.2 cm. long and 1.5–1.6 cm. wide; calyx little enlarged, with a very short tube, a wide shallow cavity, and small spreading lobes; flesh firm, dry and mealy, yellow slightly tinged with red, acidulous; nutlets 4 or 5, acute at the ends, rounded and slightly ridged or generally grooved on the back, 7–8 mm. long and 4.5–5 mm. wide.

A shrub 4–5 m. high, with stems sometimes 1 dm. in diameter, covered with dark gray scaly bark, and slender only slightly zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut brown and lustrous in their first season and darker-colored the following year, and armed with stout straight or slightly curved purplish shining spines 2.5–3 cm. long and persistent and becoming compound on old stems and branches.

Nine Mile Run, near Pittsburg, Allegheny County, O. E. Jennings and Grace E. Kinzer, (No. 43 type) October 10, 1905, May 25, 1906, May 28 and October 30, 1907, O. E. Jennings and B. H. Smith, October 5, 1907; Panther Hollow, Schenley Park, Pittsburg, Allegheny County, O. E. and Grace K. Jennings, (No. 69) May 17, 1907, O. E. Jennings and B. H. Smith, October 5, 1907, O. E. Jennings, (No. 71) May 19, 1909; Nine Mile Run, Pittsburg, O. E. Jennings, (No. 41, with a rather more shallow calyx cavity of the fruit) October 7, 1905, May 25, 1906, May 28 and October 5, 1907; Kittanning, Armstrong County, O. E. Jennings, (No. 47) October 14, 1905, May 28, 1906, May 26 and October 7, 1907.

2. **Cratægus viatica** Ashe.

Ann. Carnegie Mus., I, pt. 3, 398 (1902).

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* oblong-ovate, acuminate, rounded or cuneate at the base, coarsely often doubly serrate, with straight glandular teeth, and sometimes divided into short broad lateral lobes; about one-third grown when the flowers open at the end of May and then very thin, light yellow-green and slightly hairy along the midribs above and pale below, and at maturity thin but firm in texture, dark bluish green, smooth and lustrous on the upper surface, paler on the lower surface, 5–5.5 cm. long and 3.5–4 cm. wide, with prominent midribs and thin primary veins; petioles slender, occasionally glandular, with deciduous glands, 2.5–3 cm. in length; leaves on vigorous shoots thicker, rounded or truncate at the broad base, more coarsely serrate, more deeply lobed, and often 6–7 cm. long and broad, with stout midribs, prominent primary veins and stout winged glandular petioles. *Flowers* 2.5–3 cm. in diameter, on long slender pedicels, in compact usually 5–9-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, slender, acuminate, entire or occasionally dentate near the middle, reflexed after anthesis; stamens 18–20; anthers light rose-pink; styles 4 or 5, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening in October, on stout spreading or drooping pedicels, in few-fruited clusters short-pyriform, rounded at the apex, truncate at the base, yellowish green, punctate, pruinose, becoming lustrous, 1.1–1.2 cm. long, 9–10 mm. in diameter; calyx prominent, with a short tube, a broad deep cavity pointed in the bottom, and spreading and reflexed persistent lobes; flesh yellow-green, acid, dry and mealy; nutlets 4 or 5, usually

5, rounded at the apex, sometimes narrowed at the base, slightly ridged on the back, about 5 mm. long and 3–3.5 mm. wide.

A tree 3–4 m. high, with a trunk 1.7–2 dm. in diameter, covered with dark scaly bark, long yellowish green smooth branches wide-spreading below, ascending near the top of the tree, and forming a round-topped head, and stout only slightly zigzag branchlets, dark orange-green when they first appear, becoming dull orange-brown and marked by dull lenticels in their first season and dark red-brown the following year, and armed with numerous stout curved and reflexed purple shining spines 4.5–5 cm. long and occasionally persistent and branched on old stems.

Forbes and Woodlawn Streets, Pittsburg, Allegheny County, O. E. Jennings, (No. 96 type tree = J. A. Shafer, No. 5) June 10 and October 3, 1908, May 9, 1909; Schenley Park, Pittsburg, Allegheny County, O. E. Jennings, (No. 55) May 29, 1907, O. E. Jennings and B. H. Smith, October 5, 1907.

3. **Cratægus wilmorensis** n. sp.

Glabrous with the exception of a few hairs on the young leaves and petioles. *Leaves* ovate to oval, acuminate, concave-cuneate at the often unsymmetrical entire base, sharply often doubly serrate above, with straight glandular teeth, and usually slightly divided into 3 or 4 pairs of small acuminate spreading lobes; nearly fully grown when the flowers open at the end of May and then very thin, light yellow-green, lustrous and slightly hairy on the midribs above and pale and glabrous below, and at maturity thin, dark bluish green on the upper surface, light bluish green on the lower surface, 4–5 cm. long and 3–4 cm. wide, with thin midribs and primary veins; petioles slender, sparingly hairy on the upper side while young, soon glabrous, 1.5–2.5 cm. in length. *Flowers* on slender pedicels, in compact mostly 7–9-flowered corymbs, with linear-obovate to linear finely glandular-serrate bracts and bractlets often persistent until the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire or minutely glandular-dentate, reflexed after anthesis; stamens 20; anthers rose-color (in the bud); styles 5. *Fruit* ripening early in October, on short stout spreading pedicels, in few-fruited clusters, subglobose to short-oblong, full and rounded at the ends, green becoming reddish at maturity, about 1.2 cm. in diameter; calyx little enlarged, with a short tube, and reflexed and appressed persistent lobes dark red on the upper side; flesh thin, green and hard; nutlets 5, gradually narrowed and acute or rounded at the ends, often rather broader at the base than at the apex, ridged on the back, with a broad high deeply grooved ridge, 7–7.5 mm. long and 4–4.5 mm. wide.

A shrub sometimes 4 m. high, with stems 1.5 dm. in diameter, spreading into large thickets, and slender nearly straight branchlets, dark orange-green more or less tinged with red when they first appear, dark chestnut brown, lustrous and marked by dark lenticels in their first season and darker-colored the following year, and armed with slender straight or slightly curved purple shining spines 2–4 cm. long.

Low ground, valley of the Conemaugh River between Portage and Wilmore, Cambria County, B. H. Smith, (275 type) May 21, 1905, B. H. Smith and C. S. Sargent, September 27, 1905.

4. **Cratægus arcana** Beadle.

Bilt. Bot. Studies, I, 122 (1902); Small, Fl. S. E. States, 564; Sargent, Bot. Gazette, XXXV, 101 (The Genus Cratægus in Newcastle County, Delaware); Proc. Acad. Nat. Sci. Phila., 1905, 588; Bull. CXXII, N. Y. State Mus., 37.

Dry hillsides, valley of the Little Juniata River below Altoona, Blair County, B. H. Smith, (No. 282) May 22, 1905, B. H. Smith and C. S. Sargent, September 27, 1905, B. H. Smith, May 17, 1906; also western New York to eastern Pennsylvania, Delaware and western North Carolina.

5. **Cratægus crawfordiana** n. sp.

Glabrous. *Leaves* ovate, acuminate, abruptly cuneate or rounded at the base, finely often doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small spreading acuminate lateral lobes; nearly fully grown when the flowers open in the first week of June and then very thin, dark yellow-green above and pale below, and at maturity thin, yellow-green, smooth and lustrous on the upper surface, pale on the lower surface, 4.5–5 cm. long and 3.5–4 cm. wide, with thin prominent midribs and veins; petioles slender, glandular, with minute often persistent glands, 2–2.5 cm. in length. *Flowers* 1.3–1.9 cm. in diameter, on long slender pedicels, in wide lax mostly 8–12-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short, slender, finely glannular-serrate toward the acuminate apex, reflexed after anthesis; stamens usually 20; anthers pink; styles 3 or 4. *Fruit* ripening early in October, on stout pedicels, in few-fruited drooping clusters, oval to pyriform-oval, rounded at the apex, gradually rounded at the base, dark orange-red blotched with yellow-green, marked by large pale dots, somewhat pruinose, 1.2–1.3 cm. long and 1–1.2 cm. in diameter; calyx prominent, with a distinct tube, a deep narrow cavity pointed and tomentose in the bottom, and small reflexed often deciduous lobes; flesh thin, very light yellow; nutlets 3 or 4, acute at the ends, ridged on the back, with a low narrow ridge, 7–7.5 mm. long and 4.5–5 mm. wide.

A shrub 4–5 m. high, with stems sometimes 1 dm. in diameter and covered with pale gray bark broken into small closely appressed scales, and slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming bright chestnut brown and lustrous in their first season and dark red-brown the following year, and armed with numerous slender nearly straight chestnut brown ultimately dark gray spines 3–4 cm. long and persistent and branched on old stems.

Linesville, Crawford County, O. E. Jennings, (No. 84 type) June 12 and October 9, 1907.

Well distinguished from the other species in this group by its narrow oval or pyriform-oval fruits.

6. **Cratægus gaudens** n. sp.

Glabrous with the exception of the hairs on the young leaves and petioles. *Leaves* ovate to oval, acuminate, acutely or obtusely concave-cuneate at the base, finely doubly serrate, with straight glandular teeth, and divided into 3 or 4 pairs of short broad acute lateral lobes; not more than one-third grown when the flowers open late in May and then thin, dark yellow-green and slightly hairy along the midribs above and paler and sparingly villose on the midribs below, and at maturity thin, dark green and lustrous on the upper surface, pale on the lower surface, 5–6 cm. long and 3.5–4 cm. wide, with thin prominent midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly hairy on the upper side while young, soon glabrous, glandular, with minute usually persistent glands, 2.5–3 cm. in length. *Flowers* 2 cm. in diameter, on long slender pedicels, in narrow mostly 6- or 7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, broad, acuminate, entire, or minutely glandular-dentate above the middle, reflexed after anthesis; stamens 18–20; anthers pink; styles 3–5. *Fruit* ripening the middle of October, on long slender pedicels, in few-fruited clusters, pyriform, truncate or rounded at the apex, gradually narrowed to the long slender base often extending down one side of the pedicel, 5-angled, deep orange-red, marked by large pale dots, pruinose, 1.3–1.6 cm. long and 1.1–1.4 cm. in diameter; calyx little enlarged, with a short tube, a wide deep cavity pointed and tomentose in the bottom, and small spreading and reflexed lobes; flesh thick, succulent, light yellow tinged with pink, acid; nutlets 3–5, usually 4, narrowed and rounded at the apex, acute at the base, irregularly ridged on the back, with a high narrow grooved ridge, 7–7.5 mm. long, and 4–4.5 mm. wide.

A shrub 4–5 m. high, with stems covered with dark gray bark separating into small closely appressed scales, and stout nearly straight branchlets light orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dark red-brown the following year, and armed with numerous slender straight or slightly curved dark chestnut-brown shining spines 3.5–4.5 cm. long.

Riverview Park, Allegheny County, O. E. Jennings and Grace E. Kinzer, (No. 28 type) October 2, 1905, O. E. Jennings, May 27, 1906, October 12, 1907.

7. **Cratægus bellatula** n. sp.

Glabrous with the exception of occasional hairs on the upper surface of the midribs of young leaves. *Leaves* ovate, acuminate, abruptly cuneate or rounded at the entire base, finely often doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 4 or 5 pairs of small acuminate lobes; more than half-grown when the flowers open about the 20th of May and then very thin, yellow-green above and bluish below, and at maturity thin, smooth and yellow-green on the upper surface, paler on the lower surface, 3.5–4.5 cm. long and 2.5–3 cm. wide, with slender midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with occasional minute persistent glands, 1.5–2.5 cm. in length; leaves on vigorous shoots ovate, rounded, truncate or occasionally cordate at the broad base, coarsely serrate, deeply lobed and often 6–7 cm. long and 5–5.6 cm. wide, with stout broad-winged conspicuously glandular petioles. *Flowers* 2 cm. in diameter, on long slender pedicels, in 4–6-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes wide, acuminate, slightly and irregularly glandular-serrate below the middle, reflexed after anthesis; stamens 20; anthers rose color; styles 4 or 5. *Fruit* ripening in October, on elongated slender pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, green (on September 6th), about 1 cm. in diameter; calyx prominent, with a short tube, a deep narrow cavity, and spreading persistent lobes; flesh thin, green, dry and mealy; nutlets 5, rounded at the ends, ridged on the back, with a low broad grooved ridge, 5–5.6 mm. long and 4.5–5 mm. wide.

A broad round-topped shrub 5–6 m. high, with numerous stout stems covered with dark gray scaly bark, spreading branches, and slender only slightly zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming orange-brown and lustrous in their first season and duller gray-brown the following year, and armed with numerous straight or slightly curved purple shining spines 1.5–2 cm. long.

Rich hillsides, Bedford, Bedford County, B. H. Smith, (No. 18 type) May 20, 1909, B. H. Smith and C. S. Sargent, September 6, 1909.

8. **Cratægus amplifica** n. sp.

Leaves oblong-ovate, acuminate, cuneate or rounded at the base, coarsely often doubly serrate, with straight glandular teeth, and deeply divided into 3 or 4 pairs of acuminate spreading lobes; nearly half-grown when the flowers open about the 20th of May and then very thin, dark yellow-green and roughened above by short white hairs and pale and slightly villose in the axils of the veins below, and at maturity thin, dark yellow-green and scabrate on the upper surface, pale bluish green and almost glabrous on the lower surface, 5–6 cm. long and 4–4.5 cm. wide, with thin midribs and primary veins; petioles slender, glandular, with minute stipitate often persistent glands, hairy while young, becoming glabrous, 2.5–3.5 cm. in length; leaves on vigorous shoots thicker and often 7–8 cm. long and broad. *Flowers* 1.6–1.8 cm. in diameter, on long slender glabrous pedicels, in small compact mostly 5–7-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, coarsely glandular-serrate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 18–20; anthers pink; styles 3–5, surrounded at the base by a broad ring of pale tomentum. *Fruit* ripening late in October and persistent after the fall of the leaves, on erect pedicels, in 2–6-fruited clusters, depressed-globose, flattened at the apex, full and rounded at the base, pentagonal, light greenish yellow to dark russet, marked by numerous dark dots, pruinose, becoming lustrous, 1–1.3 cm. in diameter; calyx prominent, with a short tube, a deep narrow cavity pointed in the bottom, and small spreading often deciduous lobes; flesh thin, hard, light yellowish green; nutlets 3–5, gradually narrowed and rounded at the ends, often broader at the apex than at the base, ridged on the back, with a high narrow ridge, 6–6.5 mm. long and 4–4.5 mm. wide.

A shrub 3–4 m. high, with stems sometimes 5 dm. in diameter, covered with dark gray bark separating into long strips, and very slender zigzag glabrous branchlets dark orange-green when they first appear, becoming light chestnut brown, lustrous, and marked by dark lenticels in their first season and darker colored the following year, and armed with very numerous slender straight purple spines 3–4 cm. long.

Fern Hollow, Pittsburg, Allegheny County, O. E. Jennings, (No. 38 type) October 9, 1905, May 18, 1906.

9. **Cratægus denudata** n. sp.

Glabrous with the exception of the hairs on the young leaves. *Leaves* ovate, acute or acuminate, rounded or abruptly cuneate at the base, sharply often doubly serrate, with straight glandular teeth, and divided usually only above the middle into 4 or 5 pairs of small acuminate lobes; less than half-grown when the flowers open about the 20th of May and then thin, dark yellow-green and furnished above along the midribs and veins with occasional white hairs, and at maturity thin, dark blue-green and scabrate on the upper surface, pale bluish green on the lower surface, 3.5–4.5 cm. long and 3–3.5 cm. wide, with thin midribs and primary veins; petioles slender, wing-margined at the apex, glandular, with minute often persistent glands, 1.5–2.5 cm. in length; leaves on vigorous shoots ovate, more coarsely serrate, more deeply lobed and often 6–7 cm. long and broad. *Flowers* 1–1.3 cm. in diameter, on short slender pedicels, in small compact mostly 5- or 6-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, short, slender, acuminate, entire or occasionally minutely glandular-dentate near the middle, reflexed after anthesis; stamens 18–20; anthers dark rose color; styles 3–5, surrounded at the base by a broad ring of pale hairs. *Fruit* ripening and falling early in October, subglobose to ovoid-globose, full and rounded at the apex, flattened at the base, pentagonal, russet green to dark purplish red, pruinose, becoming lustrous, 1–1.3 cm. in diameter; calyx prominent, with a short tube, a broad deep cavity tomentose in the bottom, and spreading lobes; flesh light yellow-green, thin, juicy, acid; nutlets usually 4, narrowed at the ends, rounded and slightly grooved on the back, 6–6.5 mm. long and about 4 mm. wide.

A shrub 3–4 m. high, with stems 1.5–1.8 cm. in diameter, covered with dark scaly bark, ascending and spreading branches, and slender nearly straight dark chestnut brown lustrous branchlets armed with very slender straight purple shining spines 2.5–3 cm. long and persistent and much-branched on old stems.

Ravines, Schenley Park, Pittsburg, Allegheny County, O. E. and

Grace K. Jennings, (No. 3 type) May 23 and October 18, 1907, O. E. Jennings, October 3, 1908, May 24 and September 13, 1909.

10. **Cratægus leiophylla** Sargent.

Proc. Rochester Acad. Sci., IV, 99 (1903); Bull. CXXII, N. Y. State Mus., 41.

Valley of the Little Juniata River below Altoona, Blair County, B. H. Smith, (No. 269) May 20 and September 25, 1905; also in western New York.

11. **Cratægus dunmorensis** n. sp.

Glabrous with the exception of the hairs on the young leaves and on the calyx-lobes. *Leaves* broadly ovate, acuminate, rounded, truncate or abruptly cuneate at the base, sharply often doubly serrate, with straight glandular teeth, and deeply divided into 3 or 4 pairs of wide acuminate lateral lobes; nearly half-grown when the flowers open in the last week of May and then light yellow-green and roughened above by short white hairs and pale and glabrous below, and at maturity thin, bluish green, smooth and lustrous on the upper surface, paler on the lower surface, 3–4.5 cm. long and 3–4 cm. wide, with slender midribs and primary veins; petioles slender, glandular, with minute often persistent glands, 1.2–1.5 cm. in length; leaves on vigorous shoots truncate or rounded at the base, more coarsely serrate and more deeply lobed and often 6–7 cm. long and broad. *Flowers* 2.2 cm. in diameter, on short slender pedicels, in compact mostly 5-flowered corymbs, with linear-obovate to linear glandular green bracts and bractlets often persistent until the flowers open; calyx-tube broadly obconic, the lobes separated by wide sinuses, short, narrow, acuminate, entire or minutely glandular-serrate near the middle, glabrous on the outer, very sparingly hairy on the inner surface, reflexed after anthesis; stamens 15–20; anthers pale pink or nearly white; styles 3–5. *Fruit* ripening in October, on slender drooping pedicels, in few-fruited clusters, obovate, rather broader than high, green until fully grown, becoming dull red, pruinose, 1.2–1.3 cm. in diameter and 1–1.2 cm. long; calyx prominent, with a short tube, a wide deep cavity, and small spreading and reflexed persistent lobes dark red on the upper side below the middle; flesh thin, green, dry and hard, slightly bitter; nutlets 4 or 5, narrowed and rounded at the apex, acute at the base, rounded and grooved or slightly ridged on the back, 6.5–7 mm. long and 3.5–4 mm. wide.

A shrub 2–3 m. high, with numerous slender stems covered with smooth pale bark, spreading branches, and very slender nearly straight branchlets dark olive-green when they first appear, becoming dull chestnut brown and marked by small pale lenticels in their first season and dark red-brown the following year, and armed with numerous slender straight or slightly curved purplish shining spines 3–5 cm. long.

Hillside, Dunmore, near Scranton, Lackawanna County, A. Twining, (No. 26 type) May 28 and September 22, 1907.

12. **Cratægus advena** n. sp.

Glabrous with the exception of the hairs on the young leaves and petioles. *Leaves* ovate, acuminate, abruptly concave-cuneate or rounded at the base, sharply often doubly serrate, with straight glandular teeth, and very slightly divided into 3 or 4 pairs of small spreading lobes; nearly half-grown when the flowers open the middle of May and then very thin, light yellow-green, smooth and slightly hairy above along the midribs and paler and glabrous below, and at maturity thin, dark yellow-green, smooth and lustrous on the upper surface, pale on the lower surface, 4.5–5 cm. long and 3.5–4 cm. wide, with thin prominent midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute stipitate deciduous glands, slightly villose on the upper side while young, soon becoming glabrous, 2–3 cm. in length. *Flowers* 1.8 cm. in diameter, on long slender pedicels, in rather compact mostly 5–11-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, slightly glandular-serrate near the apex, reflexed after anthesis; stamens 15–20; anthers dark pink; styles 3–5, surrounded at the base by a broad ring of pale tomentum; *Fruit* ripening early in October, on long slender red pedicels, in few-fruited clusters, subglobose to slightly obovate, full and rounded at the ends, green when fully grown becoming red at maturity, pruinose, marked by small dark dots, 1.5 cm. in diameter; calyx little enlarged, with a short tube, a deep narrow cavity pointed and tomentose in the bottom, and small spreading lobes; flesh thin, firm and green; nutlets 3–5, gradually narrowed and rounded at the ends, rather broader at the base than at the apex, prominently ridged on the back, with a high broad deeply grooved ridge, 6–8 mm. long and about 6 mm. wide.

A tree 3–4 m. high, with a tall trunk 6–7 cm. in diameter, covered with dark scaly bark, small spreading intricately branched branches forming a wide compact handsome head, and stout nearly straight zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull reddish brown the following year, and armed with very numerous stout straight or slightly curved chestnut brown shining spines 4–5 cm. long, and occasionally persistent on old stems.

Rich hillsides; common; Bedford, Bedford County, B. H. Smith and C. S. Sargent, (No. 298 type) September 30, 1905, B. H. Smith, May 18, 1906; border of woods near Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (Nos. 9 and 10, with darker rose colored anthers) May 26, 1908, September 7, 1909, B. H. Smith, September 17, 1908, May 22, 1909.

13. **Cratægus torta** n. sp.

Glabrous with the exception of the hairs on the leaves and petioles. *Leaves* ovate, acuminate, cuneate or rounded at the base, finely doubly serrate, with straight glandular teeth, and divided into 4 or 5 pairs of narrow acuminate lateral lobes; more than half-grown when the flowers open from the middle to the end of May, and then thin, dark yellow-green and slightly roughened above by short white hairs, and pale and sparingly villose on the midribs and veins below, and at maturity thin, dark green and scabrate on the upper surface, paler on the lower surface, 4–5 cm. long and 3–4 cm. wide, with thin midribs and primary veins; petioles slender, sparingly hairy on the upper side while young, soon becoming glabrous, glandular, with usually deciduous glands, 2–2.5 cm. in length; leaves on vigorous shoots thicker, usually rounded or truncate at the broad base, more coarsely serrate, more deeply lobed, and often 5–6 cm. long and broad, with stout winged glandular petioles. *Flowers* 2.5 cm. in diameter, on short slender pedicels, in small compact mostly 4–7-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from the base, short, wide, acuminate, entire or slightly glandular-dentate near the middle, reflexed after anthesis; stamens 16–20; anthers pink; styles 3–5. *Fruit* ripening late in October and persistent until after the leaves have fallen, on slender pedicels, in 4–7-fruited erect or spreading clusters, short-oblong, 5-angled, rounded at the apex, flattened at the base, light yellow or russet green, marked by large dark dots, rather lustrous, 8–10 mm. in diameter; calyx prominent, with a distinct tube, a broad deep cavity pointed in the bottom, and small spreading usually deciduous lobes; flesh thin, hard, yellow-green, acidulous; nutlets 3–5, gradually narrowed and rounded at the ends, slightly ridged or rounded and grooved on the back, 5.5–6 cm. long and 4 mm. wide.

A slender tree 5 or 6 m. high, with a trunk sometimes 8–10 cm in diameter, and covered with dark gray bark broken into closely appressed scales, and slender zigzag branchlets, dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut-brown and lustrous in their first season and dark red-brown the following year, and armed with very numerous slender purple shining spines 3.5–4 cm. long.

Borders of woods in rich rocky soil, Nine-mile Run, Pittsburg, Allegheny County, O. E. Jennings, (No. 40 type) October 9, 1905, May 21, 1906, O. E. Jennings and B. H. Smith, October 5, 1907.

14. **Cratægus relicta** n. sp.

Glabrous. *Leaves* oblong-ovate, acuminate, rounded or rarely abruptly cuneate at the wide base, coarsely often doubly serrate, with straight or incurved glandular teeth, and more or less deeply divided into 4 or 5 pairs of short broad acuminate lateral lobes; more than half-grown when the flowers open early in May, and at maturity thin but firm in texture, dark blue-green, smooth and lustrous on the upper surface, pale bluish green on the lower surface, 5–8 cm. long and 4.5–6 cm. wide, with thin yellow midribs and primary veins; petioles slender, occasionally glandular, 2–3 cm. in length. *Flowers* on short stout pedicels, in compact 5–8-flowered corymbs; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, long, acuminate, entire or occasionally minutely dentate, reflexed after anthesis; stamens 10; styles 3, surrounded at the base by a narrow ring of pale hairs. *Fruit* ripening early in October, on stout erect or spreading pedicels, in few-fruited clusters, subglobose but often rather broader than high, slightly mammillate at the base, green flushed with dull red, 9–10 mm. in diameter; calyx little enlarged, without a tube, with a narrow shallow cavity tomentose in the bottom, and small spreading often deciduous lobes; flesh hard, greenish yellow; nutlets 3–5, broad and rounded at the base, gradually narrowed and rounded at the apex, or when 5 acute at the ends, slightly and irregularly ridged or rounded and grooved on the back, 6–6.5 mm. long and about 4 mm. wide.

A shrub 3–4 m. high, with numerous large spreading stems covered with dark scaly bark and spreading into broad thickets, slender only slightly zigzag branchlets dark chestnut brown, lustrous and marked by pale lenticels in their first season and dull reddish brown the following year, and armed with few slender straight purple spines 2–3.5 cm. long and compound and persistent on old stems.

Rocky knoll, Orbisonia, Huntingdon County, B. H. Smith and

C. S. Sargent, (No. 320 type) October 9, 1906, May 27, 1908, B. H. Smith, October 8, 1907.

The flowers of this species have not been collected.

15. **Cratægus erubescens** n. sp.

Glabrous. *Leaves* ovate, acuminate, concave-cuneate or rarely rounded at the base, coarsely often doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate lateral lobes; not more than one-third grown when the flowers open late in May and then very thin and light yellow-green, and at maturity thin but firm in texture, dark dull bluish green and smooth on the upper surface, pale on the lower surface, 5–6 cm. long and 4–4.5 cm. wide, with prominent midribs and thin primary veins; petioles stout, glandular, with occasional minute persistent glands, 2–2.5 cm. in length; leaves on vigorous shoots thicker, gradually narrowed and rounded at the broad base, more coarsely serrate and more deeply lobed, and often 6–7 cm. long and 5–6 cm. wide. *Flowers* 1.5 cm. in diameter, on short slender pedicels, in small compact mostly 5–7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from broad bases, short, slender, acuminate, entire or minutely dentate near the middle; reflexed after anthesis; petals crenulate; stamens 7–10, generally 10; anthers pale rose-pink; styles 3 or 4. *Fruit* ripening early in October, on long slender drooping pedicels, in usually 1–3-fruited clusters, subglobose but often broader than high, flattened at the ends, pentagonal, purple-red, marked by large pale dots, pruinose, becoming lustrous, 1–1.1 cm. long and 1.2–1.5 cm. wide; calyx little enlarged, without a tube, with a narrow deep cavity pointed in the bottom, and small spreading incurved persistent lobes; flesh thin, hard, dry, light yellow-green, acidulous; nutlets 3–5, broad and rounded at the apex, narrowed at the rounded base, ridged on the back, with a broad low grooved ridge, 6.5–7 mm. long and 4–4.5 mm. wide.

An arborescent shrub 3–4 m. high, with stems sometimes 1.5 cm. in diameter, covered with dark gray bark broken into small closely appressed scales, spreading branches forming a flat-topped head, and stout nearly straight branchlets deeply tinged with red when they first appear, becoming light chestnut brown very lustrous and marked by dark lenticels in their first season, and dull red-brown the following year, and armed with numerous slender nearly straight purple shining spines 3.5–5.5 cm. long.

Hillsides, in rich soil, Kittanning, Armstrong County, O. E. Jennings,

B. H. Smith and C. S. Sargent, (No. 60 type) October 7, 1906, O. E. Jennings, May 27, 1907, O. E. and Grace K. Jennings, October 7, 1907.

16. **Cratægus divisifolia** n. sp.

Glabrous with the exception of the hairs on the lower surface of the young leaves. *Leaves* oblong-ovate, acuminate, abruptly cuneate at the base, coarsely often doubly serrate, with straight glandular teeth, and divided often to the middle into 4 or 5 pairs of narrow acuminate spreading lobes; when they unfold sparingly villose on the midribs and veins below, soon becoming glabrous, less than half-grown when the flowers open about the middle of May and then thin, dark yellow-green above and paler below, and at maturity thin, firm, dark green and rather lustrous on the upper surface, pale on the lower surface, 5–6 cm. long and 4–5 cm. wide, with slender midribs and thin primary veins arching obliquely to the points of the lobes; petioles slender, glandular, with minute occasional persistent glands, 2–2.5 cm. in length; leaves on vigorous shoots thicker, broadly ovate, truncate or rounded at the wide base, coarsely serrate, more deeply lobed and often 7–8 cm. long and wide, with thick midribs and stout glabrous petioles. *Flowers* 1.6–2 cm. in diameter, on long slender pedicels, in small narrow 2–7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short, nearly triangular, entire or minutely glandular-dentate near the apex, reflexed after anthesis; stamens 9 or 10; anthers pale pink; styles 2–5, usually 4. *Fruit* ripening early in October, on slender drooping pedicels, depressed subglobose but rather broader than high, angled, often mammallate round the middle, slightly tapering to the base, dull red or occasionally blotched with green or russet green, sparingly punctate, pruinose, 1.4–1.7 cm. broad, 1.2–1.5 cm. high; calyx prominent, without a tube, with a wide shallow cup-shaped cavity tomentose in the bottom, and spreading or usually incurved often deciduous lobes; flesh thin, green, dry and hard; nutlets usually 4, narrowed and rounded at the ends, rather broader at the base than at the apex, rounded and only slightly grooved on the back, 7–8 mm. long and 5–5.5 mm. wide.

An arborescent shrub sometimes 2.5 m. high, with stems covered with dark gray bark, numerous flexuose ascending branches forming a round broadly obconic head, and stout nearly straight branchlets dark orange green and marked by pale lenticels when they first appear, becoming light chestnut brown and very lustrous in their first season and dull reddish brown the following year, and armed with numerous stout slightly curved chestnut brown ultimately dark gray spines 4–5 cm. long.

On rocky knolls, near Kutztown, Bucks County, C. L. Gruber, (No. 22 type) October 6, 1907, May 17 and September 15, 1908.

This handsome species resembles *C. arcana* Beadle in the character of the fruit but the stamens are only 10, not 20, and the deeply divided leaves, which resemble those of *C. pinnatifida* from northern China, are unlike those of any species in this group.

17. **Cratægus eduresceus** n. sp.

Glabrous with the exception of the hairs on the young leaves. *Leaves* broadly ovate, acute or acuminate, cuneate or rarely rounded at the wide entire base, sharply often doubly serrate above, with glandular teeth, and slightly divided usually only above the middle into 4 or 5 pairs of small acuminate lobes; nearly fully grown when the flowers open from the 15th to the 20th of May and then very thin, light yellow-green and roughened above by short white hairs and pale and glabrous below, and at maturity thin, yellow-green, glabrous, smooth and lustrous on the upper surface, rather lighter-colored on the lower surface, 3.5–4.5 cm. long and often nearly as broad, with thin midribs and primary veins; petioles slender, glandular, with small sometimes persistent glands, 1.5–3 cm. in length; leaves on vigorous shoots thicker, more deeply lobed, rounded at the wide base, sometimes 5.5–6 cm. long and often broader than long. *Flowers* 1.6–1.8 cm. in diameter, on long slender pedicels, in mostly 7- or 8-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, long, acuminate, occasionally furnished above the middle with large glandular teeth, or nearly entire, reflexed after anthesis; stamens 5–10, usually 10; anthers dark rose color; styles 3 or 4, surrounded at the base by a broad ring of pale tomentum. *Fruit* ripening early in October. on long slender spreading pedicels, in few-fruited clusters, obovate, rounded at the apex, slightly narrowed to the base, green, pruinose, becoming red, 8–10 mm. in diameter; calyx prominent, with a short tube, a broad deep cavity wide and tomentose in the bottom, and spreading or reflexed persistent lobes; flesh thin, dry and mealy; nutlets 3 or 4, narrowed and rounded at the apex, broader and rounded at the base, rounded and only slightly ridged on the back, 6.5–7 mm. long and 4–4.5 mm. wide.

A shrub 3–4 m. high, with slender zigzag branchlets light orange green when they first appear, becoming bright chestnut brown, lustrous and marked by pale lenticels in their first season and dull reddish brown the following year, and armed with very numerous slender straight or slightly curved chestnut brown shining spines 3.5–5 cm. long.

Edges of meadows in Edgmont Township, above Castle Rock, Delaware County, B. H. Smith, (No. 239 type) May 20 and October 6, 1904, May 19, 1909.

18. **Cratægus latifrons** n. sp.

Glabrous with the exception of the hairs on the young leaves *Leaves* broadly ovate, acuminate, abruptly concave-cuneate or rounded at the wide base, finely often doubly serrate, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small acuminate spreading lobes; more than half-grown when the flowers open the middle of May and then thin, yellow-green, smooth, lustrous and glabrous above with the exception of a few hairs on the upper side of the midribs near their base, and pale below, and at maturity thin, dark yellow-green and lustrous on the upper surface, pale on the lower surface. 4–5 cm. long and 3.5–5 cm. wide, with thin midribs and primary veins; petioles slender, glandular, with persistent glands, slightly hairy on the upper side while young, soon becoming glabrous, 2–3 cm. in length. *Flowers* 1.6 cm. in diameter, on long slender pedicels, in small compact mostly 4–6-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from the base, short, slender, acuminate, entire or minutely dentate, reflexed after anthesis; stamens 18-20; anthers cream color; styles 2–4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening in October, on slender drooping red pedicels, in few-fruited clusters, subglobose to short-oblong, full and rounded at the ends, dark red blotched with green, marked by large dark dots, 1.4–1.5 cm. in diameter; calyx prominent, with a broad shallow cavity, and spreading persistent lobes dark red on the upper side below the middle; nutlets 2–4, broad and rounded at the base, gradually narrowed and acute or rounded at the apex, ridged on the back, with a broad low grooved ridge 6.5–7 mm. long and 4.5–5 mm. wide.

A shrub 5–6 m. high, with stems sometimes 1.5–2 dm. in diameter, stout straight branches, and slender slightly zigzag branchlets dark orange-green tinged with red and marked by numerous pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull reddish brown the following year, and armed with few stout straight or slightly curved purple shining spines 2.5–3.5 cm. long.

Rocky knoll, Orbisonia, Huntingdon County, B. H. Smith, (Nos. 308 type, 303) May 19, 1906, October 8, 1907, B. H. Smith and C. S. Sargent, (No. 303) October 9, 1906, B. H. Smith, (No. 305) May 19, 1906, October 8, 1907, B. H. Smith and C. S. Sargent, October 7, 1906, B. H. Smith and C. S. Sargent, (No. 305 A) October 9, 1906.

19. **Cratægus tribulosa** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the petioles. *Leaves* broadly ovate, acute or acuminate, rounded or truncate at the wide base, sharply often doubly serrate, with glandular teeth, and divided into 3 or 4 pairs of short broad lateral lobes; about half-grown when the flowers open the middle of May and then thin, yellow-green and slightly hairy on the upper side of the midribs, and pale bluish green below, and at maturity thick, dark yellow-green, smooth and lustrous on the upper surface, paler on the lower surface, 4–5 cm. long and 4–4.5 cm. wide, with thin prominent yellow midribs and primary veins; petioles slender, glandular, with minute often persistent glands, sparingly villose on the upper side while young, becoming glabrous, often rose color in the autumn, 1.5–2.5 cm. in length; leaves on vigorous shoots truncate or slightly cordate at the base, more coarsely serrate and more deeply lobed, and often 5–6 cm. long and wide. *Flowers* 2–2.2 cm. in diameter, on long slender pedicels, in narrow mostly 4- or 5-flowered corymbs, with oblong-obovate to linear acute glandular-serrate green bracts and bractlets often persistent until the flowers open, the elongated lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes separated by wide sinuses, short, broad, acuminate, entire or occasionally minutely dentate reflexed after anthesis; stamens 20; anthers cream color; styles 4 or 5. *Fruit* ripening at the end of September, on long slender pedicels, in few-fruited clusters, short-oblong to subglobose, often rather broader than high, slightly angled, dull green tinged with red, about 1 cm. in diameter; calyx prominent, with a short tube, a broad shallow cavity wide in the bottom, and spreading and reflexed lobes; flesh thin, green, dry and hard; nutlets 4 or 5, rounded at the ends but narrower at the apex than at the base, rounded and slightly ridged on the back, 5–5.5 mm. long and about 4 mm. wide.

A narrow shrub 3 or 4 m. high, with stems sometimes 4–6 cm. in diameter, covered with dark red scaly bark, small branches, and slender zigzag branchlets, dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull red-brown the following year, and armed with numerous slender straight or slightly curved purple shining spines 4–5 cm. long, persistent and becoming branched on old stems.

Dry oak woods, Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 297 type) September 30, 1905, B. H. Smith, May 18, 1906, May 22, 1909.

20. **Cratægus incompta.**

Glabrous. *Leaves* ovate to oval, acute or acuminate, rounded or abruptly cuneate at the broad base, finely often doubly serrate, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of short lobes; nearly half-grown when the flowers open about the 20th of May and then thin, yellow-green, lustrous above and rather paler below, and at maturity thick, dark blue-green on the upper surface, pale bluish green on the lower surface, 4–4.5 cm. long and 3.5–4 cm. wide, with slender midribs and primary veins; petioles stout, slightly wing-margined at the apex, glandular, with minute often persistent glands, 1.8–2.2 cm. in length; leaves on vigorous shoots usually rounded or cordate at the base, more coarsely serrate and more deeply lobed and often 5.5–6 cm. long and nearly as broad. *Flowers* 2–2.3 cm. in diameter, on long slender pedicels, in wide 4–7-flowered corymbs, with oblong-obovate to linear glandular rose-colored bracts and bractlets often persistent until the petals fall, the long lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes separated by wide sinuses, short, acuminate, entire or irregularly and minutely dentate near the middle, reflexed after anthesis; stamens 20; anthers pale yellow; styles 2 or 3, usually 3. *Fruit* ripening in October, on long slender drooping pedicels, subglobose, or often rather broader than high, dull red, pruinose, marked by large pale dots, about 1 cm. in diameter; calyx prominent, with a short tube, a wide deep cavity broad in the bottom, and elongated reflexed persistent lobes; flesh thin, green, dry and hard; nutlets usually 3, rounded at the ends, rounded and ridged on the back, with a broad deeply grooved ridge, about 5 mm. long and 4 mm. wide.

A slender shrub 1–2 m. high, with thin stems covered with dark scaly bark and spreading into large thickets, and slender zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark red-brown in their first season and dull reddish brown the following year, and armed with many stout straight or slightly curved dark chestnut brown shining spines 3.5–5 cm. long, and persistent and very numerous on old stems.

Borders of oak and pine woods on the Maloney Home for the

Aged, Scranton, Lackawanna County, A. Twining, B. H. Smith and C. S. Sargent, (No. 72 type) May 24, 1908, A. Twining, September 19, 1908.

21. **Cratægus shaferi** Ashe.

Ann. Carnegie Mus., I, pt. 3, 397 (1902).

Glabrous. *Leaves* broadly ovate, acute or acuminate, abruptly cuneate or rounded at the broad base, sharply often doubly serrate, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small acuminate spreading lobes; tinged with red when they first appear, more than half grown when the flowers open from the 15th to the 20th of May and then thin, light yellow-green and lustrous above and paler below, and at maturity thick, dark yellow-green on the upper surface, paler and bluish green on the lower surface, 5–7 cm. long and 4–5.5 cm. wide, with thin midribs and primary veins; petioles slender, 2.5–3.5 cm. in length; leaves on vigorous shoots broadly ovate, acuminate, cordate or occasionally truncate at the base, more coarsely serrate and more deeply lobed, and often 5–6 cm. long and wide. *Flowers* 2.4–2.5 cm. in diameter, on slender pedicels, in mostly 5–7-flowered compact corymbs, with obovate to linear glandular bracts and bractlets fading rose color and often persistent until the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from broad bases, long, acuminate, entire or occasionally minutely dentate near the middle, reflexed after anthesis; stamens 20; anthers white; styles 4 or 5, surrounded at the base by a narrow ring of white hairs. *Fruit* ripening late in October and often persistent until after the leaves have fallen, on short stout erect or spreading pedicels, in few-fruited clusters, subglobose, sometimes rather broader than high, dull red blotched with green, slightly pruinose, 1.2–1.3 cm. in diameter; calyx much enlarged, with a short tube, a broad deep cavity wide and tomentose in the bottom, and spreading and reflexed persistent lobes; flesh thin, green, dry and mealy; nutlets 4 or 5, narrowed at the ends, broader at the apex than at the base, rounded and slightly grooved on the back, 6.5–7 mm. long and about 4 mm. wide.

A shrub 2–3 m. high, with numerous stems, and slender nearly straight branchlets dark green more or less tinged with red when they first appear, becoming dark chestnut brown, lustrous and marked by pale lenticels in their first season, darker-colored the following year, and armed with numerous slender straight or slightly curved purple shining spines 3–4 cm. in length.

On the Shafer farm in Moor Township, west of Carnot, in Allegheny County, J. A. Shafer, May 20 and October 8, 1901, May 18 and 20 and October 26, 1902.

Mr. Ashe has described the leaves as "at first villose on the petioles and midrib above and veins beneath," but the leaves of Shafer's specimens from which my description has been drawn are entirely glabrous even when they are unfolding.

Cratægus Shaferi is near *Cratægus cognata* Sarg., but differs from that species in the broader leaves of the young shoots, in its subglobose not obovate fruit, and by the much larger clayx of the fruit.

22. **Cratægus bedfordensis** n. sp.

Glabrous with the exception of a few hairs on the upper surface of the young leaves. *Leaves* ovate, acute or acuminate, rounded or broadly cuneate at the entire sometimes unsymmetrical base, finely doubly serrate above, with minute straight or incurved glandular teeth, and very slightly divided above the middle into 2 or 3 pairs of small acute spreading lobes; when they unfold slightly tinged with red and sparingly hairy above, with deciduous hairs, nearly half-grown and almost glabrous when the flowers open the middle of May and then thin, light yellow-green, smooth and lustrous above and paler below, and at maturity dark yellow-green and lustrous on the upper surface, dull bluish green on the lower surface, 3–4 cm. long and 2–2.8 cm. wide, with thin yellow midribs and primary veins; petioles slender, glabrous while young, with minute stipitate deciduous glands, 1.5–2 cm. in length; leaves on vigorous shoots broadly ovate, rounded at the wide base, 3.5–4 cm. long and broad. *Flowers* 1.5 cm. in diameter, on long slender pedicels, in 4–8-, usually 5-flowered corymbs, with oblong-obovate to linear glandular-serrate rose-colored bracts and bractlets often persistent until the flowers open, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed fron the base, short, broad, acuminate, entire or occasionally minutely dentate near the middle, reflexed after anthesis; stamens 20; anthers white; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening in October, on slender pedicles, in few-fruited drooping clusters, short-oblong to slightly obovate, full and rounded at the ends, green and pruinose when fully grown, turning pale red, marked by small dark dots, 8–10 mm. in diameter; calyx little enlarged, with a short tube, a broad shallow cavity wide in the bottom, and small spreading and reflexed lobes; flesh thin, green and firm; nutlets 3 or 4, gradually narrowed and rounded at the ends, rounded and slightly grooved or irregularly ridged on the back, 6–6.5 mm. long and about 4 mm. wide.

A shrub 1.5–3 m. high with stems sometimes 10 cm. in diameter, covered with dark scaly bark and spreading freely into large thickets, small, contorted dark branches, and slender rather contorted branchlets light orange-green when they first appear, becoming dark chestnut brown, lustrous and marked by small dark lenticels in their first season and dull reddish brown the following year, and nearly unarmed, or armed with numerous slender straight chestnut brown shining spines 2–4.5 cm. long.

Rich hillsides, Bedford, Bedford County; common; B. H. Smith and C. S. Sargent, (No. 300 type) September 30, 1905, B. H. Smith, May 18, 1906, May 22, 1908; in oak woods, Bedford Springs, Bedford County, (Nos. 293 and 294), B. H. Smith and C. S. Sargent, September 30, 1905, May 18, 1906.

23. **Cratægus conjuncta** Sargent.

Rhodora, V, 57 (1903); Bot. Gazette, XXXV, 379; Bull. CV, N. Y. State Mus., 54.

Keyser Valley, Scranton, Lackawanna County, A. Twining, (No. 15) June 4, 1907, May 23, 1908, (No. 56) October 22, 1907, May 23, 1908; also Illinois to eastern New York and southern New England.

24. **Cratægus duracina** n. sp.

Glabrous with the exception of a few hairs on the upper surface of the young leaves. *Leaves* ovate to rhombic, acuminate, abruptly or gradually narrowed and cuneate at the base, finely often doubly serrate, with straight glandular teeth, and divided usually only above the middle into 3–5 pairs of small acute spreading lobes; not more than one-third grown when the flowers open at the end of May and then dark yellow-green, smooth, lustrous and furnished with occasional hairs along the midribs above and paler below, and at maturity thin and firm, dark yellow-green and lustrous on the upper surface, pale on the lower surface, 4.5–6 cm. long and 3.5–4 cm. wide, with thin prominent midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute mostly deciduous glands, 2.5–3.5 cm. in length. *Flowers* about 1.5 cm. in diameter, on short slender pedicels, in small compact mostly 4–7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, slender, acuminate, entire or minutely glandular-dentate near the middle, reflexed after anthesis; stamens 17–20; anthers cream color; styles 3 or 4, usually 4. *Fruit* ripening in October, on slender elongated pedicels, in drooping few-fruited clusters, subglobose to slightly obovate, rounded at the ends, slightly concave at the base, red blotched with green, pruinose, 8–11 mm. long and 8–10 mm. thick; calyx prominent, with a short tube, a deep wide cavity broad in the bottom, and spreading and reflexed persistent lobes; flesh greenish yellow, hard, dry and subacid; nutlets usually 4, rounded at the ends, rather broader at the base than at the apex, slightly ridged on the back, 6.5–7 mm. long and 4–4.5 mm. wide.

A shrub 1.5–2 m. high, with small ascending stems, and slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut brown and lustrous in their first season and rather darker-colored the following year.

Along the roadside at the mouth of Whisky Hollow across the Allegheny River from Kittanning, Armstrong County, O. E. Jennings, (W. H. type) May 27, 1907, O. E. and Grace K. Jennings, September 28, 1909.

25. **Cratægus lecta** n. sp.

Leaves ovate to oval, acuminate, concave-cuneate at the base, coarsely often doubly serrate, with straight glandular teeth, and divided usually only above the middle into 4 or 5 pairs of small acuminate lobes; nearly one-third grown when the flowers open about the middle of May and then thin, dark yellow-green and roughened above by short white hairs and paler and slightly villose, with persistent hairs, along the midribs below, and at maturity thin but firm in texture, dark blue-green and scabrate on the upper surface, pale bluish green on the lower surface, 5–6 cm. long and 3.5–4 cm. wide, with slender prominent midribs and veins; petioles slender, covered while young with matted pale hairs, becoming glabrous, 2–3 cm. in length. *Flowers* 1.5–1.8 cm. in diameter, on short slender villose pedicels, in mostly 5–8 flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes short, slender, acuminate, entire or occasionally minutely dentate near the middle, glabrous, reflexed after anthesis; stamens 18–20; anthers pale yellow; styles 3–5. *Fruit* ripening in October, on short stout drooping or spreading pedicels, in mostly 1–3-fruited clusters, obovate, rounded at the apex, gradually tapering to the obtuse union with the pedicel, sometimes obtusely 4- or 5-angled, light yellow-green, with a dark orange-red cheek, or finally orange-red, 1.3–1.5 cm. long and broad; calyx little enlarged, with a short tube, a wide shallow cavity tomentose in the bottom, and small spreading and reflexed generally persistent lobes; flesh thin, hard, acid, greenish yellow; nutlets usually 4, broad and rounded at the apex, gradually narrowed to the rounded base, ridged on the back, with a low narrow or broad grooved ridge, 7.5–8 mm. long and 4–4.5 mm. wide.

A shrub 4–5 m. high, with a stem 7–10 cm. in diameter, covered with dark brown bark separating into large loosely attached scales, and stout nearly straight glabrous branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and very lustrous in their first season and dull gray-brown the following year, and armed with numerous stout straight or slightly curved chestnut brown shining spines 3–4.5 cm. long and compound and very numerous on old stems.

Banks of rocky ravines, between Carnot and Stoop Ferry, Allegheny County, O. E. Jennings, (Nos. 74 type and 75) May 20, 1907, O. E. and Grace K. Jennings and B. H. Smith, October 6, 1907.

4. Medioximæ n. gr.

Leaves thick, hairy on the upper surface early in the season, glabrous and usually smooth at maturity; petioles long and slender. *Flowers* in few-flowered glabrous corymbs; stamens 10 or less; anthers rose color or rarely pink. *Fruit* subglobose to short-oblong, ovate or obovate, generally longer than broad, rarely slightly angled, scarlet, crimson or orange-red, occasionally slightly pruinose, ripening late in September or in October; flesh hard and solid; mature calyx sessile; nutlets 2–5, usually 3 or 4.

In this group I have placed a number of shrubby species which in some important characters appear intermediate between the Pruinosæ and the Tenuifoliæ. From the former they differ in their thinner leaves, smaller flowers, always glabrous usually few-flowered corymbs, generally fewer stamens with rose-colored or pink anthers, and especially in the fruit; this has a sessile calyx, is rarely slightly pruinose, never green at maturity like that of many of the Pruinosæ and generally ripens earlier. From the Tenuifoliæ the plants of this group differ in their thicker leaves, generally fewer-flowered corymbs, and in their solid not succulent later-ripening fruit. In addition to the species enumerated in this paper, *Cratægus alacris* Sarg. and *Cratægus vittata* Ashe of eastern Pennsylvania may be placed in this group, as well as many of the well-known species of western New York, Ontario and Michigan which have been grouped with the Pruinosæ, like *C. opulens* Sarg., *C. maineana* Sarg., *C. diffusa* Sarg., *C. compta* Sarg., *C. dissona* Sarg., and others.

Fruit subglobose to short-oblong.
  Calyx cavity of the fruit deep and narrow.
    Leaves broadly ovate to semiorbicular, acute..........1. *C. medioxima.*
    Leaves ovate to deltoid, acuminate..........2. *C. felix.*
  Calyx cavity of the fruit broad and shallow; leaves ovate-oblong, acuminate..........3. *C. stolonifera.*
Fruit globose to depressed-globose.
  Leaves broadly ovate, abruptly cuneate or rounded at the base.
    Calyx cavity of the fruit deep and narrow.
      Flowers not more than 1 cm. in diameter; fruit obscurely pentagonal, dark red..........4. *C. ambigens.*
      Flowers at least 1.5 cm. in diameter; fruit not pentagonal, often broader than high, scarlet..........5. *C. puta.*
    Calyx cavity of the fruit broad and shallow; flowers up to 2 cm. in diameter; anthers pink..........6. *C. blairensis.*
  Leaves ovate, cuneate at the base, only slightly hairy on the upper surface; fruit flattened at the ends, obscurely angled, often broader than long; calyx cavity broad and shallow. 7. *C. leimonia.*
  Leaves ovate to rhombic, cuneate at the base; fruit depressed-globose, crimson, slightly pruinose; calyx cavity broad and shallow..........8. *C. dissona.*
Fruit short-oblong; leaves ovate, more or less scabrate on the upper surface at maturity..........9. *C. ampliata.*
Fruit short-oblong to obovate.
  Calyx cavity of the fruit broad and shallow; leaves broadly ovate. 10. *C. pyramidata.*
  Calyx cavity of the fruit deep and narrow.
    Leaves ovate, glabrous at maturity..........11. *C. impervia.*
    Leaves oblong-ovate, scabrate on the upper surface at maturity. 12. *C. luxuriosa.*
Fruit obovate.
  Leaves ovate, acuminate.
    Calyx cavity of the fruit deep and narrow; fruit slightly 5-angled. orange to greenish orange, becoming scarlet, slightly pruinose. 13. *C. recordabilis.*
    Calyx cavity of the fruit broad and shallow.
      Calyx-lobes villose on the inner surface.
        Flowers in wide lax corymbs; calyx-lobes long and slender. 14. *C. delectata.*
        Flowers in narrow compact corymbs; calyx-lobes short and broad..........15. *C. infensa.*
      Calyx-lobes glabrous.
        Mature leaves scabrate on the upper surface; flowers in 5–10-flowered corymbs; anthers rose color. 16. *C. vegrandis.*
        Mature leaves glabrous on the upper surface; flowers in 4–7-flowered corymbs; anthers pale pink......17. *C. radina.*
  Leaves oblong-ovate, blue-green, scabrate on the upper surface;

fruit dark orange-red, sometimes 3–5-angled, slightly pruinose; calyx cavity deep and narrow....................................18. *C. lætans.*

Leaves broad-ovate, scabrate on the upper surface.

Calyx cavity of the fruit deep and narrow.

Leaves yellow-green; anthers pale pink; fruit scarlet. 19. *C. ruricola.*

Leaves blue-green; anthers dark rose color; fruit orange-red. 20. *C. effera.*

Calyx cavity of the fruit broad and shallow; leaves ovate to oval, blue-green..21. *C. coerulea.*

1. **Cratægus medioxima** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* broadly ovate to semi-orbicular, acute, rounded or abruptly cuneate at the wide entire base, finely often doubly serrate above, with straight glandular teeth, and very slightly divided usually only above the middle into 3 or 4 pairs of small acute lobes; nearly fully grown when the flowers open about the 20th of May and then thin, light yellow-green, smooth, lustrous and slightly hairy above especially along the midribs and veins, and at maturity thin, dark yellow-green smooth and glabrous on the upper surface, paler on the lower surface, 4–5 cm. long and 3–3.5 cm. wide, with thin prominent midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular while young, with mostly deciduous glands, 2–2.5 cm. in length. *Flowers* 1.4–1.6 cm. in diameter, on short slender pedicels, in compact mostly 5–8-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, red and acuminate at the apex, entire, reflexed after anthesis; stamens 5 or 6; anthers deep rose-purple; styles 2–5. *Fruit* ripening and falling early in October, on short stout drooping pedicels, in few-fruited clusters, subglobose or rarely short-oblong, somewhat flattened at the ends, slightly pentagonal, dark red marked by numerous large pale dots, 1.1–1.4 cm. in diameter; calyx little enlarged, with a narrow deep cavity pointed in the bottom, and small reflexed closely appressed often deciduous lobes; flesh thick, hard, yellow-green, rather bitter; nutlets 2–5, narrowed and rounded, or when 5, acute at the ends, ridged on the back with a broad low grooved ridge, 7–7.5 mm. long and 4–4.5 mm. wide.

An arborescent shrub 3–4 m. high, with stems sometimes 2.5 cm. in diameter, covered with dark gray scaly bark, large smooth gray branches, and stout nearly straight branchlets dark orange-green more or less tinged with red when they first appear, becoming purple and marked by dark lenticels and somewhat pruinose in their first season and dark red-brown the following year, and armed with numerous stout slightly curved purple shining spines 4–4.5 cm. long.

Between Carnot and Stoops Ferry, Allegheny County, O. E. Jennings, (No. 73 type) May 20, 1907, O. E. and Grace K. Jennings and B. H. Smith, October 6, 1907.

2. **Cratægus felix** Sargent.

Proc. Acad. Nat. Sci. Phila., 1905, 589.

Corrected Characters of the Flowers.—Leaves less than one-half grown when the flowers open about the 10th of May and then very thin, yellow-green and roughened above by short white hairs. *Flowers* 1.5–1.9 cm. in diameter, on very short slender glabrous pedicels, in small compact 6–12-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, long, slender, acuminate, minutely glandular-dentate above the middle or entire, slightly hairy on the inner surface, reflexed after anthesis; stamens 5–10; anthers dark rose color; styles 3 or 4, surrounded at the base by a broad ring of pale tomentum.

Through an error caused by the mixing of specimens of two plants growing close together the flowers of *Cratægus felix* were originally described as with 18–20 stamens and pale rose-colored anthers, and this species was placed among the Pruinosæ.

3. **Cratægus stolonifera** Sargent.

Bot. Gazette, XXXV, 109 (The Genus Cratægus in New Castle County, Delaware) (1903); Proc. Acad. Nat. Sci. Phila., 1905, 623; No. IV, Ontario Nat. Sci. Bull., 38.

Valley of the Little Juniata River below Altoona, Blair County, B. H. Smith, (No. 262) May 20, 1905, B. H. Smith and C. S. Sargent, September 27, 1905; also in northern Delaware, eastern Pennsylvania and southern Michigan.

4. **Cratægus ambigens** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the calyx-lobes. *Leaves* broadly ovate, acute or acuminate, abruptly cuneate or rounded at the wide base, finely often doubly serrate, with short straight or incurved glandular teeth, and slightly divided into 3 or 4 pairs of short broad lateral lobes; about one-third grown when the flowers open at the end of May and then thin, yellow-green and slightly roughened above by short white hairs and paler below, and at maturity thick, dark yellow-green, smooth and lustrous on the upper surface, pale bluish green on the lower surface, 3–4 cm. long and 3–3.5 cm. wide, with thin prominent midribs and primary veins; petioles slender, glandular early in the season, with mostly deciduous glands, 1.5–2 cm. in length; leaves on vigorous shoots subcoriaceous, rounded or truncate at the broad base, coarsely serrate, more deeply lobed and often 5–6 cm. long and wide, with stout midribs, prominent primary veins, reticulate veinlets, and stout conspicuously glandular petioles. *Flowers* 9–10 mm. in diameter, on long slender pedicels, in small compact mostly 7–10-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short, slender, acuminate, minutely glandular-dentate above the middle, reflexed after anthesis; stamens 8–10, usually 10; anthers rose color; styles 2–4, usually 3. *Fruit* ripening early in October, on short stout drooping pedicels, in usually 1- or 2-fruited clusters, globose to depressed-globose, flattened at the apex, obscurely pentagonal, greenish yellow becoming dark purplish red, marked by numerous pale dots, somewhat pruinose, 1–1.2 cm. in diameter; calyx slightly enlarged, with a deep narrow cavity, and small spreading persistent lobes dark red on the upper side below the middle; flesh firm, greenish yellow, rather juicy and acid; nutlets 2–4, gradually narrowed and rounded at the ends, ridged on the back, with a broad high deeply grooved ridge, 7–7.5 mm. long and 3.5–4 mm. wide.

A shrub 2–3 m. high, with stout stems covered with gray scaly bark, and slender nearly straight branchlets, light orange-green more or less tinged with red when they first appear, becoming bright orange-brown and marked by dark lenticels in their first season and lighter-colored the following year, and armed with numerous stout straight or slightly curved chestnut brown shining spines 1.5–4 cm. long.

Hillsides, Kittanning, Armstrong County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 62 type) October 7, 1906, O. E. Jennings, May 27, and June 1, 1907, O. E. and Grace K. Jennings, October 7, 1907.

5. **Cratægus puta** n. sp.

Glabrous with the exception of the hairs on the young leaves and on the calyx-lobes. *Leaves* ovate, acuminate, rounded or abruptly cuneate at the base, finely often doubly serrate, with straight glandular teeth; and slightly divided into 4 or 5 pairs of broad acute lobes; nearly fully grown when the flowers open at the end of May and then thin, light yellow-green and slightly roughened above by short white hairs and pale below, and at maturity thin, yellow-green, smooth and lustrous on the upper surface, paler on the lower surface, 4–5 cm. long and 3.5–4 cm. wide, with slender prominent midribs and thin primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute often persistent glands, 2.5–3 cm. in length. *Flowers* 1.5 cm. in diameter, on long slender pedicels, in lax 6–12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate and rose-colored at the apex, minutely glandular-dentate near the middle, sparingly villose on the inner surface, reflexed after anthesis; stamens 5–10; anthers rose color; styles 3–5. *Fruit* ripening early in October, on stout drooping pedicels, in few-fruited clusters, subglobose often broader than long, full and rounded at the ends, scarlet, lustrous, marked by numerous large pale dots, 1–1.2 cm. long and 1–1.4 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading persistent lobes; flesh yellow, acid; nutlets 3–5, gradually narrowed and rounded at the ends, ridged on the back, with a broad deeply grooved ridge, 6.5–7 cm. long and about 4 mm. wide.

A shrub 5–6 m. high, with stout stems covered with ashy gray bark, small ascending branches forming a wide head, and slender nearly straight branchlets dark orange-green when they first appear, becoming light chestnut brown, lustrous and marked by small dark lenticels in their first season and dull gray-brown the following year, and armed with stout straight or slightly curved chestnut brown shining spines 1.5–2 cm. long, and numerous on the stems and branches.

Lincoln Heights, Scranton, Lackawanna County, A. Twining, (No. 3 type) May 31 and October 5, 1907.

6. **Cratægus blairensis** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* broadly ovate, acuminate, abruptly cuneate at the wide base, coarsely often doubly serrate, with straight glandular teeth, and slightly divided into 3 or 4 pairs of short broad acuminate lateral lobes; tinged with red and covered on the upper surface with soft white hairs when they unfold, more than half-grown when the flowers open about the 20th of May and then thin, light yellow-green and glabrous above and paler below, and at maturity thick, dark bluish green and lustrous on the upper surface, light yellow-green on the lower surface, 5–6.5 cm. long and 4–4.5 cm. wide, with thin mid-ribs and primary veins; petioles slender, glandular, with minute mostly deciduous glands, 2.5–4 cm. in length; leaves on vigorous shoots often rounded at the base, more coarsely serrate, more deeply lobed and 7–8 cm. long and 6–7 cm. wide, with stouter conspicuously glandular petioles and foliaceous lunate glandular-serrate deciduous stipules. *Flowers* 1.8–2 cm. in diameter, on long slender pedicels, in small compact mostly 5–7-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes separated by wide sinuses, gradually narrowed from the base, short broad, acuminate, irregularly glandular-serrate below the middle, reflexed after anthesis; stamens 10; anthers pale pink; styles 3–5, surrounded at the base by a broad ring of pale tomentum. *Fruit* ripening in October, on stout spreading pedicels, in few-fruited clusters, subglobose rather broader than long and flattened at the ends to slightly obovate, dull red, pruinose, marked by dark dots, 1–1.2 cm. in diameter; flesh green, dry and hard; calyx little enlarged, without a tube, with a wide shallow cavity, and small reflexed closely appressed lobes; nutlets 3–5, gradually narrowed and rounded at the ends, rather broader at the base than at the apex, ridged on the back, with a broad high grooved ridge, 7.5–8 mm. long and 5.5–6 mm. wide.

A tree sometimes 10 m. high, with a trunk 3 dm. in diameter, covered with dark scaly bark, large ascending branches, and stout slightly zigzag branchlets light orange-green and marked by pale lenticels when they first appear, becoming dark chestnut or orange-brown and lustrous in their first season and dull gray-brown the following year, and armed with numerous slender straight or slightly curved purple shining spines 3.5–4 cm. long.

Rich bottom-lands of the Little Juniata River, near Elizabeth Furnace, East Altoona, Blair County, B. H. Smith, (Nos. 281 type and 266) May 22, 1905, B. H. Smith and C. S. Sargent, September 27, 1905, (No. 258) B. H. Smith, May 20, 1905, B. H. Smith and C. S. Sargent, September 27, 1905.

7. **Cratægus leimonia** n. sp.

Leaves ovate, acuminate, abruptly or gradually narrowed and cuneate at the base, finely often doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acute spreading lateral lobes; about half-grown when the flowers open at the end of May and then thin, yellow-green and slightly hairy along the midribs above, paler below, and at maturity thin, light yellow-green and lustrous on the upper surface, pale yellow-green on the lower surface, 3.5–4.5 cm. long and 3–3.5 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute occasionally persistent glands, 2–2.5 cm. in length. *Flowers* not more than 1.5 cm. in diameter, on long slender pedicels, in small compact mostly 5–7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, coarsely glandular-serrate near the middle or entire, reflexed after anthesis; stamens 10; anthers rose color; styles 2–4, usually 3. *Fruit* ripening in October. on long slender drooping pedicels, in few-fruited clusters, subglobose, flattened at the ends, concave at the insertion of the pedicel, more or less obtusely 5-angled, orange-red blotched with yellow-green, marked by large pale dots, slightly pruinose, 1–1.5 cm. broad and 1–1.3 cm. long; calyx little enlarged, with a wide shallow cavity, and spreading and appressed lobes; flesh thin, light greenish yellow, slightly juicy; nutlets usually 3, broad and rounded at the base, narrowed at the apex, ridged on the back, with a broad prominent sometimes grooved ridge, 6–7 mm. long and 5–5.7 mm. wide, or when 2 nearly hemispherical in general outline.

A shrub 2–3 m. high with slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut red and lustrous during their first season and dull red-brown the following year, and armed with numerous slender straight chestnut brown spines 3–4 cm. long.

In rich alluvial soil near Kittanning, Armstrong County, O. E. Jennings, (No. 65 type) May 27, 1907, O. E. and Grace K. Jennings, September 27, 1909.

8. **Cratægus dissona** Sargent.

Rhodora, V, 60 (1903); Bot. Gazette, XXXV, 379; Proc. Acad. Nat. Sci. Phila., 1905, 601.

On an alluvial flat, West Kittanning, Armstrong County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 64) October 7, 1906, O. E. Jennings, May 27, 1907; also Illinois to western and southern New England and to eastern Pennsylvania.

9. **Cratægus ampliata** n. sp.

Glabrous with the exception of the hairs on the upper curface of the young leaves. *Leaves* ovate, acuminate, rounded or cuneate at the broad base, finely often doubly serrate, with straight glandular teeth, and deeply divided into 4 or 5 pairs of broad acuminate lateral lobes; nearly fully grown when the flowers open about the middle of May and then thin, dark blue-green, lustrous and roughened above by short white hairs and pale below, and at maturity thin but firm in texture, scabrate or nearly smooth on the upper surface, 4.5–5.5 cm. long and 3.5–5 cm. wide, with slender midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular with minute deciduous glands, 2–2.5 cm. in length; leaves on vigorous shoots thicker, cordate or truncate at the base, more coarsely serrate more deeply lobed, and sometimes 6–6.5 cm. long and broad, with stout glandular petioles. *Flowers* 1.2–1.4 cm. in diameter, on long stout pedicels, in small 5- or 6-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, long, slender, acuminate, entire or minutely glandular-dentate near the middle, reflexed after anthesis; stamens 10; anthers rose color; styles 3–5. *Fruit* ripening early in October, on stout pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, dull scarlet, 1.2 cm. long and nearly as broad; flesh thin and yellow; nutlets 3–5, rounded at the base, gradually narrowed and rounded at the apex, or when 5 acute at the ends, ridged on the back, with a high narrow slightly grooved ridge, about 6 mm. long and 4 mm. wide.

A shrub 3–4 m. high, with small stems covered with ashy gray bark, small spreading branches forming a round-topped head, and slender only slightly zigzag branchlets dark orange-brown and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull gray-brown the following year, and armed with stout slightly curved chestnut brown shining spines 3–3.5 cm. long.

Rocky knoll, Orbisonia, Huntingdon County, B. H. Smith, (No. 312 type) May 20, 1906, October 8, 1907.

10. **Cratægus pyramidata** n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. *Leaves* broadly ovate, acuminate and frequently long-pointed at the apex, rounded or abruptly cuneate at the broad entire base, coarsely often doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of short broad lobes; more than half grown when the flowers open about the 20th of May and then thin, yellow-green and roughened above by short white hairs and pale blue-green below, and at maturity thin but firm in texture, dark yellow-green, nearly smooth and lustrous on the upper surface, pale blue-green on the lower surface, 5–6 cm. long and 4.5–5 cm. wide, with thin prominent midribs and slender conspicuous primary veins; petioles slender, slightly wing-margined at the apex, glandular, with conspicuous persistent glands, 2.5–3 cm. in length; leaves on vigorous shoots cuneate, rounded or slightly cordate at the base, coarsely serrate, more deeply lobed and often 7–8 cm long and 6–7 cm. wide, with stouter broadly winged more glandular petioles. *Flowers* 2 cm. in diameter, on long slender pedicels, in wide 5- to 10-flowered corymbs, the much elongated lower pedicels from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire or occasionally slightly dentate above the middle, sparingly hairy on the inner surface, reflexed after anthesis; stamens 10; anthers dark rose color; styles 3 or 4, surrounded at the base by a broad ring of long white hairs. *Fruit* ripening late in September or early in October. on stout pedicels in few-fruited spreading clusters, short-oblong or slightly obovate, rounded at the ends, scarlet, lustrous, marked by large pale dots, 1.1–1.3 cm. long and 1–1.1 cm. wide; calyx little enlarged, with a wide shallow cavity, and spreading and appressed entire or dentate lobes dark red on the upper side below the middle; flesh thick, yellow, soft and succulent; nutlets 3 or 4, broad and rounded at the apex, narrowed to the rounded base, ridged on the back, with a broad low slightly grooved ridge, 7–8 mm. long and 4–4.5 mm. wide, with a conspicuous hypostyle often extending to below the middle of the nutlet.

A shrub 7–8 m. high, with several stems, numerous erect branches forming a narrow pyramidal head, and stout zigzag branchlets dark orange-green more or less tinged with red and marked by large pale lenticels when they first appear, becoming in their second season light chestnut brown and very lustrous, and dull gray-brown the following year, and armed with occasional stout slightly curved spines 2.5–3 cm. long or often unarmed.

Glades and borders of oak woods near the Maloney Home and Country Club, Scranton, Lackawanna County, A. Twining, B. H. Smith and C. S. Sargent, (No. 73 type) May 24, 1908, A. Twining, September 19 and October 10, 1909; (No. 74) A. Twining, September 29, 1908.

This handsome species is very distinct in its remarkable fastigiate habit.

11. **Cratægus impervia** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* ovate, acuminate and often long-pointed at the apex, broad and rounded or abruptly cuneate at the base, sharply doubly serrate, with straight glandular teeth, and divided into 5 or 6 pairs of small acuminate spreading lateral lobes; about one-third grown when the flowers open in the last week of May and then yellow-green, lustrous and roughened above by short soft white hairs and pale below, and at maturity thin, dark yellow-green, smooth, and lustrous on the upper surface, pale on the lower surface, 4.5–6 cm. long and 4.5–5 cm. wide, with stout midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glandular, with minute often persistent glands, 1.5–2 cm. in length; leaves on vigorous shoots thicker and usually rounded at the base. *Flowers* 1.5–1.6 cm. in diameter, on long stout pedicels, in rather compact 6–15-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, entire or occasionally minutely dentate above the middle, reflexed after anthesis; stamens 5–10; anthers light rose color; styles 2 or 3. *Fruit* ripening the end of September, on stout reddish drooping pedicels, in few-fruited clusters, short-oblong to slightly obovate, full and rounded at the ends, salmon-red, lustrous, marked by small pale dots, 1.2–1.5 cm. long and 1–1.2 cm. in diameter; calyx little enlarged, with a deep narrow cavity pointed in the bottom, and small spreading persistent lobes dark red on the upper side below the middle; flesh thick, yellow, dry and bitter, nutlets 2 or 3, narrowed at the ends, acute at the apex, rounded at the base, irregularly ridged on the back, with a broad low slightly grooved ridge, 7–8 mm. long and 4–4.5 mm. wide.

A shrub 3–5 m. high, with small greenish gray smooth stems spreading into thickets, and slender only slightly zigzag branchlets dark orange-green when they first appear, becoming light chestnut brown, lustrous and marked by numerous pale lenticels when they first appear, dull reddish brown the following year, and armed with many slender slightly curved chestnut brown shining spines often pointed toward the base of the branch and 1.8–3.5 cm. long.

Hillsides, Dunmore, near Scranton, Lackawanna County, A. Twining, (No. 25 type) May 28 and September 22, 1907.

12. **Cratægus luxuriosa** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the calyx-lobes. *Leaves* oblong-ovate, acuminate, gradually narrowed and cuneate or rounded at the often unsymmetrical base, finely often doubly serrate, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small acute lobes; about half-grown when the flowers open late in May and then thin, dark yellow-green and roughened above by short white hairs and paler below, and at maturity thin, dark yellow green and scabrate on the upper surface, pale bluish green on the lower surface, 6–7 cm. long and 4.5–5.5 cm. wide, with slender midribs and thin obscure primary veins; petioles slender, slightly wing-margined at the apex, occasionally glandular, with minute persistent glands, 2.5–3.5 cm. in length. *Flowers* 1.5–1.9 cm. in diameter, on short slender pedicels, in compact mostly 6–12-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire or occasionally slightly dentate near the middle, glabrous on the outer surface, very slightly villose on the inner surface, reflexed after anthesis; stamens 8–10; anthers bright purple-pink; styles 3–5. *Fruit* ripening and beginning to fall early in October, on short stout pedicels, in drooping usually 1–3-fruited clusters, subglobose to slightly obovate, scarlet, lustrous, marked by pale dots, 1.2–1.8 cm. in diameter; calyx little enlarged, with a deep narrow cavity pointed in the bottom, and spreading and incurved usually persistent lobes dark red on the upper side below the middle; flesh thick, yellow-green and acid; nutlets 3–5, usually 4, gradually narrowed and rounded at the ends, ridged on the back, with a high broad grooved ridge, 7–7.5 mm. long and 4.5–5 mm. wide.

An oval-headed tree 6–7 m. high, with a short trunk sometimes 2.5 dm. in diameter, covered with dark gray scaly bark, and stout zigzag often contorted branchlets dark orange-green and marked by large pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull reddish brown the following year, and armed with few stout slightly curved chestnut brown shining spines 2–3.5 cm. long and persistent and becoming branched on old stems.

Rich hillsides, Kittanning, Armstrong County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 59 type) October 7, 1906, O. E. Jennings, May 27, 1907, O. E. and Grace K. Jennings, October 7, 1907; flood plain of the Allegheny River in sandy soil at Whiskey Hollow, opposite Kittanning, Armstrong County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 64) October 7, 1906, O. E. Jennings, May 27, 1907; Linesville, Cooper County, O. E. Jennings, (No. 82, with deep rose-purple anthers), June 12 and October 9, 1907.

13. **Cratægus recordabilis** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* ovate, acuminate, gradually narrowed and usually rounded, or cuneate at the entire base, finely often doubly serrate above, with straight glandular teeth, and divided generally only above the middle into 4 or 5 pairs of small acuminate spreading lobes; more than half grown when the flowers open late in May and then thin, dark yellow-green, smooth, lustrous, and slightly hairy on the midribs above and pale below, and at maturity thin, dark yellow-green and very lustrous on the upper surface, pale on the lower surface, 4.5–5.5 cm. long and 3.5–4 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, 2.5–3 cm. in length; leaves on vigorous shoots truncate or rounded at the broad base, more coarsely serrate and more deeply lobed, and often 5–6 cm. long and broad. *Flowers* 1.5 cm. in diameter, on short slender pedicels, in lax mostly 5–12-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, narrow, acuminate, entire or minutely dentate above the middle; stamens 8–10; usually 10; anthers dark rose color; styles 3 or 4, usually 4. *Fruit* ripening early in October, on slender drooping pedicels, in few-fruited clusters, narrow-obovate, full and rounded at the apex, gradually contracted to the rounded base, deeply convex at the insertion of the pedicel, slightly 5-angled, orange to greenish orange, becoming scarlet at maturity, marked by large pale dots, pruinose 1.2–1.3 cm. long and 9–10 mm. in diameter; calyx little enlarged, with a deep narrow cavity pointed in the bottom, and small spreading and reflexed persistent lobes dark red on the upper side below the middle; flesh thin, light orange color, juicy, acidulous; nutlets usually 4, narrowed and rounded at the ends, broader at the apex than at the base, ridged on the back, with a low narrow ridge, 6–6.5 mm. long and 3.5–4 mm. wide.

A bushy tree 3 or 4 m. high, with a short trunk sometimes 1.2 dm. in diameter and covered with flaky bark, small ascending gray-green branches forming a round-topped head, and slender zigzag branchlets dark chestnut brown when they first appear, becoming very lustrous and marked by dark lenticels in their first season and dull red-brown the following year, and armed with stout nearly straight chestnut-brown shining spines 1.5–3.5 cm. long, persistent and becoming branched on old stems.

Hillsides, in rich soil, Kittanning, Armstrong County, O. E. Jennings, (No. 46 type) October 14, 1905, O. E. Jennings, B. H. Smith and C. S. Sargent, October 7, 1906, O. E. Jennings, May 27, 1907, O. E. and Grace K. Jennings, October 7, 1907.

14. **Cratægus delectata** n. sp.

Glabrous with the exception of the hairs on the young leaves and on the calyx-lobes. *Leaves* ovate, acuminate and long-pointed, abruptly cuneate or rounded at the base, sharply often doubly serrate, with long slender glandular teeth, and slightly divided usually only above the middle into 4 or 5 pairs of broad acuminate spreading lobes; more than half-grown when the flowers open about the 20th of May and then light yellow-green and roughened above by short white hairs and pale and glabrous below, and at maturity thin, dark yellow-green, smooth and lustrous on the upper surface, pale bluish green on the lower surface, 4–5 cm. long and 3–3.5 cm. wide, with thin very prominent midribs and primary veins; petioles slender, slightly wing-margined at the apex, 1.5–2 cm. in length; leaves on vigorous shoots usually rounded or sometimes cuneate at the base, more coarsely serrate, more deeply lobed and often 6–7 cm. long and 5–6 cm. wide, with stout petioles broad-winged nearly to the middle and often glandular with persistent glands. *Flowers* 1.5 cm. in diameter, on long slender pedicels, in wide lax mostly 7–12-flowered corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, long, slender, acuminate, minutely glandular-serrate, slightly villose on the inner surface, reflexed after anthesis; stamens 6—10; anthers light rose color; styles 3 or 4. *Fruit* ripening the end of September, on slender reddish pedicels, in few-fruited clusters, obovate, full and rounded at the apex, gradually narrowed to the base, crimson, lustrous, marked by small pale dots, 1.2–1.5 cm. long and about 1 cm. in diameter; calyx little enlarged, with a wide shallow cavity, and small closely appressed lobes dark red on the upper side below the middle; flesh thin, yellow, soft and succulent; nutlets 3 or 4, gradually narrowed and acute at the ends but rather broader at the base than at the apex, ridged on the back, with a low grooved ridge, 6–7 mm. long and about 3 mm. wide.

A broad shrub sometimes 6 m. high, with numerous stems often 1 dm. in diameter and covered with scaly bark, spreading branches, and slender slightly zigzag branchlets light chestnut brown, lustrous and marked by numerous dark lenticels in their first season and still lustrous in the second year, and armed with slender slightly curved chestnut brown shining spines 4.5–5 cm. long, and persistent on the stems.

Keyser Valley, near Scranton, Lackawanna County, A Twining, (No. 54 type) September 30, 1907, May 23 and September 23, 1908.

15. **Cratægus infensa** n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. *Leaves* ovate, acuminate, abruptly concave-cuneate or rounded at the base, sharply often doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate lateral lobes; nearly half grown when the flowers open about the middle of May and then thick, dark yellow-green and slightly hairy on the midribs above and pale below, and at maturity thin, dark yellow-green, smooth and lustrous on the upper surface, pale on the lower surface, 3.5–4 cm. long and 3–3.5 cm. wide, with thin midribs and primary veins; petioles slender, occasionally glandular, with minute sometimes persistent glands, 1.5–2.5 cm. in length; leaves on vigorous shoots cordate or truncate at the broad base, more coarsely serrate, more deeply lobed, often 5–6 cm. long and broad, with stout midribs, prominent primary veins, and stout winged conspicuously glandular petioles. *Flowers* 1.6–1.8 cm. in diameter, on long slender pedicels, in compact mostly 6–12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short, broad, acuminate, minutely glandular-dentate near the middle, glabrous on the outer surface, slightly villose on the inner surface, reflexed after anthesis; petals often tinged with pink; stamens 10; filaments pink; anthers purplish pink; styles 3 or 4, usually 4. *Fruit* ripening in October, on short red drooping pedicels, in few-fruited clusters, short-obovate, nearly truncate at the apex, gradually narrowed, long and rounded at the base, scarlet, marked by large pale dots, slightly pruinose, 9–12 mm. long and 1.2–1.6 mm. wide; calyx little enlarged, with a short tube, a wide shallow cavity tomentose in the bottom, and small spreading usually deciduous lobes; flesh thin, yellow-green, and succulent; nutlets usually 4, gradually narrowed and rounded at the ends, ridged on the back, with a broad high grooved ridge, 6–6.5 mm. long and about 4.5 mm. wide.

A small tree 4 m. high, with a trunk 1.5–2 dm. in diameter, covered with gray scaly bark, wide-spreading branches forming a broad flat-topped head, and stout nearly straight branchlets dark orange-green sometimes tinged with red and marked by large pale lenticels when they first appear, becoming dark chestnut brown or purple and lustrous in their first season and dull red-brown the following year, and armed with numerous very stout straight purple shining spines 3–4.5 cm. long and persistent and much-branched on old stems.

Charleroi, Washington County, O. E. Jennings and Grace E. Kinzer, (No. 35) October 7, 1905, O. E. Jennings, May 21, 1906, May 21 and October 14, 1907.

16. **Cratægus vegrandis** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* ovate, acuminate, abruptly cuneate or rounded at the entire base, finely often doubly serrate above, with straight or incurved glandular teeth, and slightly divided into 3 or 4 pairs of narrow acuminate lobes; more than half-grown when the flowers open in the last week of May and then slightly tinged with red, very thin, yellow-green and roughened above by short white hairs and pale below, and at maturity thin but firm in texture, dark yellow-green and scabrate on the upper surface, pale bluish green on the lower surface, 3.5–4.5 cm. long and 2.5–3.5 cm. wide, with thin prominent yellow midribs and veins; petioles slender, slightly wing-margined at the apex, 2.5–3 cm. in length; leaves on vigorous shoots thicker, usually rounded at the broad base, frequently abruptly pointed at the apex, more coarsely serrate and more deeply lobed, and often 5–6 cm. long and wide. *Flowers* 1.5 cm. in diameter, on long slender pedicels, in crowded 5–15-flowered corymbs, with oblong-obovate to linear glandular bracts and bractlets fading brown and often persistent until after the flowers open, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes separated by wide sinuses, gradually narrowed from the base, long, slender, acuminate, finely glandular-serrate near the middle, reflexed after anthesis; stamens 5–10; anthers rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening about the 20th of September, on slender drooping red pedicels, in few-fruited clusters, obovate, rounded at the apex, gradually narrowed from above the middle to the base, scarlet, lustrous, marked by large pale dots, 9–10 mm. long and 7–9 mm. in diameter; calyx little enlarged, with a broad shallow cavity, and small spreading and appressed lobes dark red on the upper side below the middle; flesh thin, yellow, soft and juicy; nutlets 3 or 4, gradually narrowed and rounded at the ends, sometimes broader at the base than at the apex, ridged on the back, with a broad low grooved ridge, 6–6.5 mm. long and 4–4.5 mm. wide.

A shrub 3–4 m. high, with small erect stems and branches covered with yellow-green bark, and slender slightly zigzag branchlets dark orange-green when they first appear, becoming bright chestnut brown, lustrous and marked by small pale lenticels in their first season and dull red-brown the following year, and armed with numerous slender slightly curved chestnut brown shining ultimately dark gray spines 3.5–4.5 cm. long, persistent and becoming branched on old stems.

Border of woods, Maloney Home, near Scranton, Lackawanna County, A. Twining, (No. 31 type) May 28 and September 23, 1907.

17. **Cratægus radina** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* ovate to broad-obovate, acuminate and long-pointed at the apex, gradually or abruptly cuneate at the entire base, sharply often doubly serrate above, with straight glandular teeth, and slightly divided often only above the middle into 4 or 5 pairs of narrow acuminate lobes; very thin, dark yellow-green and furnished with occasional hairs on the upper side of the midribs and paler below when the flowers open about the middle of May; petioles slender, wing-margined at the apex, sparingly glandular, 2–3 cm. in length; mature leaves not seen. *Flowers* 1.5–1.8 cm. in diameter, on long slender pedicels, in small compact mostly 4–7-flowered corymbs, the long lower peduncles from the axils of small narrow acuminate deciduous leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, finely glandular-serrate, reflexed after anthesis; stamens 8–10, usually 10; anthers pale pink; styles 3–5, *Fruit* ripening and falling early in October, on short slender pedicels, in few-fruited clusters, globose to slightly obovate, rounded at the apex, 5-angled, yellow-green to dark purplish red, marked by small dark dots, pruinose, becoming lustrous, 1.2–1.4 cm. in diameter; calyx little enlarged, with a broad shallow cavity, and spreading lobes; flesh pale greenish yellow, solid, juicy, acidulous; nutlets 3–5, narrowed and rounded at the ends, broader at the base than at the apex, slightly ridged on the back, 6–6.5 mm. long and 3.5–4 mm. wide.

A tree 3–4 m. high, with a trunk sometimes 1 dm. in diameter and covered with dark gray scaly bark, ascending and spreading branches forming a round-topped head, and slender nearly straight branchlets, dark green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull reddish brown the following year, and armed with numerous very slender slightly curved chestnut brown shining spines 1.5–3.5 cm. long and persistent and much-branched on old stems.

Ravines, Schenley Park, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 4 type) September 28, 1905, O. E. and Grace K. Jennings, May 20 and October 18, 1907, O. E. Jennings, October 3, 1908, May 24, 1909.

No. 20 from the same locality (O. E. Jennings, B. H. Smith and C. S. Sargent, September 25, 1905, O. E. Jennings, May 18, 1906, June 12 and October 3, 1908, May 24, 1909) with 12–20 stamens does not appear to differ in other characters from *C. radina*. The fruit, however, of No. 20 has not been collected. No. 57 from the same locality (O. E. Jennings, May 23, 1906, September 13, 1909) has the same general appearance and belongs probably also to the same species.

18. **Cratægus lætans** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* oblong-ovate, acuminate, rounded or abruptly cuneate at the base, sharply often doubly serrate, with slender straight glandular teeth, and deeply divided usually only above the middle into 3 or 4 pairs of narrow acuminate spreading or reflexed lobes; nearly half-grown when the flowers open about the middle of May and then thin, light yellow-green and slightly roughened above by short white hairs and paler below, and at maturity thin, dark blue-green, lustrous and scabrate on the upper surface, pale bluish green on the lower surface, 4–5 cm. long and 2.5–4 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with occasional minute usually deciduous glands, 2–2.5 cm. in length; leaves on vigorous shoots thicker, rounded at the base, coarsely serrate, deeply divided into 4 or 5 pairs of acute lateral lobes and often 6–7 cm. long and wide. *Flowers* 1.2–1.3 cm. in diameter, on short slender pedicels, in small compact mostly 6–12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire, reflexed after anthesis; stamens 10; anthers deep rose color; styles 2–4, surrounded at the base by a narrow ring of pale hairs. *Fruit* ripening early in October and persistent until after the leaves have fallen, on slender drooping pedicels, in mostly 6–9-fruited clusters, obovate or rarely short-oblong, flattened or slightly depressed at the apex and rounded at the narrow base, sometimes 3–5-angled, dark orange-red, slightly pruinose, marked by numerous pale dots, 1.1–1.3 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading often persistent lobes dark red on the upper side below the middle; flesh thick, rather succulent, greenish yellow, acidulous; nutlets usually 3 or 4, rounded at the apex, acute at the base, ridged on the back, with a low grooved ridge, 5–5.5 mm. long and 4–4.5 mm. wide.

A shrub 3–4 m. high, with smooth stems covered with dark gray scaly bark, and slender nearly straight branchlets dark orange-green when they first appear, becoming dark orange-brown, lustrous and marked by dark lenticels in their first season and dull reddish brown the following year, and armed with slender straight or slightly curved chestnut brown shining spines 2–3 cm. long and occasionally persistent and becoming branched on old stems.

Nine-mile Run, Pittsburg, Allegheny County, O. E. and Grace K. Jennings, (No. 68 type) May 17, 1907, O. E. Jennings and B. H. Smith, October 5, 1907.

19. **Cratægus ruricola** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* broad-ovate, acuminate, gradually narrowed and rounded or cuneate at the often unsymmetrical base, coarsely often doubly serrate, with straight glandular teeth, and deeply divided into 4 or 5 pairs of narrow acuminate spreading often recurved lobes; tinged with red when they unfold, about one-third grown when the flowers open early in May and then thin, yellow-green and roughened above by short white hairs, and at maturity thin, dark yellow-green and scabrate on the upper surface, paler on the lower surface, 5–8 cm. long and 3.5–6 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, 2.5–4 cm. in length. *Flowers* on short stout pedicels, in small compact 4–8-, usually 4 or 5-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, entire or minutely dentate near the middle, reflexed after anthesis; stamens 8–10; anthers pale pink; styles 3 or 4. *Fruit* ripening and falling early in October, on long slender pedicels, in few-fruited drooping clusters, obovate, full and rounded at the apex, gradually narrowed to the rounded base, scarlet, about 1.5 cm. long and broad; calyx little enlarged, with a short tube, a deep narrow cavity, and spreading lobes; flesh yellow, juicy; nutlets 3 or 4, broad and rounded at the apex, narrowed and acute at the base, ridged on the back, with a broad groove ridge, 5.5–6 mm. long and about 4 mm. wide.

A shrub 1.2–1.5 m. high, with small stems, and slender zigzag branchlets dark orange-green when they first appear, becoming light orange-brown, lustrous and marked by dark lenticels in their first season, and armed with numerous stout or slender straight or slightly curved chestnut brown spines 3.5–5 cm. long.

Chadsford, Delaware County, B. H. Smith and C. S. Sargent, (No. 250 type) October 3, 1904, B. H. Smith, May 6 and September 13, 1905, October 8, 1908.

20. **Cratægus effera** n. sp.

Glabrous with the exception of the hairs on the upper surface of the leaves. *Leaves* broad-ovate, acute or acuminate, rounded or abruptly cuneate at the wide base, finely often doubly serrate, with straight glandular teeth, and divided usually only above the middle into 3 or 4 pairs of short broad lobes; nearly half-grown when the flowers open late in May and then yellow-green and roughened above by short white hairs and glabrous below, and at maturity thick, dark bluish green, scabrate or nearly smooth on the upper surface, pale on the lower surface, 5–6 cm. long and 4–4.5 cm. wide, with slender prominent midribs and primary veins; petioles stout, slightly wing-margined at the apex, glandular, with usually persistent glands, 2.5–3 cm. in length; leaves on vigorous shoots thicker, usually rounded at the base and often 6–7 cm. long and wide, with stout winged conspicuously glandular petioles. *Flowers* 2 cm. in diameter, on long slender pedicels in 7- or 8-flowered corymbs; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire or minutely dentate near the middle, reflexed after anthesis; stamens 7 or 8; anthers dark rose color; styles 3 or 4. *Fruit* ripening early in October, on slender drooping pedicels, in few-fruited clusters, obovate, full and rounded at the apex, slightly narrowed to the rounded base, orange-red, marked by small pale dots, 1–1.2 mm. long and broad; calyx little enlarged, with a deep narrow cavity pointed in the bottom, and small spreading and closely appressed lobes dull red on the upper side below the middle; flesh thin, dry and hard; nutlets 4 or 5, rounded at the apex, gradually narrowed and rounded at the base, rounded and slightly grooved on the back, 6.5–7 mm. long and about 4 mm. wide.

A shrub sometimes 5 m. high, with stout stems covered with dark scaly bark, and slender slightly zigzag branchlets dark dull chestnut brown and marked by small pale lenticels in their first season and dull gray-brown the following year, and armed with very stout nearly straight purplish spines 2.5–3 cm. long.

Country Club, Scranton, Lackawanna County, A. Twining, (No. 44 type) October 4, 1907, May 24 and September 19, 1908, B. H. Smith, A. Twining and C. S. Sargent, May 24, 1908; Taylor's Hill, near Scranton, A. Twining, (No. 43) June 8, 1907.

21. **Cratægus cœrulea** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* ovate to oval, acuminate, abruptly or gradually narrowed and rounded or cuneate at the base, finely often doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of narrow acuminate lateral lobes; deeply tinged with red when they unfold, about one-half grown when the flowers open at the end of May and then thin, dark bluish green, smooth and slightly hairy above, with short soft hairs, and paler below, and at maturity thin, dark blue-green and smooth on the upper surface, pale blue-green on the lower surface, 3–4 cm. long and 2.5–3.5 cm. wide; petioles slender, slightly wing-margined at the apex, glandular, with minute usually deciduous glands, 1–1.3 cm.

in length; leaves on vigorous shoots broadly ovate and rounded at the base to rhombic, often 4–5 cm. long and 3.5–5 cm. wide, with stout glandular petioles broad-winged to below the middle. *Flowers* 1.5 cm. in diameter, on slender pedicels, in compact 5–10-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, slender, acuminate, entire or minutely and irregularly glandular-dentate, reflexed after anthesis; stamens 5; anthers light rose color; styles 2–4, surrounded at the base by a broad ring of pale tomentum. *Fruit* ripening late in September, on slender pedicels, in few-fruited clusters. obovate, bright orange-red, lustrous, marked by small pale dots, 1–1.2 cm. long and broad; calyx little enlarged, with a wide shallow cavity, and spreading persistent lobes; flesh yellow, thin, and solid; nutlets 2–4, acute at the ends, ridged on the back, with a high narrow grooved ridge, about 5 mm. long and 3 mm. wide.

A shrub 2–2.5 m. high, with stems covered with smooth gray bark, and very slender slightly zigzag branchlets dark orange-green when they first appear, becoming light chestnut brown, lustrous and marked by small dark lenticels in their first season and dull reddish brown the following year, and armed with stout recurved chestnut brown shining spines 2.5–3.5 cm. long.

Lincoln Heights, near Scranton, Lackawanna County, A. Twining, (No. 4 type and No. 5), May 31 and September 25, 1907, (No. 45) September 20, 1907, May 1908; Keyser Valley, near Scranton, A. Twining, (No. 16, with larger fruit) May 25 and October 1, 1907, September, 1908.

5. Tenuifoliæ.

Leaves thin, hairy on the upper surface early in the season, glabrous at maturity (scrabrate in No. 10), usually yellow-green; petioles long and slender. Flowers in glabrous corymbs; stamens 10 or less (in the following species); anthers rose color or pink. Fruit short-oblong to obovate, scarlet, lustrous, ripening in September; flesh soft and succulent; mature calyx small and sessile; nutlets 2–4.

- Calyx cavity of the fruit deep and narrow; fruit short-oblong to slightly obovate, usually about 1.2 cm. long and 1 cm. wide.
  - Petioles rarely more than 2 cm. in length.
    - Flowers up to 1.8 cm. in diameter; anthers dark rose color. 1. *C. tenella.*
    - Flowers not more than 1.2 cm. in diameter; anthers light rose color........2. *C. angustisepala.*
  - Petioles more than 2 cm. in length.
    - Corymbs 8–12-flowered; fruit short-oblong to slightly obovate.

Lobes of the leaves in 4 or 5 pairs.
Lobes of the leaves narrow, long-pointed...3. *C. glaucophylla.*
Lobes of the leaves short, acuminate....................4. *C. insolita.*
Lobes of the leaves in 6 or 7 pairs, small and spreading.
5. *C. flammata.*
Corymbs 4- or 5-flowered; lobes of the leaves long, narrow, spreading or recurved..6. *C. siderea.*
Calyx cavity of the fruit wide and shallow.
Leaves smooth.
Lobes of the leaves long, spreading, often recurved; fruit obovate, becoming oval when fully ripe..........7. *C. rufipes.*
Lobes of the leaves small and spreading; fruit short-oblong; leaves blue-green..8. *C. antheina.*
Lobes of the leaves narrow, acuminate, usually pointing toward the apex of the leaf; fruit short-oblong.
9. *C. propensa.*
Leaves scabrate on the upper surface; fruit pruinose.
10. *C. Heidelbergensis.*

1. **Cratægus tenella** Ashe.

Ann. Carnegie Mus., I, pt. 3, 338 (1902); Sargent, Bot. Gazette, XXXV, 108 (The Genus Cratægus in Newcastle County, Delaware); Proc. Acad. Nat. Sci. Phila., 1905, 608.

Roadsides and fields between Stroudsburg and Tannersville, Monroe County, B. H. Smith and C. S. Sargent, (Nos. 1, 3 and 6) May 22, 1908, B. H. Smith, September 19, 1908; near Scranton, Lackawanna County, A. Twining, (No. 24) October 3, 1907, May 24, 1908; Dunmore, near Scranton, A. Twining, (No. 20) October 3, 1907, May 24, 1908; valley of the Little Juniata River below Altoona, Blair County, B. H. Smith, (No. 260) May 20, 1905; valley of the Conemaugh between Wilmore and Portage, Blair County, B. H. Smith, (No. 271) May 21, 1905, May 17, 1906, B. H. Smith and C. S. Sargent, September 26, 1905, (No. 274) B. H. Smith, May 21, 1905, B. H. Smith and C. S. Sargent, September 26, 1905; near Wilmore, Blair County, B. H. Smith and C. S. Sargent, (No. 274½) September 26, 1905, B. H. Smith, May 17, 1906; also eastern Pennsylvania and northern Delaware.

No. 210 from near Kutztown resembles *C. tenella* in its fruit; the leaves are somewhat thicker and darker green, and the flowers are more cup-shaped. This plant grows on hillsides, while *C. tenella* in this region is usually found only on low ground.

2. **Cratægus angustisepala** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* obovate to oval or ovate, acuminate and long-pointed at the apex, cuneate at the base, finely often doubly serrate, with straight or incurved glandular teeth, and very slightly divided usually only above the middle into 2 or 3 pairs of narrow acuminate lobes; about half-grown when the flowers open late in May and then yellow-green and roughened above by short white hairs and pale below, and at maturity very thin, dark yellow-green and smooth on the upper surface, paler on the lower surface, 3–4 cm. long and 2.5–3 cm. wide, with thin midribs and primary veins; pedioles slender, slightly wing-margined at the apex, glabrous, with small scattered often persistent glands, 1.2–1.8 cm. in length. *Flowers* 1–1.2 cm. in diameter, on long very slender pedicels, in small mostly 6–8-flowered corymbs, with small linear-obovate to linear glandular bracts and bractlets often persistent until the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, very slender, acuminate, entire or minutely glandular-dentate near the middle, reflexed after anthesis; stamens 5–10; anthers light rose color; styles 3. *Fruit* ripening about the 20th of September, on slender red pedicels, in few-fruited clusters, short-oblong to slightly obovate, full and rounded at the ends, scarlet, lustrous, 1.2–1.3 cm. long and about 1 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading lobes dark red on the upper side below the middle; flesh thin, yellow, soft and juicy; nutlets 3, gradually narrowed and rounded at the ends or acute at the apex, ridged on the back, with a broad low grooved ridge, 5–6.5 mm. long and 3–3.5 mm. wide.

A shrub 3–4 m. high, with slender stems covered with smooth pale gray bark and spreading into thickets, and slender zigzag branchlets, bright green when they first appear, becoming light chestnut-brown, lustrous and marked by small pale lenticels in their first season and dull red-brown the following year, and armed with numerous slender straight or curved chestnut-brown spines 2–3 cm. long.

Low moist soil in meadows, Throop, near Scranton, Lackawanna County, A. Twining, (No. 21 type and No. 22) May 24 and September 22, 1907; near Scranton, A. Twining, (No. 23) May 24, 1907, September 29, 1908; Dunmore, near Scranton, A. Twining, (No. 27) May 28, 1907, September 20, 1908; near Scranton, A. Twining, (No. 53) September, 1907; Chinchilla, Lackawanna County, A. Twining, (No. 65) October 3, 1907.

No. 28 from Dunmore with larger flowers, 5–10 stamens and larger fruit, provisionally referred to this species, is perhaps distinct. A. Twining, May 28 and September 27, 1907.

3. **Cratægus glaucophylla** Sargent.

Rhodora, V, 140 (1903); Proc. Rochester Acad. Sci., IV, 12; Bull. Michigan State Board Geolog. Surv., 1906, 536; No. 4, Ontario Nat. Sci. Bull., 36; Bull. CXXII, N. Y. State Mus., 102.

Charleroi, Washington County, O. E. Jennings and Grace E. Kinzer, (No. 37) October 7, 1905, O. E. Jennings, May 21 and October 14, 1907; near Hillside Station, Westmoreland County, O. E. Jennings, (No. 77) May 25, 1907, O. E. and Grace K. Jennings, September 16, 1909; also western New England, western New York and through southern Ontario to southern Michigan.

4. **Cratægus insolita** Sargent.

Proc. Acad. Nat. Sci. Phila., 1905, 622.

Berks County, woods beyond reservoir on hill, near Kutztown, C. L. Gruber, (No. 140) May 15, 1906; North Heidelberg Township, C. L. Gruber, (No. 181) September 8, 1906; Lackawanna County, Lincoln Heights, Scranton, A. Twining, (No. 2) May 31, 1907, September 27, 1908; Keyser Valley, Scranton, A. Twining, (No. 11) May 27 and October 1, 1907; Virginia near Scranton, A. Twining, (No. 40) May 29, 1907; also in Delaware County.

5. **Cratægus flammata** n. sp.

Leaves ovate, acuminate and long-pointed at the apex, rounded, abruptly cuneate or slightly cordate at the base, finely often doubly serrate, with straight glandular teeth, and divided into 6 or 7 pairs of small acuminate spreading lateral lobes; nearly half grown when the flowers open about the 20th of May and then very thin, yellow-green and roughened above by short white hairs and pale blue-green below, and at maturity thin, yellow-green, smooth and glabrous on the upper surface, 5–6 cm. long and 3.5–4.5 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute often persistent glands, 2.5–4.5 cm. in length. *Flowers* 1.5 cm. in diameter, on slender pedicels, in mostly 7–10-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, acuminate and red at the apex, minutely glandular-serrate below the middle, reflexed after anthesis; stamens 5–8; anthers dark rose color; styles 2–4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening in September and persisting late into October, on short slender reddish pedicels, in few-fruited clusters, short oblong, full and rounded at the ends, scarlet, lustrous, marked by occasional small pale dots, 1–1.2 cm. long and 8–10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading lobes dark red on the upper side below the middle; flesh yellow, sweet and of pleasant flavor; nutlets 2–4, gradually narrowed and rounded at the ends, ridged on the back, with a low slightly grooved ridge, 5–6 mm. long and 3–4 mm. wide.

A shrub 2–3 m. high, with small erect stems covered with green-gray bark, and slender only slightly zigzag branchlets, dull chestnut brown and marked by large pale lenticels in their first season and dull gray-brown the following year, and armed with stout light brown ultimately gray spines 2.5–3 cm. long.

Woods, Birdseye, near Scranton, Lackawanna County, A. Twining, (No. 61 type) October 23, 1907.

6. **Cratægus siderea** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* ovate to oval or obovate, acuminate, gradually or abruptly narrowed to the entire base, finely doubly serrate above, with straight glandular teeth, and deeply divided often only above the middle into long narrow spreading or recurved acuminate lobes, about half-grown when the flowers open the middle of May and then very thin, yellow-green, and covered above by short white hairs and pale and glabrous below, and at maturity thin, yellow-green and scabrate on the upper surface, pale on the lower surface, 4–6 cm. long and 3–4 cm. wide, with slender midribs, and thin obscure primary veins; petioles slender, slightly wing-margined at the apex, 2–2.5 cm. in length. *Flowers* 1 cm. in diameter, on long slender pedicels, in small 4- or 5-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire, reflexed after anthesis; stamens 7–9, usually 8; anthers rose color; styles 3 or 4. *Fruit* ripening late in September, on long slender pedicels, in drooping clusters, obovate, gradually narrowed to the long base, light yellow-green, becoming dark red when fully ripe, marked by small dark dots, 1–1.2 cm. long and 9–10 mm. in diameter near the rounded apex; calyx little enlarged, with a short tube, a deep narrow cavity pointed and tomentose in the bottom, and reflexed closely appressed lobes; flesh thin, dry and mealy; nutlets 3 or 4, narrowed and rounded at the ends, rounded and slightly ridged on the back, 5–5.5 mm. long and 3.5–4 mm. wide.

A shrub 3–4 m. high, with small stems, and slender zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull red-brown the following year, and armed with numerous slender straight or slightly curved chestnut brown spines 2–3 cm. long.

Hill above Panther Hollow, Schenley Park, Pittsburg, Allegheny County, O. E. and Grace K. Jennings, (No. 70 type) May 17, 1907, O. E. Jennings, September 4, 1908, September 13, 1909.

7. **Cratægus rufipes** Ashe.

Jour. Elisha Mitchell Sci. Soc., XX, 51 (1904); Sargent, Proc. Acad. Nat. Sci. Phila., 1905, 609.

Keyser Valley, Scranton, Lackawanna County, B. H. Smith and A. Twining, (No. 66) May 23, 1908, A. Twining, September 14, 1908, (No. 57) A. Twining, October 22, 1907, September 23, 1908; borders of woods, Shady Valley Road, near Orbisonia, Huntingdon County, B. H. Smith, (No. 318) May 20, 1906, October 8, 1907, (No. 310) May 20, 1906, May 27 and October 8, 1907, B. H. Smith and C. S. Sargent, May 27, 1908; meadows near Altoona, Blair County, B. H. Smith and C. S. Sargent, (No. 291) September 25, 1905; near Hillside Station, Westmoreland County, O. E. Jennings, (No. 76) May 25, 1907, O. E. and Grace K. Jennings, September 16, 1908; also in Berks and Bucks Counties.

8. **Cratægus antheina** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* ovate, acuminate, abruptly cuneate or rounded at the base, finely often doubly serrate, with straight glandular teeth, and divided into 4 or 5 pairs of small acuminate spreading lateral lobes; less than half grown when the flowers open about the 10th of May and then thin, bluish green and roughened above by small white hairs, and at maturity thin, dark blue-green, smooth and lustrous on the upper surface, paler on the lower surface, 4.5–6.5 cm. long and 3–4.5 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with often persistent glands, 1.5–3 cm. in length. *Flowers* 1.6–2 cm. in diameter, on long slender pedicels, in 5–10-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, minutely glandular-serrate or sometimes entire, reflexed after anthesis; stamens 5–8; anthers dark rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening the end of September, on long slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the apex, gradually or abruptly narrowed at the base, scarlet, marked by small pale dots, slightly glaucous, 1–1.3 cm. long and 9–12 mm. in diameter; calyx little enlarged, with a wide shallow cavity, and spreading and reflexed often deciduous lobes; flesh thin, yellow, rather juicy; nutlets 3 or 4, narrowed at the apex, broader and rounded at the base, ridged on the back, with a broad low doubly grooved ridge 7–7.5 mm. long 4–4.5 mm. wide, with a prominent hypostyle extending to below the middle of the nutlet.

A shrub, with slender zigzag branchlets light orange-green and marked by pale lenticels when they first appear, becoming light orange-brown in their first season and darker-colored the following year, and armed with numerous slender slightly curved light red-brown spines 2–4.5 cm. long.

Borders of woods near West Leesport, Bucks County, C. L. Gruber, (No. 219 A type) September 29, 1905, May 13 and September 15, 1906, October 3, 1909.

9. **Cratægus propensa** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the calyx-lobes. *Leaves* oblong-ovate, acuminate, rounded or cuneate at the base, finely often doubly serrate, with straight glandular teeth, and divided into 5 or 6 pairs of narrow acuminate lobes usually pointing toward the apex of the leaf; more than half-grown when the flowers open about the 20th of May and then dark yellow-green, lustrous and slightly roughened above by short white hairs and pale bluish green below, and at maturity very thin, yellow-green, smooth, glabrous and lustrous on the upper surface, paler on the lower surface, 5–6 cm. long and 3.5–4 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, often rose color in the autumn, 2–2.5 cm. in length. *Flowers* 1.8 cm. in diameter, on long slender pedicels, in wide lax mostly 9–12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, long, slender, acuminate, entire, very slightly hairy on the inner surface, reflexed after anthesis; stamens 6–10; anthers dark rose color; styles 3 or 4. *Fruit* ripening the middle of September, on elongated pedicels, in few-fruited drooping clusters, short-oblong, full and rounded at the ends, scarlet, lustrous, marked by small pale dots, 1–1.2 cm. long and 8–10 mm. in diameter; calyx little enlarged, with a wide deep cavity pointed in the bottom, and spreading and appressed lobes dark red on the upper side below the middle, their tips often deciduous from the ripe fruit; flesh yellow, thick, soft and succulent; nutlets 3 or 4, rounded at the apex, acute at the base, only slightly ridged and occasionally grooved on the back, about 7 mm. long and 4 mm. wide.

A shrub 4–5 m. high, with numerous stems sometimes 12–15 cm.

in diameter, and slender nearly straight branchlets dark orange-green more or less tinged with red and marked by pale lenticels when they first appear, becoming light chestnut red and lustrous in their first season and dull red-brown or gray the following year, and armed with occasional straight very stout gray spines 1.5–2 cm. long.

Hillsides, Keyser Valley, Scranton, Lackawanna County, A. Twining, B. H. Smith and C. S. Sargent, (No. 68 type) May 23, 1908, A. Twining, September 14, 1908, (No. 12) A. Twining, September 23, 1908.

10. **Cratægus heidelbergensis** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* oblong-ovate, acuminate and long-pointed at the apex, rounded or abruptly cuneate at the wide base, finely often doubly serrate, with straight glandular teeth, and rather deeply divided into 3–6, usually 5, pairs of narrow acuminate spreading lobes; nearly half-grown when the flowers open from the 10th to the middle of May and then light yellow-green and roughened above by short white hairs and pale below, and at maturity thin, dark yellow-green and scabrate on the upper surface, pale bluish green on the lower surface, 4–6.5 cm. long and 2.5–4 cm. wide, with thin conspicuous midribs and primary veins; petioles slender, slightly wing-margined at the apex, 1.5–2 cm. in length; leaves on vigorous shoots usually rounded at the base, more coarsely serrate, more deeply lobed and often 7–8 cm. long and 6 cm. wide. *Flowers* 1.4–1.7 cm. in diameter, on long slender pedicels, in lax usually 6–12-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, linear, acuminate and red at the apex, entire or minutely glandular-dentate near the middle, reflexed after anthesis; stamens 5–8, rarely 9; anthers purple; styles 2–5, usually 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening the end of August and falling early in September, on long slender pedicels, in few-fruited clusters, obovate or rarely short-oblong to subglobose, scarlet frequently blotched with russet, marked by small pale dots, occasionally slightly pruinose, 1.2–1.7 cm. long and 1.2–1.5 cm. thick; calyx little enlarged, with a broad deep cavity tomentose in the bottom, and spreading and appressed generally persistent lobes dark red on the upper side below the middle; flesh orange-yellow slightly tinged with red, soft and acid; nutlets usually 3 or 4, rounded at the apex, acute at the base, rounded and slightly grooved or ridged on the back, 5.5–6 mm. long and about 4 mm. wide.

A shrub 3–4 m. high, with numerous large angular ridged stems and branches covered with dark gray bark and usually spreading into thickets, and slender zigzag branchlets dark olive-green tinged with red when they first appear, becoming light chestnut brown, very lustrous and marked by pale lenticels in their first season and olive-brown to red-brown the following year, and armed with numerous stout straight or slightly curved light chestnut brown shining spines 2.5–5 cm. long.

Dry gravelly soil, Forge Hill, North Heidelberg Township, near Kutztown, Berks County, common; C. L. Gruber, (No. 173 type) May 12 and September 8, 1902; border of stony upland woods about three miles north of Kutztown, C. L. Gruber, (Nos. 203 and 237) May 15, August 1 and September 6, 1906.

6. Molles.

Leaves thin, broad, cuneate or rounded at the base; petioles long; flowers large, in many-flowered corymbs; fruit subglobose or obovate, scarlet, more or less pubescent at the ends, up to 2.5 cm. in diameter, with thick succulent flesh; nutlets 3–5, narrowed at the ends, only slightly ridged; stamens in the following species usually 10; anthers pink or rose color.

Cratægus pennsylvanica Ashe.

Ann. Carnegie Mus., I, pt. III, 394 (1902).

Leaves ovate, acuminate, rounded or abruptly cuneate at the base, coarsely often doubly serrate, with straight glandular teeth, and slightly divided into 3 or 4 pairs of short broad acuminate lobes; slightly tinged with red when they unfold, more than half-grown when the flowers open the middle of May and then thin, dark yellow-green and roughened above by short white hairs and villose on the midribs and veins below, and at maturity thin, dark yellow-green and scabrate on the upper surface, paler, scabrate and still somewhat villose on the stout midribs and primary veins, 6.5–8 cm. long and 5–6 cm. wide; petioles slender, slightly wing-margined at the apex, villose through the season, occasionally glandular, 3–3.5 cm. in length; leaves on vigorous shoots rounded or truncate at the base, very coarsely serrate, more deeply lobed, often 10–12 cm. long and broad, with stout midribs, prominent primary veins, conspicuously glandular petioles, and large foliaceous lunate coarsely glandular-serrate persistent stipules. *Flowers* 1.8–2 cm. in diameter, on slender densely villose pedicels, in broad lax hairy mostly 8–15-flowered corymbs, with oblong-obovate to linear-obovate glandular bracts and bractlets, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, covered with long white hairs, the lobes long, slender, acuminate, laciniately glandular-serrate, glabrous on the outer surface, villose on the inner surface, reflexed after anthesis; stamens 8–12; anthers faintly tinged with pink; styles 3–5. *Fruit* ripening and falling early in October, on short stout drooping slightly hairy pedicels, in 4–12-fruited clusters, short-obovate, full and rounded at the apex, bright orange-red marked by small pale dots, puberulous at the ends, 1.8–2.5 cm. in diameter; calyx little enlarged, with a deep narrow cavity wide and tomentose in the bottom, and small spreading lobes dark red on the upper side below the middle, their tips often deciduous from the ripe fruit; flesh thick, orange-yellow, somewhat acidulous, fragrant, edible, sometimes made into jelly; nutlets 3–5, rounded at the apex, acute at the base, rounded and slightly grooved or ridged on the back, the conspicuous hypostyle extending to the middle of the nutlet, about 8 mm. long and 5 mm. wide.

A tree sometimes 10 m. high, with a tall trunk often 4 dm. in diameter, covered with dark gray scaly bark, large spreading branches forming a wide symmetrical round-topped head, and stout slightly zigzag branchlets dark orange-green and more or less tinged with red when they first appear, becoming dark chestnut brown, marked by large dark lenticels and more or less pubescent in their first season, dark red-brown the following year, and armed with stout straight or slightly curved chestnut brown shining spines 3–4 cm. long.

Meadows, in low moist soil, near Pittsburg, Allegheny County, common; J. A. Shafer, Stowe Township, near Turner Station, October 3. 1901, J. A. Shafer and W. W. Ashe, October, 1901; near Pittsburg, (type tree) O. E. Jennings, B. H. Smith and C. S. Sargent, September 28, 1905; Riverview Park, Allegheny City, Allegheny County, O. E. Jennings and Grace E. Kinzer, (No. 30) October 2, 1905, O. E. Jennings, May 24, 1906, May 20, September 14 and October 14, 1907, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 23) September 25, 1905, O. E. and Grace K. Jennings, May 18, 1907, O. E. Jennings, September 22, 1907.

Specimens of a species in this group collected in the valley of the Conemaugh between Portage and Wilmore, in Cambria County, by Mr. B. H. Smith, (No. 276) May 21, 1905, and May 17, 1906, is probably *C. Ellwangeriana* Sargent. The specimens show the peculiar stipules of that species, but without the fruit this determination is only provisional, and it has been impossible to obtain fruit from this tree as in 1905 and 1906 insects destroyed the flowers as soon as they opened.

7. Coccineæ.

Leaves large, thin, oblong, acutely and more or less deeply lobed; petioles long; flowers in usually wide many-flowered corymbs; anthers pink, rose color or purple; fruit subglobose, short-oblong, obovate or oval, scarlet, 1–2.2 cm. long; flesh succulent; nutlets 3–5, prominently grooved, and usually ridged on the back; stamens in the following species usually less than 10. (*Coccineæ*, Loudon, *Arb. Brit.*, II, 816 [1838]; Eggleston, *Gray Man.*, ed. 7, 473. *Flabellatæ*, Sargent, *Rhodora*, III, 22 [1901].)

- Fruit subglobose to short-oblong.
  - Flowers not more than 1.6 cm. in diameter, on short densely villose pedicels; fruit 1–1.2 cm. in diameter......1. *C. Burkeana.*
  - Flowers up to 2.2 cm. in diameter, on long only slightly hairy pedicels; fruit 1.4–1.9 cm. long........................2. *C. sejuncta.*
- Fruit depressed-globose to slightly obovate...........3. *C. pedicellata.*
- Fruit obovate or oval.
  - Flowers not cup-shaped, in small compact 8–12-flowered corymbs; leaves broadly ovate; fruit obovate.................4. *C. cristata.*
  - Flowers cup-shaped, in broad many-flowered corymbs; leaves oval to ovate; fruit oval..............................5. *C. Holmesiana.*

1. **Cratægus Burkeana** n. sp.

Leaves ovate, acute or acuminate, abruptly cuneate or rounded at the base, sharply often doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acute lateral lobes; nearly half-grown when the flowers open about the 10th of May and then thin, light yellow-green and roughened above by short white hairs and paler and sparingly villose on the midribs and veins below, and at maturity thin, yellow-green and scabrate on the upper surface, nearly glabrous on the lower surface, 5–8 cm. long and 4.5–8 cm. wide, with stout midribs, and thin prominent primary veins; petioles slender, slightly wing-margined at the apex, densely villose early in the season, becoming almost glabrous, 1.5–3 cm. in length; leaves on vigorous shoots usually cordate at the broad base, more coarsely serrate and more deeply lobed and often 8–10 cm. long and broad, with thicker midribs and primary veins and stout glandular petioles. *Flowers* 1.2–1.6 cm. in diameter, on short densely villose pedicels, in small compact hairy mostly 5–10-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, slightly villose, the lobes long, slender, acuminate, coarsely glandular-serrate, glabrous on the outer surface, villose on the inner surface, reflexed after anthesis; stamens 5–8; anthers dark purple; styles

3–5. *Fruit* ripening late in September, on slender drooping slightly hairy pedicels, in wide clusters, subglobose to short-oblong or slightly obovate, rounded at the ends, crimson, lustrous, marked by small pale dots, 1–1.2 cm. in diameter; calyx prominent, with a wide shallow cavity, and spreading lobes, dark red on the upper side below the middle; flesh thick, light orange-yellow, juicy, acidulous; nutlets 3–5 acute at the apex, narrowed and rounded at the base, rounded and sometimes slightly grooved on the back, about 5 mm. long and 3 mm. wide.

A tree 5 or 6 m. high, with a trunk 2 dm. in diameter, covered with dark gray flaky bark, large spreading branches forming a round-topped head, and slender only slightly zigzag glabrous branchlets dark orange-green when they first appear, becoming light chestnut brown, lustrous and marked by dark lenticels in their first season and dark red-brown the following year, and armed with slender straight chestnut brown shining spines 2–2.5 cm. long.

Schenly Park, Pittsburg, Allegheny County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 21 type) September 28, 1905, O. E. Jennings and Grace E. Kinzer, May 24, 1906, May 17, 1907, O. E. Jennings, September 27, 1907.

This species is named for Mr. George William Burke, Superintendent of the Parks of Pittsburg, who has aided materially Dr. Jennings in his investigations of Cratægus in that city.

2. **Cratægus sejuncta** Sargent.

Bull. N. Y. State Mus., CV, 65 (1906), CXXII, 71; No. 4, Ontario Nat. Sci. Bull., 48.

Roadside near Robesonia, Berks County, C. L. Gruber, (No. 226) August 2 and September 2, 1905, May 12, 1906; also western New England, and through New York to southern Ontario.

From the type at West Albany, New York, of this widely distributed and rather variable species the Robesonia plant differs in its somewhat larger flowers (1.5–2 cm. in diameter), in its 15–20-flowered (not 8–10-flowered) corymbs, in the presence of a few hairs on the calyx-tube, and in its rather larger fruits.

3. **Cratægus pedicellata** Sargent.

Bot. Gazette, XXXI, 226 (1901); Silva N. Am., XIII, 101, t. 677; Proc. Rochester Acad. Sci., IV, 116; Man., 448, f. 365; No. 4 Ontario Nat. Sci. Bull., 46; Bull. N. Y. State Mus., CXXII, 69; Eggleston, Gray's Man., ed. 7, 475 (in part).

Between Stoopes Ferry and Carnot, Allegheny County, O. E. Jennings and Grace E. Kinzer, (No. 31) October 4 and 6, 1905, O. E.

Jennings, May 20, 1907, B. H. Smith, O. E. and Grace K. Jennings, October 9, 1907; Linesville, Crawford County, O. E. Jennings, (No. 91) October 9, 1907; also southern Ontario to western New York.

In the Pennsylvania plant the stamens are often only 5–7 and the mature leaves are rather less scabrate than those of *C. pedicellata* as it grows near Rochester, New York, where the species was first distinguished.

4. **Cratægus cristata** Ashe.

Ann. Carnegie Mus., I, pt. III, 392 (1902).

Leaves ovate, acute or acuminate, abruptly cuneate or rounded at the broad base, sharply often doubly serrate, with straight glandular teeth, and divided into 4 or 5 pairs of narrow acuminate lateral lobes; deeply tinged with red and villose on both surfaces when they unfold, nearly one-third grown when the flowers open about the 10th of May and then very thin, light yellow-green and roughened above by short white hairs, and paler and slightly villose on the midribs below, and at maturity thin, scabrate, dark yellow-green on the upper surface, paler on the lower surface, 7–9 cm. long and 6–7 cm. wide, with slender midribs and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, villose through the season, occasionally glandular, with persistent glands, 2–3 cm. in length; leaves on vigorous shoots rounded or truncate at the wide base, more coarsely serrate and more deeply lobed, and often 9–10 cm. long and broad, with stout petioles sometimes 4–5 cm. long. *Flowers* 1.7–1.8 cm. in diameter, on short pedicels, in small compact slightly hairy mostly 8–12-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes long, slender, acuminate, minutely glandular-dentate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 5–8; anthers dark pink; styles 3–5. *Fruit* ripening late in September, on long drooping red pedicels, in few-fruited clusters, obovate, full and rounded at the apex, gradually narrowed at the base, deep orange-red, marked by small pale dots, often glaucous, 1.2–1.4 cm. long and 1.1–1.2 cm. in diameter; calyx prominent, with a wide deep cavity pointed in the bottom, and small coarsely serrate persistent lobes; flesh thick, light orange-yellow, juicy, acidulous; nutlets 3–5, gradually narrowed and rounded at the ends, ridged on the back, with a broad low rounded ridge, 7–7.5 mm. long and 4–4.5 mm. wide.

A tree occasionally 5–7 m. high, with a short trunk 1.5–2 dm. in diameter, covered with dark gray scaly bark, or often shrubby, with numerous large stems, and slender slightly zigzag branchlets dark orange-green more or less tinged with red and covered with matted pale hairs when they first appear, becoming dull light chestnut brown in their first season and darker-colored the following year, and armed with many stout straight purple spines 2.5–3 cm. long.

Stowes Township, near Turner Station, Allegheny County, W. W. Ashe and J. A. Shafer, October 1901; on a hillside facing Forbes Avenue, opposite Woodland Avenue, Pittsburg, Allegheny County, W. W. Ashe and J. A. Shafer, October 1901, May 1902; Schenley Park, Pittsburg, Allegheny County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 22) September 28, 1905, O. E. Jennings, May 24, 1906, May 17 and September 22, 1907; on the flood plain of the Olive River at Fleming Park beyond McKee's Rocks, near Pittsburg, Allegheny County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 25, with rather smaller fruit containing often 4 or 5 nutlets), September 29, 1905, O. E. Jennings, May 17, 1907; Nine-mile Run, Pittsburg, O. E. Jennings, October 9, 1905, O. E. and G. K. Jennings, (No. 42, with more hairy corymbs) May 17, 1907. East Altoona, Blair County, B. H. Smith, (No. 265) May 20, 1905, May 17, 1906, B. H. Smith and C. S. Sargent, September 25, 1905; valley of the Conemaugh, between Portage and Wilmore, Cambria County, B. H. Smith, May 21, 1905, B. H. Smith and C. S. Sargent, September 26, 1905.

5. **Cratægus Holmesiana** Ashe.

Jour. Elisha Mitchell Sci. Soc., XVI, pt. II, 78 (1900); Sargent, Silva N. Am., XIII, 119, t. 676; Proc. Rochester Acad. Sci., IV, 114; Man., 449, f. 366; Proc. Acad. Nat. Sci., Phila., 1905, 630; No. IV, Ontario Nat. Sci. Soc. Bull., 53; Bull. CXXII, N. Y. State Mus., 71; Eggleston, Gray Man., ed. 7, 473.

Keyser Valley, Scranton, Lackawanna County, A. Twining, B. H. Smith and C. S. Sargent, (No. 67) May 23, 1906, A. Twining, September 14, 1908; Orbisonia, Huntingdon County, B. H. Smith, (No. 315) May 20, 1906, October 8, 1907; also Bucks and Berks Counties (var. *villipes* Ashe), and from Ontario to New England.

S. Rotundifoliæ.

Leaves subcoriaceous or thin, obovate to ovate or rhombic, cuneate at the base; petioles short or long. Flowers in mostly glabrous many- or few-flowered corymbs; anthers yellow or rose color. Fruit subglobose to short-oblong or obovate, red, ripening late, 1–1.5 cm. in diameter; nutlets usually 3 or 4. (*Rotundifoliæ*, Eggleston, Rhodora, X, 75 [1908]; *Coccineæ*, Sargent, Rhodora, III, 26 (not Loudon) [1901].)

Corymbs many-flowered; stamens 10; anthers pale yellow; fruit subglobose.
  Leaves subcoriaceous; fruit 1.2–1.5 cm. in diameter. 1. *C. rotundifolia.*
  Leaves thin; fruit usually less than 1 cm. in diameter. 2. *C. Dodgei.*
Corymbs few-flowered.
  Stamens 10 or less.
    Anthers pale yellow; stamens 10; leaves broadly ovate, thick; fruit subglobose to short-oblong........................3. *C. grossa.*
    Anthers slightly tinged with pink; stamens 5 or 6; leaves rhombic to slightly obovate, thin; fruit obovate. 4. *C. dacrioidea.*
  Stamens 10–15; anthers cream color; leaves ovate to obovate, thin..5. *C. varians.*
  Stamens 20 (15–20 in No. 9).
    Anthers cream color.
      Flowers less than 2 cm. in diameter, in 3–6-flowered corymbs.
        Leaves obovate, crenately serrate, glabrous. 6. *C. Brownii.*
        Leaves ovate to oval or rhombic, with straight teeth, villose above while young................7. *C. repentina.*
      Flowers at least 2.5 cm. in diameter, in 5–12-flowered corymbs; leaves ovate to obovate, villose while young. 8. *C. scopulorum.*
    Anthers rose color; leaves broadly ovate to obovate; fruit subglobose, usually broader than long........9. *C. ignava.*

1. **Cratægus rotundifolia** (Ehrhart) Moench.

Bäum. Weiss, 29, t. 1 (1785). Eggleston, Britton N. Am. Trees, 464; Gray Man., ed. 7, 468.
Mespilus glandulosa Ehrhart. Beitr., III, 20 (1788).
Cratægus horrida Medicus, Gesch. Bot., 84 (1793).
Mespilus rotundifolia Du Roi, Harbk. Baume (excl. syn. *Cratægus glandulosa* Aiton) (1795).
Cratægus glandulosa Willdenow, Berl. Baumz., 84 (excel. syn. *Cratægus sanguinea*) (1796).
Cratægus coccinea Lindley, Bot. Reg., XXIII, t. 1957 (not Linnæus) (1837).
Cratægus coccinea, var. *rotundifolia* Sargent, Bot. Gazette, XXXI, 14 (1900); Silva N. Am., XIII, 134; Man., 460; Proc. Acad. Nat. Sci. Phila., 1905, 631; Bull. N. Y. State Mus., CV, 64, CXXII, 72.
Cratægus rotundifolia var. *Bicknellii* Eggleston, Rhodora, X, 79 (1908); Gray Man., ed. 7, 469.

Keyser Valley, near Scranton, Lackawanna County, A. Twining, (No. 14) May 23 and September 14, 1908, June 4, 1909; East Altoona, Blair County, B. H. Smith and C. S. Sargent, (No. 290), B. H. Smith, May 17, 1906; between Portage and Wilmore, Cambria County, B. H. Smith, May 21, 1905, B. H. Smith and C. S. Sargent, September 26, 1905; also eastern Canada and New England to Illinois.

2. **Cratægus Dodgei** Ashe.

Elisha Mitchell Sci. Soc., XIX, 26 (March, 1901); Sargent, Proc. Acad. Nat. Sci. Phila., 1905, 632; Rhodora, VII, 213; Bull. CV, N. Y. State Mus., 64, CXXII, 72; Rep. Geolog. Surv. Michigan, 1906, 555.
Cratægus Gravesii Sargent, Rhodora, V, 159 (June, 1901).
Cratægus fallens Gruber, Proc. Bucks Co. Nat. Sci. Club, I, 19 (Cratægus in Bucks County) (1903).
Cratægus rotundifolia Eggleston, Gray Man., ed. 7, 468 (in part) (not Moench) (1908).

Lincoln Heights, Scranton, Lackawanna County, A. Twining, (No. 1) May 31, 1907; valley of the Little Juniata River below Altoona, Blair County, B. H. Smith, (No. 263) May 20, 1905, B. H. Smith and C. S. Sargent, September 27, 1905, (No. 268) B. H. Smith, May 20, 1905.

3. **Cratægus grossa** n. sp.

Glabrous. *Leaves* broadly ovate, acute, abruptly cuneate at the wide base or rarely obovate and gradually narrowed at the base, finely often doubly serrate, with straight or incurved glandular teeth, and very slightly divided usually only above the middle into 3 or 4 pairs of short broad acuminate lobes; nearly half-grown when the flowers open the middle of May and then thin, yellow-green, very smooth and lustrous above and pale below, and at maturity thick, dark yellow-green and lustrous on the upper surface, pale on the lower surface, 4.5–5.5 cm. long and 3.5–4.5 cm. wide, with prominent midribs and thin primary veins; petioles slender, slightly wing-margined at the apex, 2–2.5 cm. in length. *Flowers* 1.6–1.8 cm. in diameter, on short slender pedicels, in compact mostly 4–10-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed to the base, short, broad, acuminate, entire or slightly glandular-dentate, reflexed after anthesis; stamens 10; anthers cream color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening the end of September, on short stout erect pedicels, in few-fruited clusters, subglobose to short-oblong, full and rounded at the ends, dull orange-red, marked by numerous pale dots, 8–10 mm. in diameter; calyx little enlarged, with a wide shallow cavity pointed and tomentose in the bottom, and small spreading and appressed often deciduous lobes; flesh thin and hard; nutlets 3 or 4, acute at the base, gradually narrowed and rounded at the apex, rounded and slightly grooved on the back, 5–5.5 mm. long and about 4 mm. wide.

A broad round-topped shrub 1.5–2 m. high, with small ashy gray stems, and slender slightly zigzag often contorted branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut brown and lustrous in their first season and dull gray-brown the following year, and armed with numerous stout or slender slightly curved purple shining spines 3–6 cm. long.

Upland pastures and the borders of woods, common; near Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 296 type) September 30, 1905, September 7, 1909, B. H. Smith, May 18, 1906, May 22, 1909; road above Bedford Springs Hotel, Bedford, Bedford County, B. H. Smith, May 22, 1909, B. H. Smith and C. S. Sargent, September 7, 1909; field near cemetery, Bedford, Bedford County, B. H. Smith, (No. 17) May 22, 1909, B. H. Smith and C. S. Sargent, September 7, 1909.

4. **Cratægus dacrioidea** n. sp.

Leaves rhombic or slightly obovate, acute, acuminate or rarely orbicular and rounded at the apex, gradually narrowed to the long concave-cuneate base, sharply often doubly serrate, with straight glandular teeth, and sometimes slightly divided above the middle into small acute lobes, nearly fully grown when the flowers open about the 20th of May and then very thin, dark yellow-green, slightly roughened by short white hairs and villose on the midribs above and pale and glabrous below, and at maturity thin, dull yellow-green, smooth or scabrate on the upper surface and pale yellow-green on the lower surface, 3.5–5 cm. long and 2.5–3 cm. wide, with thin yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, becoming glabrous, glandular, with minute glands, 1.5–2.5 cm. in length. *Flowers* very fragrant, 2–3 cm. in diameter, on short slender slightly villose pedicels, in small compact 3–5-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes short, broad, laciniately glandular-serrate, glabrous, reflexed after anthesis; stamens 5 or 6; anthers faintly tinged with pink, soon becoming white; styles 3–5. *Fruit* ripening early in October, obovate, gradually narrowed to the base, somewhat narrowed at the apex, orange-red, lustrous, marked by large pale dots, 1.2–1.5 cm. long and 1–1.2 cm. in diameter; calyx little enlarged, with a short tube, a deep narrow cavity pointed in the bottom, and small spreading often deciduous lobes; flesh yellow-green, dry and hard; nutlets 3, gradually narrowed and rounded at the ends, rather broader at the base than at the apex, ridged on the back, with a deeply grooved ridge, 6–6.5 mm. long and 3.5–4 mm. wide.

A shrub 1–2 m. high, with very slender stems covered with smooth dark bark, and nearly straight branchlets dark orange-green tinged with red and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull red-brown the following year, and armed with numerous very slender straight purple shining spines 4–4.5 cm. long.

Borders of woods, Shade Gap Road, near Orbisonia, Huntingdon County, B. H. Smith, (No. 317 type) May 20, 1906, October 8, 1907.

5. **Cratægus varians** n. sp.

Glabrous. *Leaves* ovate to obovate, acuminate, gradually or abruptly narrowed and cuneate at the entire base, coarsely often doubly serrate, with broad straight glandular teeth, and slightly divided into 3 or 4 pairs of broad acute lateral lobes; nearly half-grown when the flowers open from the middle to the end of May and then very thin, yellow-green, smooth and lustrous above and paler below, and at maturity thin, yellow-green, pale, 5–7 cm. long and 3–5 cm. wide, with slender prominent midribs, and thin primary veins; petioles slender, narrowly wing-margined sometimes nearly to the middle, 2.5–4 cm. in length on the lower surface. *Flowers* 2.5 cm. in diameter, on short slender pedicels, in very compact mostly 5–7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes separated by wide sinuses, gradually narrowed from the base, short, broad, acuminate, entire or occasionally minutely glandular-dentate near the middle, reflexed after anthesis; stamens 10–15; anthers cream color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening and falling at the end of September, on long stout erect or spreading pedicels, in few-fruited clusters, subglobose, dark red blotched with green, marked by numerous large pale dots, 1–1.2 cm. in diameter; calyx little enlarged, with a short tube, a wide shallow cavity, and spreading often deciduous lobes; flesh green and hard; nutlets 3 or 4, gradually narrowed and acute at the ends, or, when 3, broad and rounded at the apex, ridged on the back, with a broad deeply grooved ridge, 6–6.5 mm. long and about 4 mm. wide.

An irregularly topped shrub 3–7 m. high, with several large spreading stems covered with pale scaly bark, small spreading and ascending branches, and slender nearly straight branchlets, dark orange-green and marked by numerous pale lenticels when they first appear, becoming bright chestnut brown and lustrous in their first season and light red- or orange-brown the following year, and armed with stout or slender straight or slightly curved chestnut brown shining spines 2.5–4 cm. long.

Glades in low moist soil surrounded by oak woods, near Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 292 type) September 29, 1905, B. H. Smith, May 18, 1906, May 22, 1909.

6. **Cratægus Brownii** Britton.

Bull. Torrey Bot. Club, I, 44 (1900).
Cratægus Margaretta Eggleston, Britton, N. Am. Trees, 463 (in part) (not Ashe) (1908); Gray Man., ed. 7, 464.

Orbisonia, Huntingdon County, B. H. Smith, (No. 319) May 20, 1906, B. H. Smith and C. S. Sargent, October 9, 1906; also mountains of Virginia.

7. **Cratægus repentina** n. sp.

Glabrous with the exception of the hairs on the young leaves and petioles. *Leaves* ovate to oval or rhombic, acuminate at the ends, or acute at the apex and abruptly cuneate at the base, finely often doubly serrate, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small acute lobes usually pointing toward the apex of the leaf; deeply tinged with red when they unfold, not more than one-third grown when the flowers open about the 20th of May and then dark yellow-green, smooth, lustrous and slightly hairy above and pale and glabrous below, and at maturity thin but firm in texture, dark yellow-green on the upper surface, pale on the lower surface, 5–5.5 cm. long and 3.5–4 cm. wide, with thin prominent midribs and primary veins; petioles slender, narrowly wing-margined often to the middle, slightly villose on the upper side while young, soon becoming glabrous, 2–3 cm. in length; leaves on vigorous shoots broadly ovate, acute, rounded at the wide base, coarsely serrate, deeply lobed, and often 5–6 cm. long and broad, with stout conspicuously glandular petioles. *Flowers* 1.8 cm. in diameter, on long slender pedicels, in compact 3–6-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, entire or occasionally minutely dentate near the middle, reflexed after anthesis; stamens 10–20; anthers cream color, minute; styles 3 or 4. *Fruit* ripening the middle of September, on stout drooping pedicels, in few-fruited clusters, subglobose to slightly obovate, red, pruinose, 1.2–1.3 cm. in diameter; calyx little enlarged, with a short neck, a deep narrow cavity pointed in the bottom, and reflexed appressed persistent lobes dark red on the upper side below the middle; flesh thin, firm, pale green; nutlets 3 or 4, narrowed and rounded at the apex, acute at the base, rounded and slightly grooved on the back, about 6 mm. long and 4 mm. wide.

A tree or arborescent shrub sometimes 5 m. high, with stems covered with gray scaly bark, spreading and erect branches, and slender only slightly zigzag branchlets dark orange-green and marked by numerous pale lenticels when they first appear, becoming light orange-brown and lustrous in their first season and darker orange-brown the following year, and armed with numerous slender straight or slightly curved shining spines 3–3.5 cm. long and persistent and compound on old stems.

Borders of woods on rich hillsides, near Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 14 type) May 26, 1908, September 7, 1909, B. H. Smith, September 17, 1908 and May 22, 1909.

8. **Cratægus scopulorum** n. sp.

Glabrous with the exception of the hairs on the young leaves and on the calyx-lobes. *Leaves* ovate to obovate, acuminate and short-pointed at the apex, cuneate or rounded at the base, sharply often doubly serrate, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small acuminate lobes; about one-third grown when the flowers open at the end of May and then very thin, concave, yellow-green, roughened above by short white hairs and slightly villose along the midribs and veins below; mature leaves not seen; leaves on vigorous shoots ovate, rounded at the broad base, more coarsely serrate, slightly lobed and often 6–7 cm. long and 5–6 cm. wide, with thick midribs, slender primary veins, and stout broadly winged slightly glandular petioles. *Flowers* 2.5–2.6 cm. in diameter, on short slender pedicels, in 5–12-flowered corymbs; calyx-tube narrowly obconic, the lobes gradually narrowed to the base, long, slender, laciniately glandular-serrate above the middle, sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers almost white; styles 3–5, surrounded at the base by a broad ring of pale tomentum. *Fruit* ripening late in September, on slender pedicels, in few-fruited clusters, short-oblong to slightly obovate, orange-red, marked by small pale dots, 8–10 mm. in diameter; calyx little enlarged, with a broad deep cavity, and small closely appressed lobes; flesh red; nutlets 3–5, rounded at the apex, acute at the base, ridged on the back, with a low narrow ridge, 6–6.5 mm. long and about 4 mm. wide.

A shrub 3–4 m. high, with stout stems covered with dark scaly bark and spreading into thickets, and slender slightly zigzag branchlets light orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull gray-brown the following year, and armed with slender slightly curved shining spines 2.5–3.5 cm. long.

Hillside at the base of Campbell's Ledge, Luzerne County, A. Twining, (No. 32 type) May 30 and September 28, 1907.

9. **Cratægus ignava** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* broadly ovate to obovate, acute or acuminate, gradually narrowed and concave-cuneate at the entire base, sharply often doubly serrate above, with straight glandular teeth, and divided usually only above the middle into 4 or 5 pairs of small acute spreading lobes; deeply tinged with red and covered above by long white hairs when they unfold, nearly one-third grown when the flowers open about the 20th of May and then dark yellow-green and roughened above by short hairs and pale bluish green below, and at maturity thin, yellow-green, scabrate on the upper surface, 5–6 cm. long and 4.5–5.5 cm. wide, with thin prominent midribs and primary veins; petioles stout, narrowly wing-margined sometimes to the middle, glandular, with occasional minute persistent glands, 2–2.5 cm. in length; leaves on vigorous shoots ovate, rounded or abruptly cuneate at the broad base, coarsely serrate, more deeply lobed, and often 6–7 cm. long and wide. *Flowers* 1.5 or 1.6 cm. in diameter, on long stout pedicels, in compact mostly 5–7-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes separated by wide sinuses, long, slender, acuminate, entire or minutely dentate near the middle, reflexed after anthesis; stamens 15–20; anthers light rose color; styles 2–4, surrounded at the base by a narrow ring of pale hairs. *Fruit* ripening late in September, on long stout drooping pedicels, in few-fruited clusters, subglobose or rather broader than long, light green when fully ripe, becoming russet, 1.6–1.7 cm. in diameter; calyx little enlarged, with a wide shallow cavity broad in the bottom, and small spreading lobes dark red on the upper side below the middle and often deciduous from the ripe fruit; flesh thick, firm, light green; nutlets 2–4, usually 3, rounded and obtuse at the ends, ridged and slightly grooved on the back, 8.5–9 mm. long and 6.5–7 mm. wide.

An arborescent shrub 6–7 m. high, with stems covered with gray scaly bark, spreading branches, and slender nearly straight branchlets dark orange-green and more or less tinged with red when they first appear, becoming bright orange-brown and lustrous in their first season and darker-colored the following year, and armed with slender straight or slightly curved chestnut brown shining spines

3.5–5 cm. long, persistent and becoming compound on old stems and branches.

Borders of oak woods, near Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 8 type) September 17, 1908, B. H. Smith, May 26, 1908, May 22, 1909.

9. Intricatæ.

Leaves usually cuneate; petioles short, glandular; flowers large, opening late, in small few, usually 3–7-flowered corymbs, with generally large conspicuous glandular bracts and bractlets; stamens 10 or less in the following species; fruit late-ripening, subglobose to short-oblong or obovate, sometimes broader than high, red, orange color, bright yellow or russet green more or less blotched with red, 1–1.5 cm. in diameter; flesh hard; nutlets 3–5, rounded at the ends.

- Anthers yellow.
  - Leaves and corymbs glabrous.
    - Fruit short-oblong to subglobose.
      - Leaves ovate to oval, 4.5–6 cm. in length, glabrous when young; flowers 2.5–3 cm. in diameter, in 5–8-flowered corymbs.....1. *C. Twiningii.*
      - Leaves ovate, 3–4 cm. in length, slightly hairy above while young; flowers 1.5–2 cm. in diameter, in 4–6-flowered corymbs.....2. *C. leptalea.*
    - Fruit short-oblong, orange red.
      - Leaves ovate, deeply lobed; flowers on slender pedicels, in 5-flowered corymbs, their bracts and bractlets small but conspicuous; fruit occasionally slightly obovate, 8–10 mm. in diameter.....3. *C. fructuosa.*
      - Leaves ovate to oval, only slightly lobed; flowers on stout pedicels, in 5- or 6-flowered corymbs, with large bracts and bractlets; stamens 6–8; fruit up to 1.4 cm. in diameter.....4. *C. lætula.*
    - Fruit oblong-obovate.
      - Leaves oblong-ovate.
        - Flowers on long slender pedicels; fruit russet green with a red cheek.....5. *C. Kinzeræ.*
        - Flowers on short pedicels; fruit orange color. 6. *C. intricata.*
      - Leaves oblong to oval.....7. *C. apposita.*
  - Leaves scabrate; corymbs villose.
    - Fruit short-oblong to subglobose.
      - Leaves rhombic to oval, narrowed at the base; flowers in 5–7-flowered corymbs.....8. *C. confusa.*
      - Leaves ovate, rounded or abruptly cuneate at the base; flowers in 3–5-flowered corymbs.....9. *C. contortula.*

Fruit oblong; leaves broadly ovate and rounded at the base to rhombic....................10. *C. callista.*
Fruit ovate; leaves ovate to oval, cuneate at the base 11. *C. alpista.*
Anthers rose color or pink.
Leaves smooth and glabrous at maturity; corymbs glabrous.
Fruit short-oblong to slightly obovate, canary yellow.
Leaves ovate to obovate; flowers in 6–12-flowered corymbs; anthers dark rose color....................12. *C. fortunata.*
Leaves oval to ovate; flowers in 5–6-flowered corymbs; anthers light pink....................13. *C. lutcola.*
Fruit depressed-ovate to short-oblong, rather broader than high, russet green more or less tinged with red; leaves ovate; anthers faintly tinged with pink....14. *C. Jenningsii.*
Leaves scabrate; anthers pink.
Flowers on densely villose pedicels, in small 3-flowered corymbs; calyx-tube villose; young leaves villose on the midribs and veins below; fruit subglobose to short-oblong..15. *C. scabra.*
Flowers on glabrous pedicels, in broad 3–7-flowered corymbs; calyx-tube and young leaves glabrous; fruit slightly obovate....................16. *C. gratiosa.*

1. **Cratægus Twiningii** n. sp.

Glabrous. *Leaves* ovate to oval, acute or acuminate, abruptly or acutely cuneate at the base, coarsely doubly serrate, with straight or incurved glandular teeth, and slightly divided above the middle into 2 or 3 pairs of short acuminate lobes; tinged with red when they unfold, nearly half-grown when the flowers open at the end of May and then thin, light yellow-green, smooth and lustrous on the upper surface and paler on the lower surface, and at maturity thin, dark yellow green above, pale below, 4.5–6 cm. long and 3.5–4.5 cm. wide, with stout midribs and slender primary veins; petioles stout, broadly wing-margined to below the middle, glandular, with minute persistent glands, often rose color in the autumn, 1.5–2.5 cm. in length; leaves on vigorous shoots broadly ovate and rounded or cuneate at the base, or nearly orbicular, coarsely serrate, more deeply lobed and often 6–7 cm. long and broad, with stout broadly winged conspicuously glandular petioles. *Flowers* 2.5–3 cm. in diameter, on short stout pedicels, in small compact 5–8-flowered corymbs, with large oblong-obovate to linear more or less falcate green coarsely glandular-serrate bracts and bractlets persistent until after the flowers open; calyx-tube broadly obconic, the lobes separated by wide sinuses, foliaceous, short, broad, acuminate, laciniately glandular-serrate above the middle, reflexed after anthesis; stamens 10; anthers yellow; styles 3–5, surrounded at the base by a broad ring of pale hairs. *Fruit* ripening early in

October, on short stout erect pedicels, in few-fruited clusters, short-oblong to subglobose, green tinged with red, 1.1–1.2 cm. in diameter; calyx prominent, with a wide shallow cavity broad and slightly tomentose in the bottom, and small spreading lobes dark red on the upper side; flesh green, dry and hard; nutlets 3 or 4, full and rounded at the ends, broader at the apex than at the base, ridged on the back, with a broad high deeply grooved ridge, 7–7.5 mm. long and 5 mm. wide.

A shrub 1–1.5 m. high, with stems covered with yellow-gray bark, and stout nearly straight branchlets dark orange-green and marked by large pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull red-brown the following year, and armed with numerous slender straight or slightly curved chestnut brown shining spines 1.5–2.5 cm. long.

Lincoln Heights, Scranton, Lackawanna County, A. Twining, (No. 9 type) June 8 and October 5, 1907, (No. 46) October 5, 1907.

This species is named for its discoverer, Mr. Alfred Twining, of Scranton, who first called attention to the richness of Lackawanna County in forms of Cratægus.

2. **Cratægus leptalea** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* ovate, acuminate, abruptly cuneate or rounded at the base, finely often doubly serrate, with straight glandular teeth, and divided into 3 or 4 pairs of short broad acute lateral lobes; nearly fully grown when the flowers open from the 20th to the 25th of May and then thin, yellow-green and furnished above with occasional white hairs and paler below, and at maturity thin, very smooth, yellow-green, paler on the lower surface than on the upper surface, 3–4 cm. long and 2.5–3 cm. wide, with thin midribs and primary veins; petioles slender, narrowly wing-margined to below the middle, glandular, with minute persistent glands, 1–1.5 cm. in length; leaves on vigorous shoots broadly ovate, rounded or abruptly cuneate at the wide base, more coarsely serrate and more deeply lobed, and often 5–5.5 cm. long and broad. *Flowers* 1.5–2 cm. in diameter, on short stout pedicels, in small compact 4–6-flowered corymbs, with large conspicuous glandular bracts and bractlets, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes foliaceous, acuminate, laciniately glandular-serrate, reflexed after anthesis; stamens 10; anthers white or cream color; styles 4 or 5. *Fruit* ripening in October, on stout erect pedicels, in mostly 3–5-fruited clusters, short-oblong to subglobose, about 1 cm. in diameter; calyx little enlarged, with a short tube, a broad shallow cavity, and spreading usually persistent lobes; flesh thin, green, dry and mealy; nutlets 4 or 5, gradually narrowed and rounded at the ends, rounded and ridged on the back, with a low narrow ridge, 7–8 mm. long and about 4 mm. wide.

A narrow shrub about 1 m. high, with small stems and branches, and slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming dark chestnut brown and lustrous in their first season and dull gray-brown the following year, and armed with numerous very slender nearly straight purple spines 2–3.5 cm. long.

Fields on hills above Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 12 type) May 26, 1908, September 7, 1909, B. H. Smith, September 17, 1908.

3. **Cratægus fructuosa** n. sp.

Glabrous with the exception of a few hairs on the upper surface of the young leaves. *Leaves* ovate, acuminate, abruptly or gradually narrowed and cuneate at the base, finely often doubly serrate, with straight glandular teeth, and divided into three or four pairs of short broad acute lateral lobes; not more than one-third grown when the flowers open about the 20th of May and then thin, yellow-green and slightly hairy on the upper side of the midribs, and at maturity thin, yellow-green, smooth and lustrous on the upper surface, pale on the lower surface, 4–4.5 cm. long and about 3.5 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with persistent glands, 2–2.5 cm. in length; leaves on vigorous shoots ovate, rounded at the wide base, more coarsely serrate, more deeply lobed and often 5.5–6 cm. long and broad, with stout broadly winged conspicuously glandular petioles. *Flowers* 1.6–1.8 cm. in diameter, on slender pedicels, in 5-flowered corymbs, with small but conspicuous glandular-serrate bracts and bractlets persistent until the flowers open; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, finely glandular-serrate above the middle, reflexed after anthesis; stamens 10; anthers cream color; styles 3 or 4. *Fruit* ripening in October, on short stout pedicels, in few-fruited erect and spreading clusters, depressed-globose, rounded at the ends, deep orange-red, lustrous, about 1 cm. long and 1.2 cm. wide; calyx prominent, with a short tube, a wide deep cavity pointed in the bottom, and spreading persistent lobes; flesh thin, firm, light yellow; nutlets 4 or 5, gradually narrowed and rounded at the ends, rather thicker at the apex than at the base, only slightly ridged on the back, 5.5–6 mm. long and about 4 mm. wide.

A shrub 1.5–2 m. high, with small ascending stems and branches covered with close dark bark, slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull reddish brown the following year, and armed with numerous stout nearly straight purple spines 2.5–3 cm. long.

Serpentine Ridge north of West Chester, Chester County, B. H. Smith, (No. 21 type) May 17 and October 5, 1909, B. H. Smith and Dr. W. T. Sharpless, May 22, 1909.

4. **Cratægus lætula** n. sp.

Glabrous with the exception of a few hairs on the young leaves and petioles. *Leaves* ovate to oval, acute or acuminate and often short-pointed at the apex, cuneate or rounded at the base, coarsely doubly serrate, with straight glandular teeth, and very slightly divided above the middle into 2 or 3 pairs of small lobes; more than half-grown when the flowers open about the 20th of May and then thin, yellow-green and furnished with a few hairs along the upper side of the slender midribs and veins, and at maturity thin, dark yellow-green, smooth and lustrous on the upper surface, pale on the lower surface, 3.5–4.5 cm. long and 2.5–3 cm. wide; petioles slender, slightly wing-margined at the apex, sparingly villose early in the season, soon becoming glabrous, glandular, with persistent glands, rose colored in the autumn, 1–1.5 cm. in length. *Flowers* 1.6 cm. in diameter, on long stout pedicels, in broad 3–6-flowered corymbs, with long broad ligulate laciniately glandular-serrate conspicuous bracts and bractlets persistent until after the petals fall; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, short, acute, laciniately glandular-serrate above the middle, reflexed after anthesis; stamens 6–10; anthers white, becoming pale yellow; styles 3 or 4. *Fruit* ripening in October, on elongated slender pedicels, in few-fruited drooping clusters, depressed-globose, full and rounded at the ends, deep dull red, about 1 cm. long and 1.3 cm. wide; calyx little enlarged, with a deep wide cavity broad in the bottom, and spreading and reflexed often deciduous lobes; flesh thick, yellow, dry and firm; nutlets 3 or 4, gradually narrowed and rounded at the ends, ridged on the back with a low narrow ridge, 5–5.6 mm. long and about 4 mm. wide.

An intricately branched shrub 2–3 m. high, with small stems covered with dark bark, and slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull gray-brown the following year, and armed with numerous slender straight chestnut brown spines 3.5–5 cm. long and often pointing toward the base of the branch.

Preston Run Barrens, Newtown, Delaware County, B. H. Smith, (No 246 type) May 27 and September 28, 1904, May 19 and September 29, 1909.

5. **Cratægus Kinzeræ** n. sp.

Glabrous. *Leaves* oblong-ovate, acuminate, gradually or abruptly narrowed to the cuneate base, sharply often doubly serrate, with straight glandular teeth, and deeply divided into 4 or 5 pairs of narrow acuminate spreading lateral lobes; about half-grown when the flowers open in the first week of June and then very thin, yellow-green and smooth above, paler below, and at maturity thin, dark yellow-green and lustrous on the upper surface, pale on the lower surface, 3.5–5 cm. long and 2.5–3.5 cm. wide, with slender midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute persistent glands, 1.2 cm. in length; leaves on vigorous shoots thin, rounded or abruptly cuneate at the broad base, more coarsely serrate, deeply lobed, and often 7–8 cm. long and 5–6 cm. wide. *Flowers* 1.5–1.8 cm. in diameter, on long slender pedicels, in small rather lax mostly 5–7-flowered corymbs, with conspicuous oblong-obovate to linear glandular-serrate bracts and bractlets fading brown and persistent until the petals have fallen, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, slender, acuminate, laciniately glandular-serrate above the middle, reflexed after anthesis; stamens 8–10, usually 10; anthers large, creamy white; styles 2–4, usually 3, surrounded at the base by a narrow ring of short white hairs. *Fruit* ripening and falling early in October, on slender erect or spreading pedicels, in few-fruited clusters, oblong-obovate, full and rounded at the apex, gradually narrowed to the long slender base, russet-green to russet-orange with a dark red cheek, 1.2–1.4 cm. long and 1–1.2 cm. in diameter; calyx little enlarged, with a wide shallow cavity hairy in the bottom, and small spreading and appressed persistent lobes; flesh thin, hard, becoming succulent when fully ripe, light greenish yellow; nutlets 2–4, usually 2 or 3, broad and rounded at the ends, or, when 2, narrowed and rounded at the ends and rather broader at the base than at the apex, ridged on the back, with a broad low slightly grooved ridge, 6.5–7 mm. long and 4–4.5 mm. wide.

An intricately branched shrub 2–3 m. high, with small spreading stems covered with dark gray bark, and spreading into thickets, and slender slightly zigzag branchlets, dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and dull red-brown the following year, and armed with only occasional slender straight chestnut brown shining spines 2–2.5 cm. long and sometimes persistent and branched on old stems.

Schenley Park, Pittsburg, Allegheny County, O. E. Jennings, (No. 56 type) May 27, 1906, May 17 and June 8, 1907, O. E. Jennings, October 5, 1907.

This beautiful and distinct plant is named for Miss Grace E. Kinzer, now Mrs. Jennings, the intelligent and zealous assistant of her husband in his botanical labors.

6. **Cratægus intricata** Lange.

Bot. Tidskr., XIX, 246 (1894); Sargent, Rhodora, III, 28; Bull. No. CV N. Y. State Mus., 67, No. CXXII, 104.

Hillside above Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 16) May 26, 1908; also New England to western New York.

7. **Cratægus apposita** Sargent.

Bot. Gazette, XXXV, 103 (The Genus Cratægus in Newcastle County, Delaware) (1903); Proc. Acad. Nat. Sci. Phila., 1905, 643.

Keyser Valley, Scranton, Lackawanna County, A. Twining (No. 52) June 13, 1907, September 20, 1908; also in Berks, Bucks and Delaware Counties; and in Newcastle County, Delaware.

8. **Cratægus confusa** n. sp.

Cratægus circur Ashe, Ann. Carnegie Mus., I, pt. 3, 397 (in so far as relates to Pittsburg, Pennsylvania) (1902).

Leaves rhombic to oval, acuminate at the ends, finely often doubly serrate, with straight or incurved glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of short broad acuminate lobes; about one-third grown when the flowers open late in May or early in June, and then very thin, light yellow-green and roughened above by short white hairs and paler and sparingly villose on the midribs below, and at maturity thin, yellow-green and scabrate on the upper surface, pale and almost glabrous on the lower surface, 4–6 cm. long and 3–5 cm. wide, with thin prominent midribs and primary veins; petioles slender, narrowly wing-margined nearly to the middle, densely villose early in the season, becoming nearly glabrous, glandular, with numerous persistent glands, 1.2–2 cm. in length; leaves on vigorous shoots thicker, concave-cuneate at the base, coarsely serrate, often 6–7 cm. long and 5–6 cm. wide. *Flowers* 1.8 cm. in diameter, on short slender villose pedicels, in small compact hairy mostly 5–7-flowered crowded corymbs, with conspicuous oblong-obovate to linear glandular-serrate bracts and bractlets fading brown and persistent until the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, coated with matted pale hairs, the lobes long, slender, acuminate, finely glandular-serrate, glabrous on the outer surface, slightly villose on the inner surface, reflexed after anthesis; stamens 10; anthers very large, pale cream color; styles 3 or 4, surrounded at the base by a broad ring of pale tomentum. *Fruit* ripening early in October and generally persistent after the leaves fall, on short stout villose erect pedicels, in mostly 2–5-fruited clusters, short-oblong to subglobose, truncate at the apex, rounded or flattened at the base, russet-green with a dark russet-red cheek, marked by numerous dark dots, 1.2–1.7 cm. in diameter; calyx prominent, with a short tube, a wide deep cavity pointed in the bottom, and spreading and reflexed persistent lobes; flesh thin, rather juicy, light yellow-green; nutlets 3 or 4 usually 3, broad and rounded at the ends, ridged on the back, with a broad low ridge, 6.5–7 mm. long and 5 mm. wide.

A shrub 1–2 m. high, with small spreading stems, and stout nearly straight branchlets dark orange-green, villose and marked by pale lenticels when they first appear, becoming dark brown or purple and lustrous in their first season and darker-colored the following year, and armed with occasional slender straight purple spines 4-5 cm. long.

Hillsides, Riverview Park, Allegheny City, Allegheny County, O. E. Jennings and Grace E. Kinzer, (No. 54 type) May 24, 1906, O. E. Jennings, B. H. Smith and C. S. Sargent, October 8, 1906, O. E and Grace K. Jennings, June 8 and October 14, 1907.

9. **Cratægus contortula** n. sp.

Leaves ovate, acute or acuminate, rounded or abruptly cuneate at the wide base, finely doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acute lateral lobes; nearly fully grown when the flowers open about the 20th of May and then thin, yellow-green and roughened above by short white hairs and villose on the midribs and veins below, and at maturity thin, yellow-green and scabrate on the upper surface and still hairy on the lower surface on the prominent midribs and thin primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute persistent glands, villose early in the season, becoming nearly glabrous, 1.5–2 cm. in length; leaves on vigorous shoots broadly ovate, rounded at the base, coarsely serrate, more deeply lobed and often 6–7 cm. long and 5–6 cm. wide. *Flowers* 1.5–1.8 cm. in diameter on short stout pedicels thickly coated with long white glandular hairs, in small compact 3–5-flowered corymbs, with conspicuous glandular bracts and bractlets; calyx-tube narrowly obconic, villose, the lobes abruptly narrowed from broad bases, long, foliaceous, laciniately glandular-serrate above the middle, glabrous on the outer surface, slightly hairy on the inner surface, reflexed after anthesis; stamens 10; anthers cream color; styles 5, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening in October, on stout elongated hairy pedicels, in mostly 2–4-fruited clusters, subglobose to short-oblong, green slightly blotched with red (September 6), about 1 cm. in diameter; calyx little enlarged, with a short tube, a wide shallow cavity broad in the bottom, and spreading often deciduous lobes; flesh thin, green, dry and hard; nutlets 5, gradually narrowed and rounded at the ends, narrower at the apex than at the base, 5–5.5 mm. long and 3.5–4 mm. wide.

A shrub 1 m. high or less, with small contorted intricately branched stems, and slender branchlets orange-green and coated with long white hairs when they first appear, still more or less hairy and dark chestnut brown at the end of their first season and dark gray-brown and glabrous the following year, and armed with numerous slender straight spines 1.5–2 cm. long.

Rich hillsides, Bedford, Bedford County; rare; B. H. Smith and C. S. Sargent, (No. 15 type) May 25, 1908, September 6, 1909.

10. **Cratægus callista** n. sp.

Leaves broadly ovate and rounded at the base to rhombic, acute and often short-pointed at the apex, sharply often doubly serrate, with straight glandular teeth, and divided above the middle into 3 or 4 pairs of short broad acute lobes; nearly fully grown when the flowers open about the 20th of May and then thin, light yellow-green and roughened above by short white hairs, and slightly hairy below on the slender midribs and primary veins, and at maturity thick, yellow-green and scabrate on the upper surface, scabrate and still hairy on the lower surface, 4–5 cm. long and 3.5–4 cm wide; petioles stout, narrowly wing-margined to below the middle, glandular, with numerous persistent glands, villose early in the season, becoming glabrous, 1.5–2 cm. in length; leaves on vigorous shoots broadly ovate, truncate or rounded at the base, coarsely serrate, more deeply lobed and often 6–6.5 cm. long and broad, with stout broadly winged conspicuously glandular petioles. *Flowers* 1.8–2 cm. in diameter, on stout sparingly villose pedicels, in small compact 3–5-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, coated with matted pale hairs, the lobes gradually narrowed from the base, long, slender, acuminate, glandular-serrate above the middle, slightly hairy, reflexed after anthesis; stamens 10; anthers pale yellow; styles 3–5, surrounded at the base by a broad ring of white hairs. *Fruit* ripening early in October, on short stout hairy pedicels, in few-fruited erect clusters, oblong, full and rounded at the ends, orange-red, 1–1.2 cm. long and 8–9 mm. in diameter; calyx prominent, with a wide deep cavity, and enlarged spreading lobes villose and dark red on the upper surface below the middle; flesh thin, yellow, dry and hard; nutlets 3–5, usually 3 or 4, narrowed and rounded at the ends, ridged on the back, with a broad doubly grooved ridge, 6–6.5 mm. long and about 4 mm. wide.

A shrub 1–2 m. high, with numerous small stems, and stout slightly zigzag branchlets dark orange-green marked by pale lenticels and slightly hairy when they first appear, becoming bright chestnut brown, lustrous and glabrous at the end of their first season and dark gray the following year, and armed with numerous slender slightly curved purple spines 2.5–3.5 cm. long.

Thickets near Rockhill Station, Bucks County, C. D. Fretz and C. S. Sargent, (No. 155 type) September 17, 1902, C. D. Fretz, May 22, 1903.

11. **Cratægus alpista** n. sp.

Leaves ovate to oval, acuminate, gradually or abruptly narrowed at the base, sharply often doubly serrate, with straight glandular teeth, and slightly divided into 5 or 6 pairs of slender acuminate lateral lobes, yellow-green and covered above by short white hairs and slightly villose on the midribs and veins below when the flowers open about the 20th of May; mature leaves not collected. *Flowers* 1.8–2 cm. in diameter, on short stout densely villose pedicels, in compact 3–5-flowered corymbs, with conspicuous glandular bracts and bractlets; calyx-tube broadly obconic, coated with matted white hairs, the lobes gradually narrowed from wide bases, long, acuminate, glandular-serrate above the middle, villose on the outer surface, glabrous on the inner surface, reflexed after anthesis; stamens 10; anthers cream color; styles 3 or 4. *Fruit* ripening in October, on elongated slender nearly glabrous pedicels, in few-fruited erect clusters, ovate, gradually narrowed and rounded at the apex, truncate at the base, dull red blotched with green, slightly hairy toward the apex, 1–1.2 cm. in diameter; calyx prominent, with a short hairy tube, a deep narrow cavity tomentose in the bottom, and spreading often deciduous lobes; flesh thin, green and firm; nutlets 3 or 4, gradually narrowed and rounded at the ends, ridged on the back, with a broad high grooved ridge, 6–6.5 mm. long and 4–4.5 mm. wide.

A shrub 1.5–2 m. high, with slender stems, and stout zigzag branchlets dark olive green and covered with long pale hairs when they first appear, becoming light chestnut brown, lustrous, glabrous, and marked by dark lenticels in their first season and dull green the following year, and armed with very numerous slender straight or slightly curved purple spines 2.5–4 cm. long.

Rocky knolls, Orbisonia, Huntingdon County, B. H. Smith, (No. 314 type) May 20, 1906, B. H. Smith and C. S. Sargent, May 27, 1908.

12. **Cratægus fortunata** n. sp.

Glabrous with the exception of the hairs on the calyx-lobes. *Leaves* oval to slightly obovate, acute at the ends and usually 3.5 cm. long and 2.5 cm. wide, to broadly ovate and acute at the apex, abruptly cuneate at the base and usually 3–3.5 cm. long and broad, finely often doubly serrate, with short straight or incurved glandular teeth, and sometimes slightly divided above the middle into 2 or 3 pairs of short broad acuminate lobes; deeply tinged with red when they unfold, nearly fully grown when the flowers open from the middle to the 20th of May and then light yellow-green and smooth above and pale below, and at maturity thin, dark yellow and lustrous on the upper surface, very pale and yellow below, with thin prominent midribs and primary veins, and conspicuous reticulate veinlets; petioles slender, narrowly wing-margined to below the middle, glandular, with minute deciduous glands, 1–1.8 cm. in length; leaves on vigorous shoots broadly ovate, rounded at the wide base, more coarsely serrate and more deeply lobed, and often 4–5 cm. long and wide. *Flowers* 2 cm. in diameter, on short slender pedicels, in small compact mostly 6–12-flowered corymbs, with oblong-obovate to linear glandular-serrate bracts and bractlets fading brown and persistent until the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, wide, coarsely glandular-serrate, glabrous on the outer surface, sparingly villose on the inner surface, reflexed after anthesis; stamens 10; anthers dark rose color; styles 2 or 3, usually 3, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening late in October, on short slender erect or spreading pedicels, in compact usually 4–9-fruited clusters, short-oblong to slightly obovate, full and rounded at the ends, bright canary yellow, marked by numerous large dark dots, 1–1.4 cm. in diameter; calyx prominent, with a short tube, a deep narrow cavity, and small spreading and reflexed lobes; flesh yellow, succulent, juicy, bitter and acid; nutlets 2 or 3, rounded at the ends, ridged on the back, with a broad slightly grooved ridge, 6.5–7 mm. long, and 4–4.5 mm. wide.

A round-headed shrub 2–3 m. high, with stout much-branched stems covered with close light gray bark, and slender nearly straight branchlets, dark orange-green and marked by pale lenticels when they first appear, becoming bright chestnut brown and very lustrous in their first season and dark red-brown the following year, and armed with very numerous slender straight purple shining spines pointing toward the base of the branch.

Open pastures, Washington County, Charleroi, O. E. Jennings and Grace E. Kinzer, (No. 34 type) October 7, 1905, May 21, 1906, O. E. Jennings, May 21 and October 14, 1907. Hillside above Twilight, O. E. Jennings, (No. 52) May 21, 1906, and half a mile west of Belle Vernon, O. E. Jennings, (No. 53) October 14, 1907, are probably of this species.

13. **Cratægus luteola** n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. *Leaves* oval to ovate, acute or acuminate, concave-cuneate at the base, coarsely often doubly serrate, with broad glandular teeth, and slightly divided above the middle into 2 or 3 pairs of broad acuminate lobes; more than half-grown when the flowers open about the middle of May and then thin, dark yellow-green, very smooth and slightly hairy on the midribs above and pale and glabrous below, and at maturity rather thick, dark yellow-green on the upper surface, light yellow-green on the lower surface, 4–5 cm. long and 3–4 cm. wide, with thick midribs, slender primary veins and conspicuous reticulate veinlets; petioles stout, narrowly wing-margined to below the middle, slightly hairy on the upper side while young, soon becoming glabrous, glandular, with minute persistent glands, 8–10 mm. in length; leaves on vigorous shoots ovate, abruptly cuneate at the base, more coarsely serrate and more deeply lobed, and often 6 cm. long and 5 cm. wide, with stouter broadly winged petioles. *Flowers* 1.8 cm. in diameter, on short slender pedicels, in small compact mostly 5- or 6-flowered corymbs, with large oblong acuminate glandular-serrate bracts and bractlets fading brown and often persistent until the flowers open, the short lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes separated by wide sinuses, short, broad, acuminate, entire or glandular-serrate near the apex, glabrous on the outer surface, furnished on the inner surface with a few pale hairs, reflexed after anthesis; stamens 6–10; anthers light pink; styles 3. *Fruit* ripening early in October, on short stout erect pedicels, in few-fruited clusters, subglobose to slightly obovate, light canary yellow, 1–1.2 cm. long, 8–10 mm. in diameter, calyx little enlarged, with a short tube, a deep narrow cavity, and deciduous lobes; flesh green, dry and hard; nutlets 3, rounded at the ends, slightly ridged on the back, about 6 mm. long and 3.5–4 mm. wide.

A shrub 2–3 m. high, with small spreading stems covered with dark gray bark scaly near the ground, small spreading branches, and slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming bright chestnut brown and lustrous in their first season and dull red-brown the following year, and armed with slender straight chestnut brown shining spines 1.5–2.5 cm. long.

Hillsides, very common; Orbisonia, Huntingdon County, B. H. Smith, (No. 304 type) May 19 and 20, 1906, October 8, 1907.

14. **Cratægus Jenningsii** n. sp.

Glabrous. *Leaves* ovate, acute or acuminate, gradually or abruptly narrowed and concave-cuneate, or broad and rounded at the base, coarsely often doubly serrate, with short glandular teeth, and slightly divided into 4 or 5 pairs of short acuminate lateral lobes; about one-third grown when the flowers open late in May and then very thin, light yellow-green and smooth above and pale bluish green below, and at maturity thick, dark blue-green and lustrous on the upper surface, paler on the lower surface, 5–7 cm. long and 4.5–5 cm. wide, with stout midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, narrowly wing-margined to below the middle, glandular with persistent glands, often rose color in the autumn, 1.5–2 cm. in length; leaves on vigorous shoots usually concave-cuneate at the broad base, coarsely serrate and often 8–9 cm. long and 7–8 cm. wide, with prominent midribs and primary veins and stout rose-colored conspicuously glandular petioles. *Flowers* 1.8–2 cm. in diameter, on long slender pedicels, in small mostly 5–9-flowered corymbs, with small linear-obovate to linear glandular bracts and bractlets fading brown and generally deciduous before the petals fall, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, slender, coarsely glandular-serrate at the acuminate apex, reflexed after anthesis; stamens 8–10; anthers faintly tinged with pink; styles 3 or 4, usually 3, surrounded at the base by a narrow ring of pale hairs. *Fruit* ripening late in October, on slender erect or spreading pedicels, in generally 5- or 6-fruited clusters, depressed-ovate to short-oblong, flattened at the ends, russet-green to dark russet-red or bronze color, marked by numerous pale dots, 1.2–1.4 cm. long and rather broader than high; calyx little enlarged, with a narrow deep cavity pointed in the bottom, and small spreading and reflexed persistent lobes; flesh thin, hard, light greenish yellow; nutlets 3 or 4, gradually narrowed and rounded at the ends, rather broader at the apex than at the base, ridged on the back, with a broad low slightly grooved ridge, 7–8 mm. long, and 4.5–5 mm. wide.

A shrub 3–4 m. high, with stout ascending stems covered with dark gray bark, stout nearly straight branchlets light orange-brown and marked by pale lenticels when they first appear, becoming dark chestnut brown and lustrous in their first season and dull reddish brown the following year, and armed with few stout straight purple shining spines 3.5–4 cm. long.

Hillsides, Kittanning, Armstrong County, O. E. Jennings, B. H. Smith and C. S. Sargent, (No. 58 type) October 7, 1906, O. E. Jennings, May 27, 1907, O. E. and Grace K. Jennings, October 7, 1907, (No. 51, with calyx-lobes somewhat dilated toward the apex) O. E. Jennings, October 14, 1905, May 28, 1906, O. E. Jennings, B. H. Smith and C. S. Sargent, October 7, 1906.

In associating the name of this species with that of its discoverer, Dr. Otto E. Jennings, head of the Botanical Department of the Carnegie Museum at Pittsburg, I am glad to express my admiration for his skill and industry in making known the flora of western Pennsylvania.

15. **Cratægus scabra** n. sp.

Leaves ovate, acute or acuminate, cuneate at the base, coarsely often doubly serrate, with wide straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of short broad lobes; coated with soft white hairs when they unfold, about one-third grown when the flowers open the middle of May and then thin, dark yellow-green, and roughened above by short white hairs and pale and slightly villose along the midribs and veins below, and at maturity thin, dark green and scabrous on the upper surface, pale yellow-green and scabrous on the lower surface, 5–6 cm. long and 4–5 cm. wide, with stout midribs and primary veins; petioles stout, wing-margined nearly to the middle, conspicuously glandular, 2–2.5 cm. in length; stipules lanceolate, more or less falcate, glandular-serrate, large and conspicuous, sometimes persistent until the petals fall; leaves on vigorous shoots usually rounded at the broad base, more coarsely serrate and more deeply lobed, and often 7–8 cm. long and 6–6.5 cm. wide, with lunate foliaceous coarsely glandular stipules. *Flowers* on short stout densely villose pedicels, in small compact mostly 3–5-flowered corymbs, with narrow oblong-obovate conspicuously glandular bracts and bractlets fading brown and persistent until the petals fall; calyx-tube narrowly obconic, densely coated with long matted pale hairs, the lobes short, broad, acuminate, coarsely glandular-serrate above the middle, glabrous on the outer surface, villose on the inner surface, reflexed after anthesis; stamens 5–10; anthers pale pink; styles 3 or 4. *Fruit* ripening early in October, on short slender pedicels, in few-fruited clusters, subglobose to short-oblong, green, about 1.2 cm. in diameter; flesh thin, green and hard; nutlets 3 or 4, broad and rounded at the apex, gradually narrowed and rounded at the base, slightly ridged on the back, with a low narrow ridge, 6–7 mm. long and 4–4.5 mm. wide.

A shrub 1–2 m. high, with small erect stems and branches, slender branchlets, dark orange-green tinged with red and marked by pale lenticels when they first appear, light chestnut brown and lustrous in their first season and dull red-brown the following year, and armed with very numerous slender straight or slightly curved chestnut brown shining spines 2.5–3 cm. long.

Rocky knoll, Orbisonia, Huntingdon County, B. H. Smith, (No. 313 type) May 20, 1906, October 8, 1908, (No. 306) B. H. Smith, May 19, 1906, B. H. Smith and C. S. Sargent, May 27, 1908.

16. **Cratægus gratiosa** n. sp.

Glabrous with the exception of the hairs on the upper surface of the leaves. *Leaves* ovate to oval, acute and often short-pointed at the apex, cuneate at the base, coarsely often doubly serrate, with straight glandular teeth, and slightly divided into 3 or 4 pairs of short broad lateral lobes; when they unfold slightly tinged with red and coated above with short white hairs, nearly fully grown when the flowers open at the end of May and then thin, yellow-green and still hairy above, and at maturity thick, yellow-green and scabrate on the upper surface, paler and lustrous on the lower surface, 3.5–4.5 cm. long and 2–3.5 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined to below the middle, glandular, 1–2 cm. in length; leaves on vigorous shoots broadly ovate, rounded or very abruptly cuneate at the wide base, more coarsely serrate, and often deeply lobed, with narrow acuminate lobes, their petioles stout, broadly winged and conspicuously glandular. *Flowers* 1.8 cm. in diameter, on long slender pedicels, in wide compact 3–7, usually 5–7-flowered corymbs, with large conspicuous viscid glandular bracts and bractlets mostly deciduous before the flowers open; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, short, acuminate, sharply glandular-serrate near the middle, reflexed after anthesis; stamens 10; anthers pink; styles 2 or 3. *Fruit* ripening in October, on elongated slender erect or spreading pedicels, in mostly 3- or 4-fruited clusters, slightly obovate, full and rounded at the apex, green blotched with red (September 7th), 8–10 mm. long and nearly as broad; calyx little enlarged, with a short tube, a deep narrow cavity, and spreading and reflexed lobes; flesh thin, green and hard; nutlets 2 or 3, rounded at the ends, rounded and ridged on the back, with a broad low slightly grooved ridge, 5–6 mm. long and about 4 mm. wide.

A narrow shrub rarely 1 m. high, with very slender erect stems and branches, and slender nearly straight branchlets orange-brown and marked by orange-colored lenticels when they first appear, becoming chestnut brown and very lustrous in their first season and gray-brown the following year, and armed with numerous slender straight chestnut brown shining spines 3–4 cm. long.

Fields on hills above Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 11 type) May 26, 1908, September 7, 1909, B. H. Smith, May 22, 1909.

10. Anomalæ.

Flowers in 8–15-flowered corymbs; anthers rose color; fruit short-oblong to oval, 1–1.5 cm. in length; nutlets usually marked by obscure ventral depressions; leaves cuneate.
- Stamens 20; leaves broad-ovate; fruit oval, orange-red; arborescent........1. *C. putata.*
- Stamens 15–20; leaves ovate to oval; fruit short-oblong, dark red; shrubby, spreading into large thickets........2. *C. errata.*

1. **Cratægus putata** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. *Leaves* broadly ovate, acuminate, gradually or abruptly cuneate at the base, finely often doubly serrate, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small spreading lateral lobes; about half-grown when the flowers open at the end of May and then thin, yellow-green, smooth, lustrous, and slightly hairy along the midribs above and pale below, and at maturity thick, dark yellow-green and glabrous on the upper surface, pale bluish green on the lower surface, 6–7 cm. long and 4.5–6 cm. wide, with thin midribs and primary veins; petioles slender, narrowly wing-margined nearly to the base, often rose color in the autumn, 1.8–2.2 cm. in length. *Flowers* 2 cm. in diameter, on long slender pedicels, in mostly 8–12-flowered corymbs, with oblong-obovate often falcate to linear glandular-serrate deep rose-colored bracts and bractlets mostly persistent until the flowers open; calyx-tube broadly obconic, the lobes separated by wide sinuses, gradually narrowed from the base, long, slender, red and acuminate at the apex, minutely glandular-serrate below the middle, reflexed after anthesis; stamens 20; anthers light rose color; styles 2 or 3. *Fruit* ripening early in October on slender pedicels, in few-fruited clusters, oval, orange-red, lustrous, marked by many large dark dots, about 1 cm. long and 8 mm. in diameter; calyx prominent, with a short tube, a deep narrow cavity pointed in the bottom, and small reflexed closely appressed persistent lobes; flesh thin, yellow, dry and mealy; nutlets 2 or 3, usually 3, gradually narrowed and rounded at the ends, ridged on the back, with a broad slightly grooved ridge, marked on the inner faces by slight depressions, 6–6.5 mm. long and about 4 mm. wide.

A tree 5 m. high, with a trunk sometimes 1.5 dm. in diameter, covered with scaly bark, and stout nearly straight branchlets, light orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and armed with numerous stout or slender nearly straight purple shining spines 4–5 cm. long, often pointed toward the base of the branch, and persistent and becoming branched on older stems.

Virginia, near Scranton, Lackawanna County, A. Twining, (No. 41 type) May 28 and October 1, 1907.

2. **Cratægus errata** n. sp.

Glabrous with the exception of the hairs on the young leaves. *Leaves* ovate to oval, acute or acuminate, gradually narrowed and concave-cuneate at the base, finely often doubly serrate, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small acuminate lobes; more than half-grown when the flowers open about the 10th of June and then light yellow-green, smooth and slightly hairy along the midribs above and lighter yellow-green and glabrous below, and at maturity rather thick, dark yellow-green, smooth, lustrous and glabrous on the upper surface, light yellow-green on the lower surface, 4–5 cm. long and 3–3.5 cm. wide, with thick midribs, and slender primary veins; petioles stout, slightly wing-margined at the apex, often rose color below the middle in the autumn, 1–1.5 cm. in length; leaves on vigorous shoots often rounded at the broad base, more coarsely serrate and more deeply lobed, and often 5–6 cm. long and broad. *Flowers* 1.8 cm. in diameter, on long stout pedicels, in mostly 12–15-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, finely glandular-serrate near the middle, reflexed after anthesis; petals tinged with pink; stamens 15–20; anthers bright pink; styles 3 or 4. *Fruit* ripening the end of October, on long stout pedicels, in drooping few-fruited clusters, short-oblong, full and rounded at the ends, dark red, lustrous, marked by small pale lenticels, 1–1.2 cm. in diameter; calyx prominent, with a wide deep cavity pointed in the bottom, and reflexed persistent lobes dark red on the upper side below the middle; flesh thin, dry and mealy; nutlets 3 or 4, narrowed and rounded at the apex, acute at the base, ridged on the back, with a broad low ridge, 6–7 mm. long and about 4 mm. wide, and furnished with very shallow depressions on the inner faces.

A broad shrub 3–4 m. high, with small stems covered below with pale scaly bark and smooth above, and spreading into large thickets, and stout slightly zigzag branchlets light yellow-green and marked by pale lenticels when they first appear, becoming light chestnut brown and lustrous in their first season and light reddish-brown the following year, and armed with stout straight or slightly curved purplish shining spines 2–3.5 cm. long, and numerous and persistent on old stems.

Low moist rich soil, Keyser Valley, near Scranton, Lackawanna County, common, A. Twining, (No. 47 type) June 13 and October 22, 1907.

B. Nutlets with longitudinal cavities on their ventral faces (Group Tomentosæ).

11. Tomentosæ.

Fruit obovate to subglobose or short-oblong, orange-red or scarlet, becoming soft and succulent at maturity, 6–12 mm. in diameter; nutlets 2 or 3, obtuse at the ends, prominently ridged on the back; flowers small, opening late, in tomentose or villose rarely glabrous corymbs; leaves thin to subcoriaceous.
Leaves thin with midribs and veins only slightly impressed on their upper surface; stamens 20.
Corymbs villose; leaves pubescent below during the season.
Anthers rose color..1. *C. tomentosa.*
Anthers pale yellow..2. *C. structilis.*

Corymbs and mature leaves glabrous.
Flowers in many-flowered corymbs; young leaves glabrous below; anthers white..............................3. *C. tanuphylla.*
Flowers in few-flowered corymbs; young leaves villose below; anthers pink....................................4. *C. propixa.*
Leaves subcoriaceous, with midribs and veins deeply impressed on their upper surface.
Stamens 20; anthers pink.
Pedicels stout, densely villose; leaves oblong-ovate to obovate, acuminate, slightly hairy on the lower surface; corymbs many-flowered; calyx-tube villose. 5. *C. succulenta.*
Pedicels slender, only slightly hairy; leaves obovate, mostly rounded at the apex; corymbs narrow, 10–15-flowered; calyx-tube glabrous...6. *C. vaga.*
Stamens 10–15; anthers rose color; pedicels and leaves glabrous. 7. *C. lœtifica.*
Stamens 10 or less.
Anthers pale pink; calyx-tube of the flower glabrous; fruit ovate..8. *C. diaphora.*
Anthers yellow; calyx-tube of the flower slightly villose; fruit subglobose to short-oblong..........................9. *C. agaia.*

1. **Cratægus tomentosa** Linnæus.

Spec., 467 (1753); Sargent, Silva N. Am., IV, 101, t. 183; Proc. Rochester Acad. Sci., IV, 132; Man., 492, f. 406; Proc Acad. Nat. Sci. Phila., 1905, 653; Rep. Geolog. Surv. Michigan, 1906, 560; No. 4 Ontario Nat. Sci. Bull., 75; Rep. Missouri Bot. Gard., XIX, 116.
Cratægus Chapmani, var. *Plukenetii* Eggleston, Rhodora, X, 83 (1908); Gray Man., ed. 7, 478.

"Scottsdown Road," Allegheny County, J. A. Shafer, June 3, 1903; also New York to Missouri and western North Carolina.

2. **Cratægus structilis** Ashe.

Jour. Elisha Mitchell Sci. Soc., XIX, 12 (1903); Sargent, Proc. Acad. Nat. Sci. Phila., 1905, 656; Rep. Geolog. Surv. Michigan, 1906, 562; Bull. Ont. Nat. Sci. Soc., 1908, 76; Bull. N. Y. State Mus., CXXII, 77.

Orbisonia, Huntingdon County, B. H. Smith, (No. 311) May 20, 1906, October 8, 1907, B. H. Smith and C. S. Sargent, May 27, 1908; also in Berks County, and in western New York to southern Ontario and eastern Michigan.

3. **Cratægus tanuphylla** n. sp.

Glabrous with the exception of the hairs on the inner surface of the calyx-lobes. *Leaves* oblong-obovate, acuminate, gradually narrowed to the entire base, finely and often doubly serrate above, and slightly divided above the middle into 4 or 5 pairs of small acuminate lobes; more than half-grown when the flowers open and then thin, dark dull yellow-green above and paler below, and at maturity 6–9 cm. long and 3.5–4.5 cm. wide, with thin midribs and primary veins; petioles slender, wing-margined nearly to the base, 1.5–2.5 cm. in length. *Flowers* 1.2–1.5 cm. in diameter, on long slender pedicels, in wide lax mostly 15–20-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, coarsely glandular-serrate above the middle, densely villose on the inner surface, reflexed after anthesis; stamens 20; anthers white; styles 2 or 3, usually 2. *Fruit* ripening in October, on slender drooping pedicels, in many-fruited clusters, short-oblong, full and rounded at the ends, crimson, lustrous, about 1 cm. in diameter; calyx little enlarged, with a narrow shallow cavity, and spreading often deciduous lobes; flesh yellow; nutlets 2 or 3, rounded at the ends, ridged on the back, slightly penetrated on the inner faces by small irregular grooves, 5–6 mm. long and 3–3.5 mm. wide.

A tree, with slender slightly zigzag branchlets light orange-green when they first appear, becoming dark chestnut brown and lustrous in their first season and armed with numerous stout straight chestnut-brown spines 3.5–4.5 cm. long.

Hollow back of cemetery near Staunton Avenue, Pittsburg, Allegheny County, J. A. Shafer, (No. 21 type) October 1901, May 1902.

This species differs from all the other thin-leaved Tomentosæ by the absence of hairs from the leaves and corymbs.

4. **Cratægus propixa** n. sp.

Leaves broadly obovate, acute or acuminate, concave-cuneate at the entire base, finely often doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 4 or 5 pairs of small acuminate spreading lobes; nearly fully grown when the flowers open in the first week of June and then thin, dark yellow-green, smooth, lustrous and slightly hairy along the midribs above and pale and villose on the midribs and veins below, and at maturity thin, dark yellow-green, smooth and lustrous on the upper surface, pale and scabrate on the lower surface, 8–9 cm. long and 6–6.5 cm. wide, with thin light yellow midribs and primary veins; petioles slender, narrowly wing-margined to the middle, often rose color in the autumn, 1–1.3 cm. in length. *Flowers* 1.5–1.6 cm. in diameter, on long stout glabrous pedicels, in narrow mostly 10–15-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from the base, long, slender, acuminate, laciniately glandular-serrate above the middle, glabrous on the outer surface, sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pink; styles 2 or 3, surrounded at the base by a few pale hairs. *Fruit* ripening the end of September. on slender drooping pedicels, in few-fruited clusters, subglobose to ovate, crimson, lustrous, marked by large pale dots, 7–8 mm. in diameter; calyx prominent, with a short tube, a deep narrow cavity pointed in the bottom, and small recurved persistent lobes; flesh thin, yellow, soft and succulent; nutlets 2 or 3, full and rounded at the ends, slightly ridged on the back, with a low narrow ridge, penetrated on the inner faces by broad shallow cavities, 5–5.5 mm. long and about 4 mm. wide.

A shrub 2–3 m. high, with several stout nearly straight stems, and glabrous branchlets light orange-green and marked by pale lenticels when they first appear and light chestnut brown and very lustrous the following season, and armed with numerous slender straight or slightly curved purple shining spines 4.5–5.5 cm. long and compounded and persistent on old stems.

Hillsides at the base of Campbell's Ledge, near Scranton, Luzerne County, A. Twining, (No. 36 type) June 8 and September 28, 1907.

5. **Cratægus succulenta** Link.

Handbook, II, 76 (1831); Sargent, Silva N. Am., XIII, 139, t. 131; Proc. Rochester Acad. Sci., IV, 133; Man., 497, f. 411; Proc. Acad. Nat. Sci. Phila., 1905, 75; Bull. U. S. State Mus., CV, 72, CXXII, 80; Ont. Nat. Sci. Bull., 1908, 92.

Township west of Carnot, Allegheny County, J. E. Shafer, (No. E 4) May 21 and October 17, 1902; also southern Ontario and western New York to southern New England and eastern Pennsylvania.

6. **Cratægus vaga** n. sp.

Leaves obovate, acute or rounded and often abruptly short-pointed at the apex, cuneate at the entire base, finally often doubly serrate above, with straight glandular teeth, and very slightly divided above the middle into 3 or 4 pairs of small acute lobes; less than half grown when the flowers open late in May and then thin, yellow-green, smooth, lustrous, and slightly hairy along the midribs above and light blue-green and sparingly villose along the midribs and veins below, and at maturity thick, dark yellow-green, very lustrous and glabrous on the upper surface, still slightly hairy below on the stout conspicuous midribs and primary veins, 4.5–6 cm. long and 3.5–4.5 cm. wide; petioles stout, narrowly wing-margined to below the middle, slightly hairy on the upper side, soon becoming glabrous, often red in the autumn, 1–1.5 cm. in length. *Flowers* 1.6–1.8 cm. in diameter, on long slender pedicels furnished with occasional white hairs, in narrow mostly 10–15-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes wide, elongated, coarsely glandular-serrate, glabrous on the outer surface, villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale pink; styles 2 or 3. *Fruit* ripening late in September, on long drooping pedicels, in few-fruited clusters, ovate to oval, orange-red, lustrous, 7–8 mm. long and 6–7 mm. wide; calyx prominent, with a short tube, a deep narrow cavity, and spreading often deciduous lobes; flesh thin, yellow, dry and mealy; nutlets 2 or 3, rounded at the apex, gradually narrowed at the base, only slightly ridged on the back, penetrated on the inner faces by long deep cavities, about 5 mm. long and 3.5–4 mm. wide.

A shrub 3–4 m. high, with small stems spreading into large dense round-topped thickets, small erect branches, and stout nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut brown and very lustrous in their first season and darker-colored the following year, and armed with numerous slender straight or slightly curved light chestnut brown shining spines 3.5–4 mm. long.

Borders of swamps and in oak woods near Bedford Springs, Bedford County, B. H. Smith and C. S. Sargent, (No. 13 type) May 26, 1908, B. H. Smith, September 17, 1908, May 22, 1909; meadows, valley of the Little Juniata River below Altoona, Blair County, B. H. Smith, (Nos. 267 and 283) May 20, 1905, B. H. Smith and C. S. Sargent, September 25, 1905.

7. **Cratægus lætifica** n. sp.

Glabrous with the exception of the hairs on the inner surface of the calyx-lobes. *Leaves* obovate, broad and rounded or acute and short-pointed at the apex, gradually narrowed to the cuneate base, coarsely often doubly serrate usually only above the middle, with straight glandular teeth, and occasionally slightly lobed, with broad acute lobes; when the flowers open at the end of May thick, dark yellow-green and very lustrous above and pale below, and at maturity subcoriaceous, glabrous, dark yellow-green, smooth and lustrous on the upper surface, paler on the lower surface, 4–5 cm. long and 3.5–4 cm. wide, with stout midribs, and prominent primary veins connected by conspicuous reticulate veinlets and deeply impressed on the upper side of the leaf; petioles stout, narrowly wing-margined nearly to the base, 8–10 mm. in length; leaves on vigorous shoots thicker, more coarsely serrate, usually acuminate at the apex, 6–7 cm. long and 5–6 cm. wide. *Flowers* 1–1.2 cm. in diameter, on slender pedicels, in crowded very compact 10–22-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes glandular-serrate, villose on the inner surface, reflexed after anthesis; stamens 10–15; anthers rose color. *Fruit* ripening at the end of September, on long drooping glabrous pedicels, in many-fruited clusters, subglobose to ovate, full and rounded at the ends, crimson, lustrous, marked by large pale dots, 1.2–1.4 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading serrate lobes villose on the upper side; flesh yellow, soft and succulent, nutlets 2 or 3, gradually narrowed and rounded at the ends, ridged on the back, with a broad high deeply grooved ridge, only slightly penetrated on the inner face, by short narrow cavities, 5.5–6 mm. long and about 4 mm. wide.

A handsome tree 3–4 m. high, with a short trunk covered with dark scaly bark, large spreading and ascending branches forming a broad symmetrical head, and stout slightly zigzag branchlets, light chestnut-brown and marked by small dark lenticels in their first season and dull gray-brown the following year, and armed with numerous stout slightly curved chestnut brown shining spines 4–5 cm. long and persistent, compound and very numerous on the trunk and large branches.

Rich hillsides, Bedford, Bedford County, B. H. Smith and C. S. Sargent, (No. 299 type) September 30, 1905.

This species is remarkable in the small cavities of the nutlets.

8. **Cratægus diaphora** n. sp.

Leaves obovate to oval, acute and often short-pointed at the apex, gradually narrowed and cuneate and entire at the base, finely often doubly serrate above, with straight glandular teeth, and occasionally slightly divided above the middle into 2 or 3 pairs of small acute lobes; nearly fully grown when the flowers open about the 10th of June and then thin, light yellow-green, smooth, lustrous, and slightly hairy along the midribs above and pale and slightly hairy in the axils of the leaves below, and at maturity thick, yellow-green, glabrous and lustrous on the upper surface, pale and still slightly hairy on the lower surface, 4–5 cm. long and 3.5–4 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined often to the middle, 1–1.5 cm. in length; leaves on vigorous shoots thicker, oval to obovate, more coarsely serrate and often 6–7 cm. long and 5–6 cm. wide, with stout broadly winged rose-colored petioles. *Flowers* 1.8 cm. in diameter, on long slender glabrous or occasionally slightly hairy pedicels, in wide lax many-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes long, slender, acuminate, finely glandular-serrate, glabrous on the outer surface, slightly villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale pink; styles 2 or 3, usually 2. *Fruit* ripening in October on long slender glabrous pedicels, in many-fruited drooping clusters, ovate, crimson, lustrous, marked by large pale dots, 1.3–1.5 cm. in diameter; calyx prominent, with a short tube, a wide shallow cavity, and spreading often deciduous lobes; flesh thick, yellow, soft and succulent; nutlets usually 2, rounded at the ends, ridged on the back, with a broad low grooved ridge, penetrated on the inner faces by narrow deep cavities, 5–5.6 mm. long and about 4 mm. wide.

A shrub 3–4 m. high, with numerous small stems covered with gray scaly bark, spreading into large thickets, and stout zigzag glabrous branchlets bright orange-green and marked by pale lenticels when they first appear, becoming bright chestnut brown and lustrous in their first year, and armed with numerous very stout straight chestnut brown shining spines 3.5–6 cm. long and often pointed toward the base of the branch.

Keyser Valley, Scranton, Lackawanna County, A. Twining, (No. 48 type) June 13, 1907, A. Twining, B. H. Smith and C. S. Sargent, September 5, 1909.

9. **Cratægus agaia** n. sp.

Leaves obovate to rhombic or oval, acute or acuminate, often short-pointed at the apex, gradually narrowed and cuneate at the entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 2 or 3 pairs of small acute lobes; nearly half-grown when the flowers open at the end of May and then thin, yellow-green and roughened above by short white hairs and slightly hairy along the midribs and veins below, and at maturity subcoriaceous, glabrous, dark yellow-green, smooth and lustrous on the upper surface, paler on the lower surface, 5–6 cm. long and 4–5 cm. wide, with thin midribs and primary veins; petioles slender, narrowly wing-margined to below the middle, slightly villose early in the season, soon becoming glabrous, 1.5–2 cm. in length; leaves on vigorous shoots thicker, more coarsely serrate and often 7–8 cm. long and 6–7 cm. wide, with stout rose-colored midribs, more prominent veins and stout rose-colored petioles. *Flowers* 1.8 cm. in diameter, on long slender slightly hairy pedicels, in wide lax 12–20-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, sparingly villose, the lobes broad, short, acuminate, coarsely glandular-serrate above the middle, glabrous on the outer surface, villose on the inner surface, reflexed after anthesis; stamens 8–10; anthers cream color; styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. *Fruit* ripening in October, on long slender glabrous or slightly hairy pedicels, in many-fruited clusters, subglobose to short-oblong, full and rounded at the ends, dark crimson, very lustrous, marked by large pale dots, 1–1.2 cm. in diameter; calyx little enlarged, with a short tube, a deep narrow cavity pointed and tomentose in the bottom, and spreading reflexed lobes hairy on the upper surface; flesh thick, yellow, soft and succulent; nutlets 2 or 3, broad and rounded at the ends, rounded and ridged on the back, with a broad low grooved ridge, penetrated on the inner faces by broad deep cavities, 6.5–7 mm. long and about 4 mm. wide.

A tree 4–5 m. high, with a short trunk covered with dark gray scaly bark, small spreading branches and stout zigzag glabrous branchlets, light orange-green and marked by large orange-colored lenticels when they first appear, becoming light chestnut brown and very lustrous in their first season and reddish-brown the following year, and armed with numerous stout or slender chestnut brown shining spines 3.5–6 cm. long.

Hillsides, Keyser valley, Scranton, Lackawanna County, A. Twining, (No. 50 type) May 25, June 3 and 13, 1907, September 27, 1909, A. Twining, B. H. Smith and C. S. Sargent, September 5, 1909.

April 5.

Arthur Erwin Brown, Sc.D., Vice-President, in the Chair.

Thirty-seven persons present.

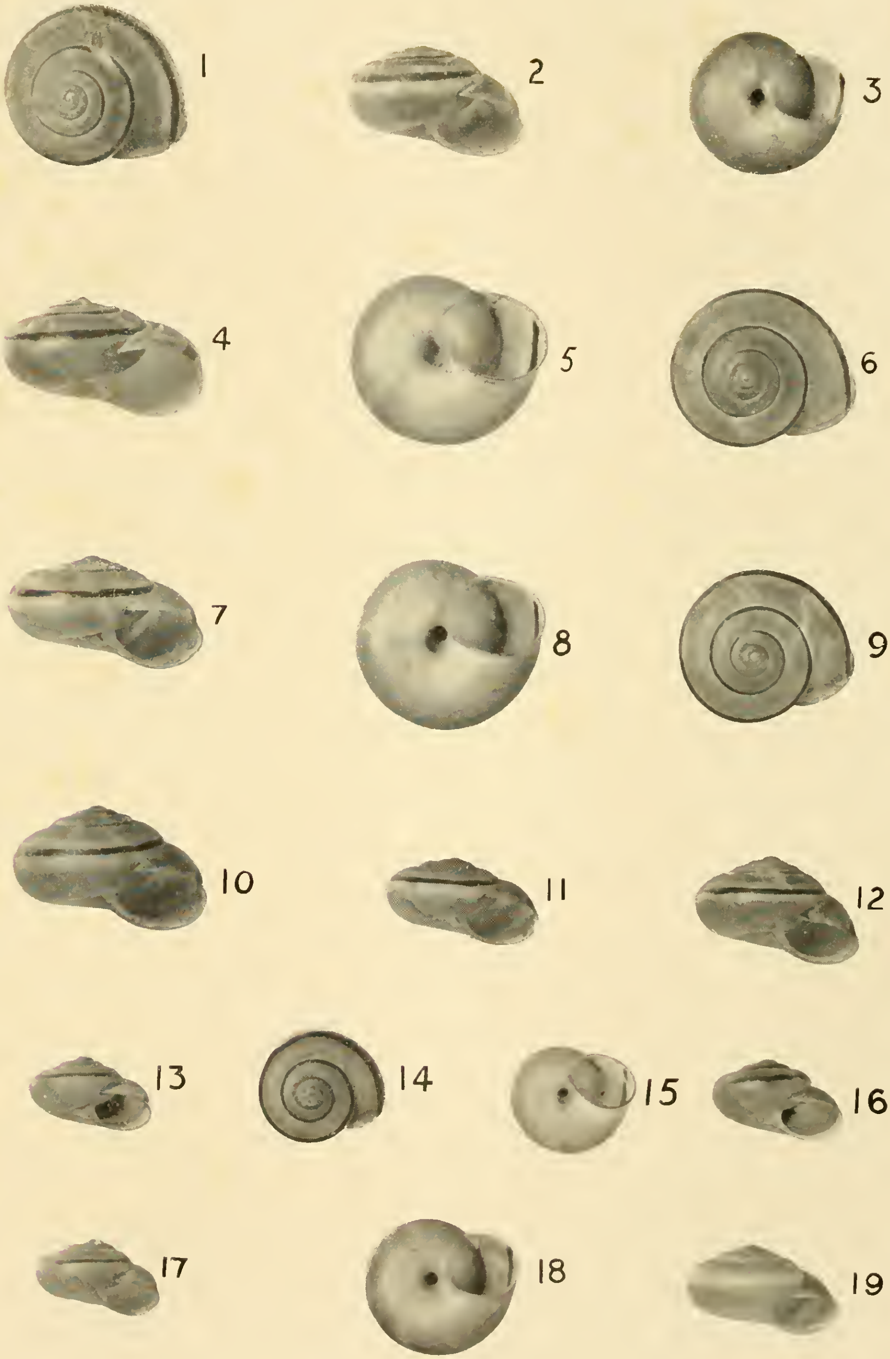
The death of Nathaniel E. Janney, a member, March 3, 1910, was announced.

The reception of papers under the following titles was reported by the Publication Committee:

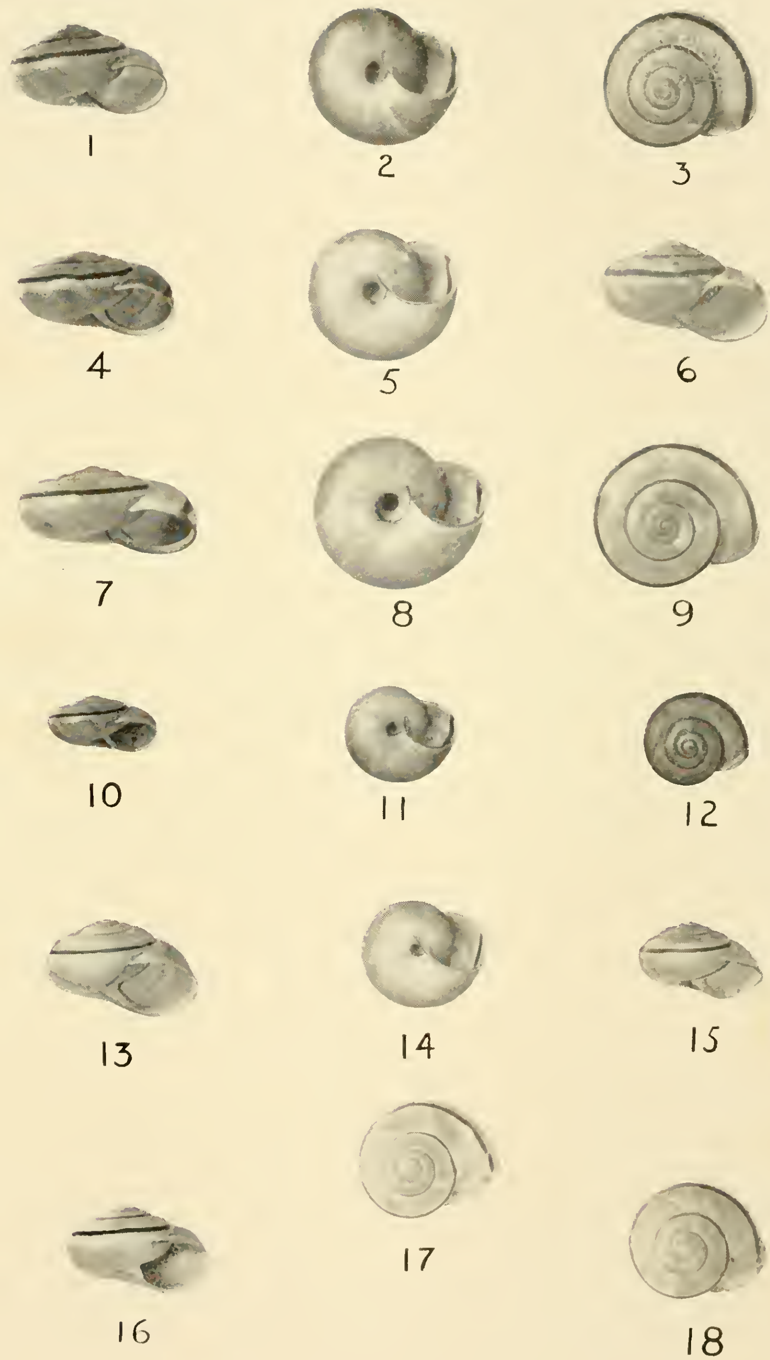
"A new fish of the Genus Paralepis from New Jersey," by Henry W. Fowler and Dr. Richard J. Philips (April 1, 1910).

"The Polychætus Annelids dredged by the U. S. S. 'Albatross' off the coast of Southern California in 1904. II: Polynoidæ, Aphroditidæ, and Segaleonidæ," by J. Percy Moore, Ph.D. (April 5, 1910).

The Recording Secretary read the following:



PILSBRY AND FERRISS: MOLLUSCA OF SOUTHWESTERN STATES.



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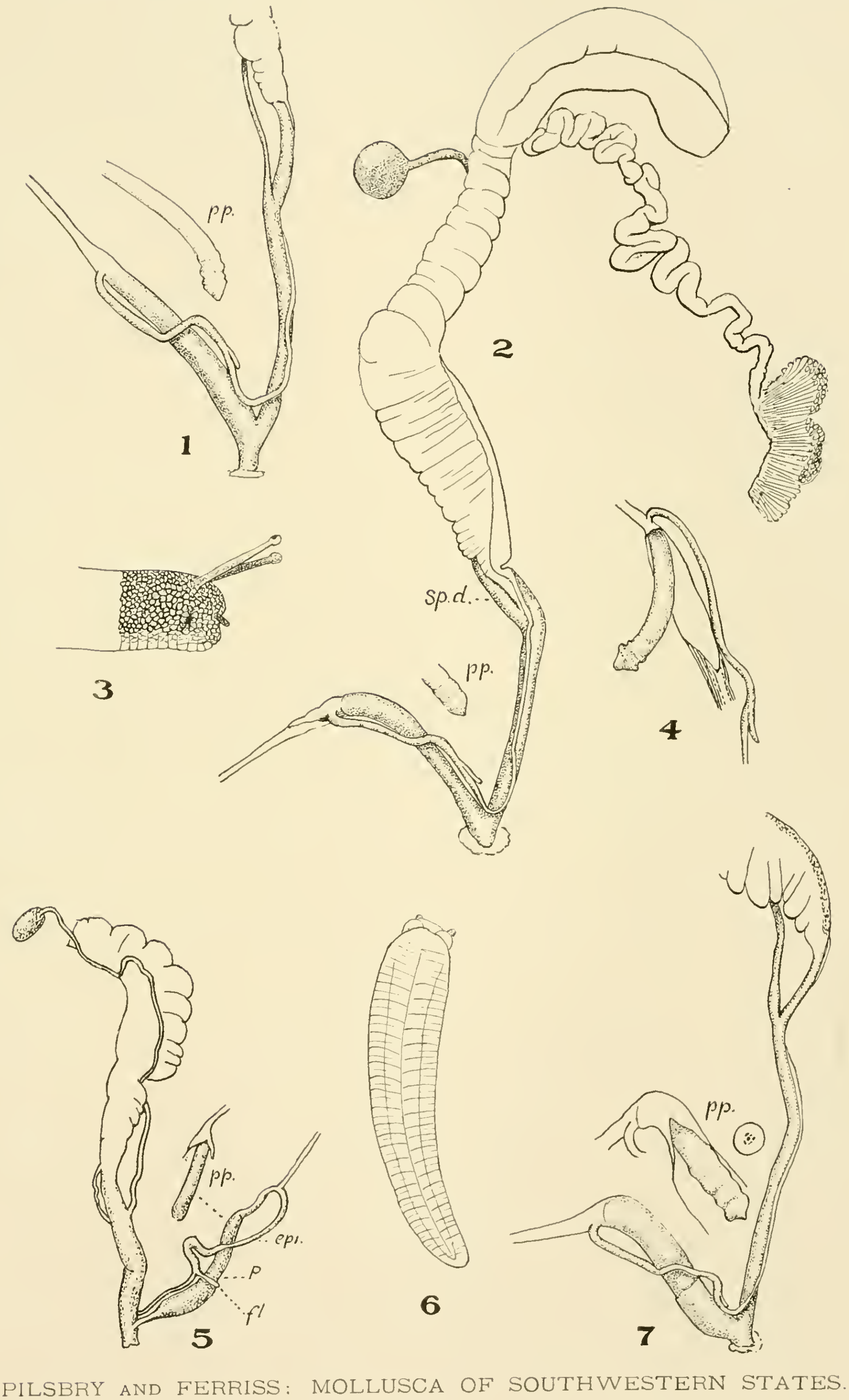

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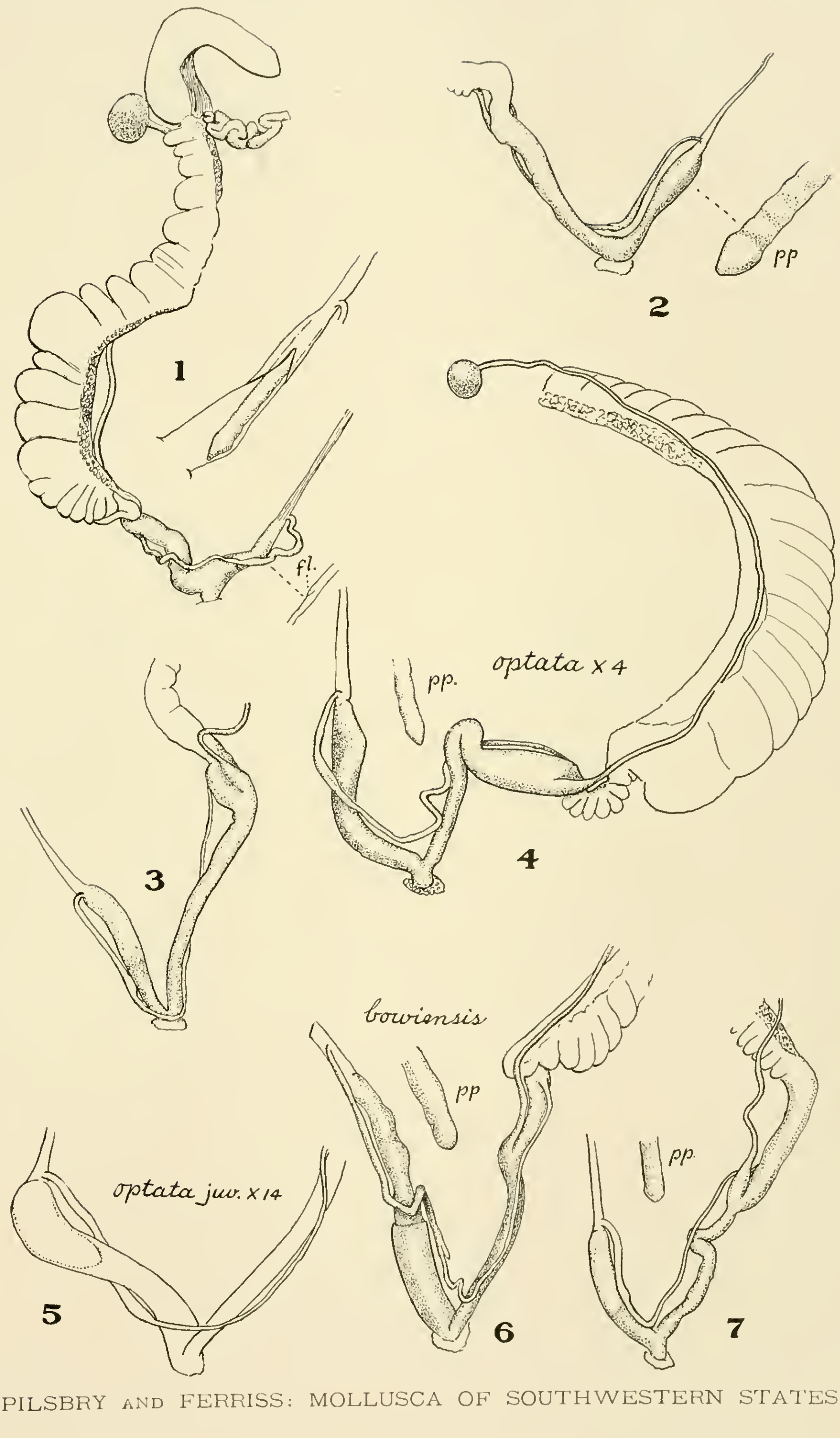

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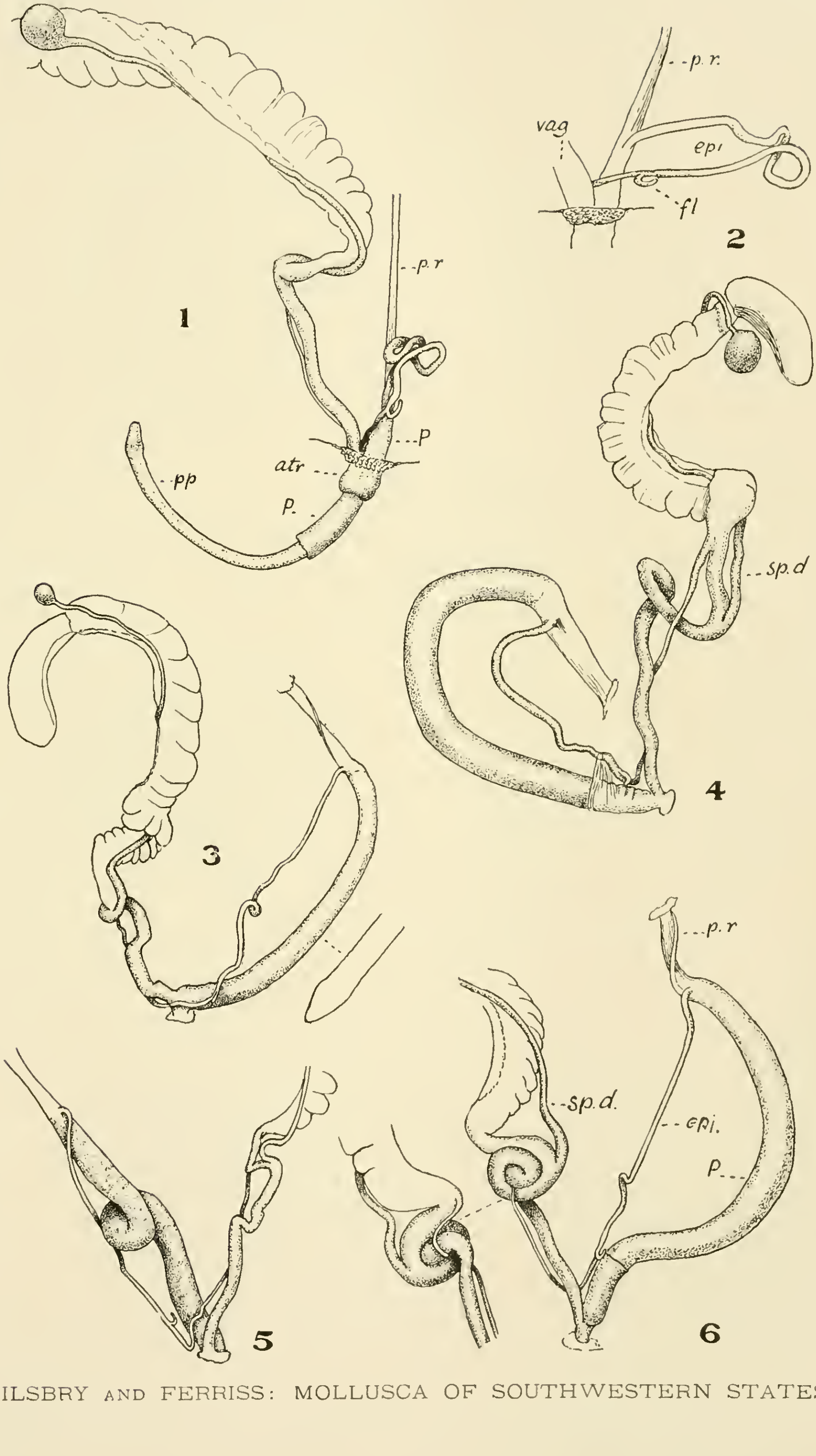

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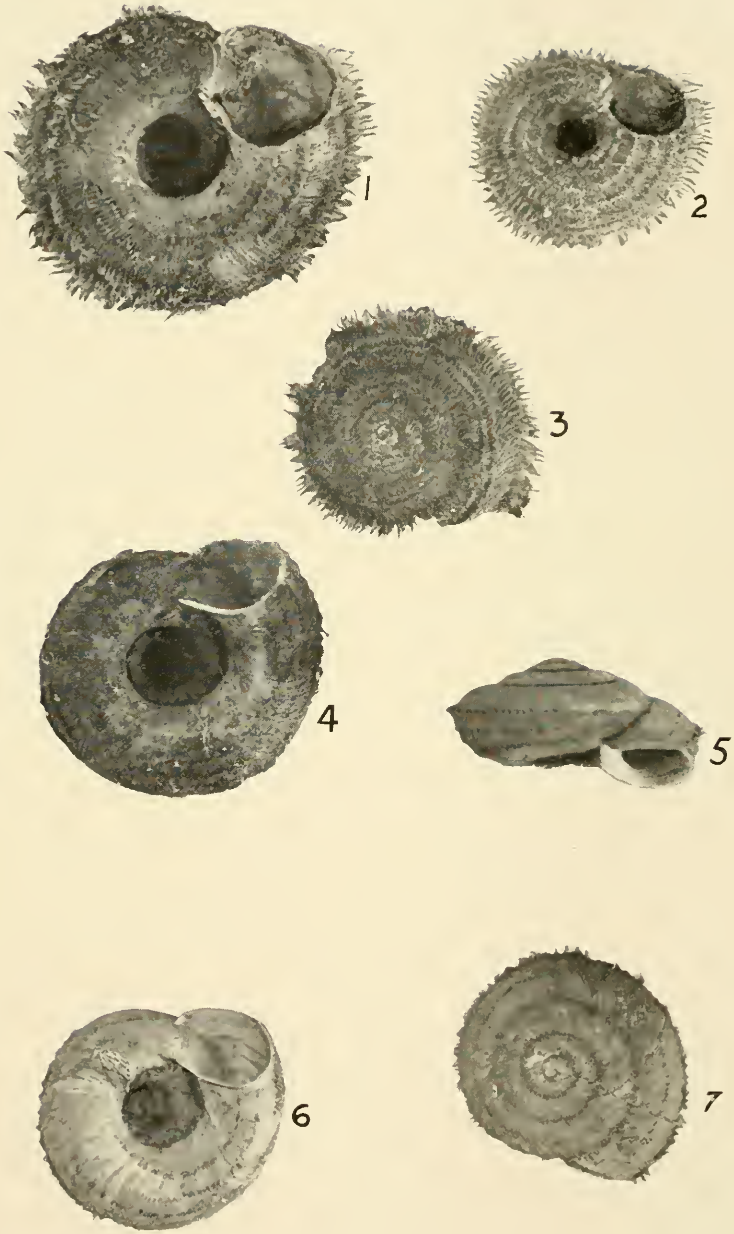

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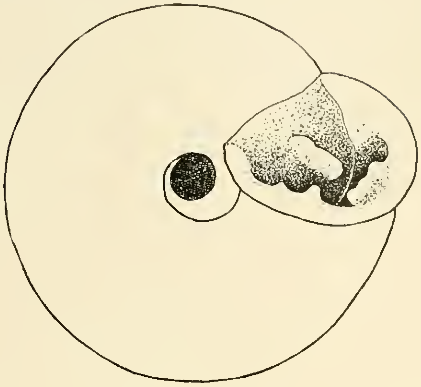

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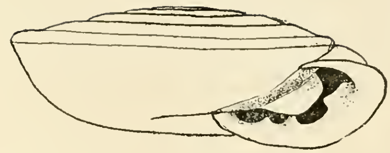

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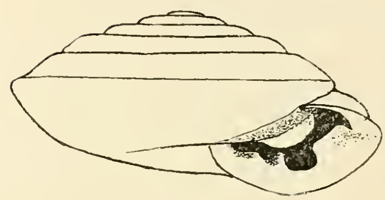

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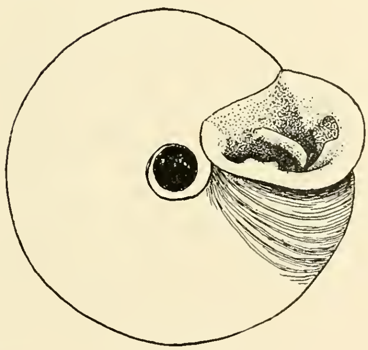

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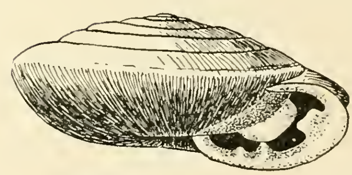

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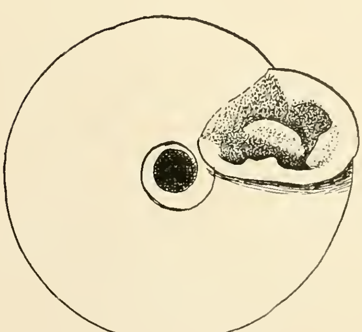

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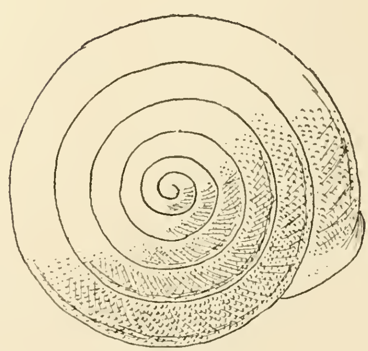

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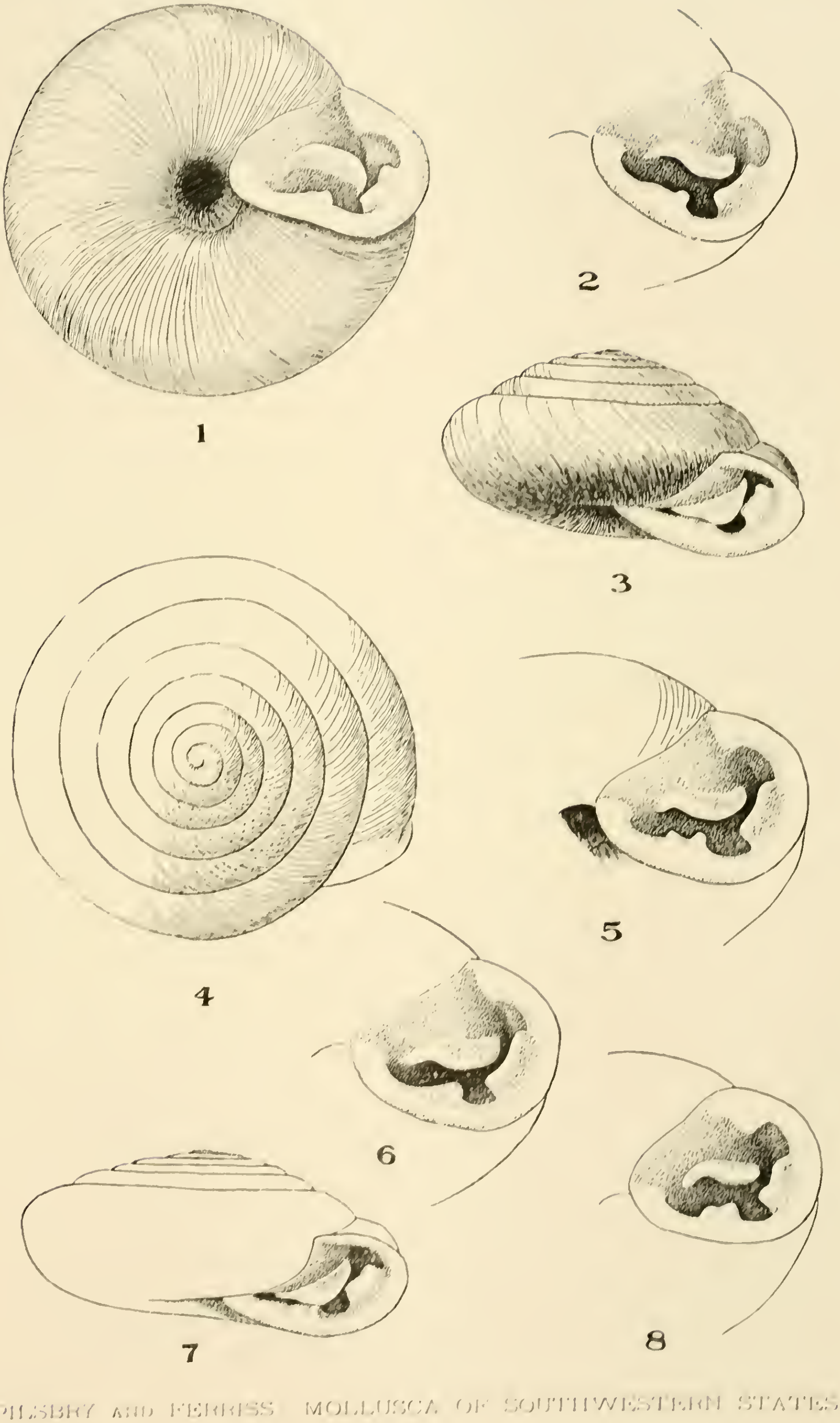

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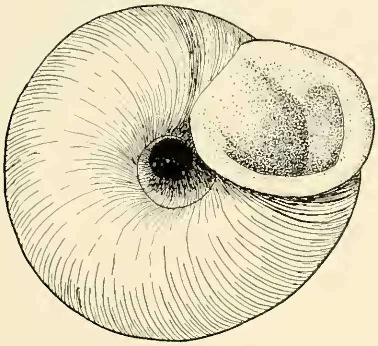

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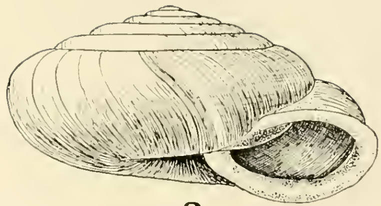

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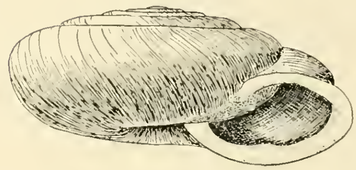

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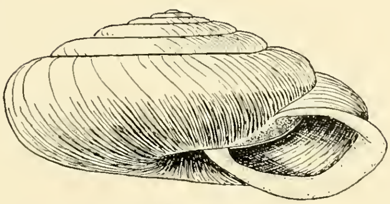

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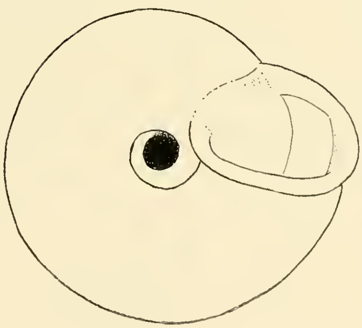

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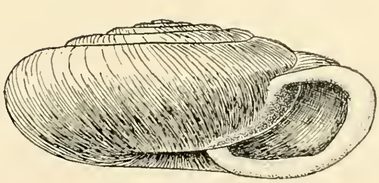

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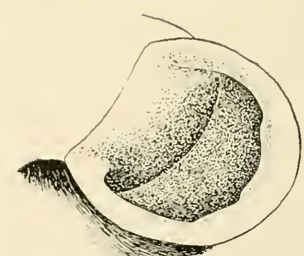

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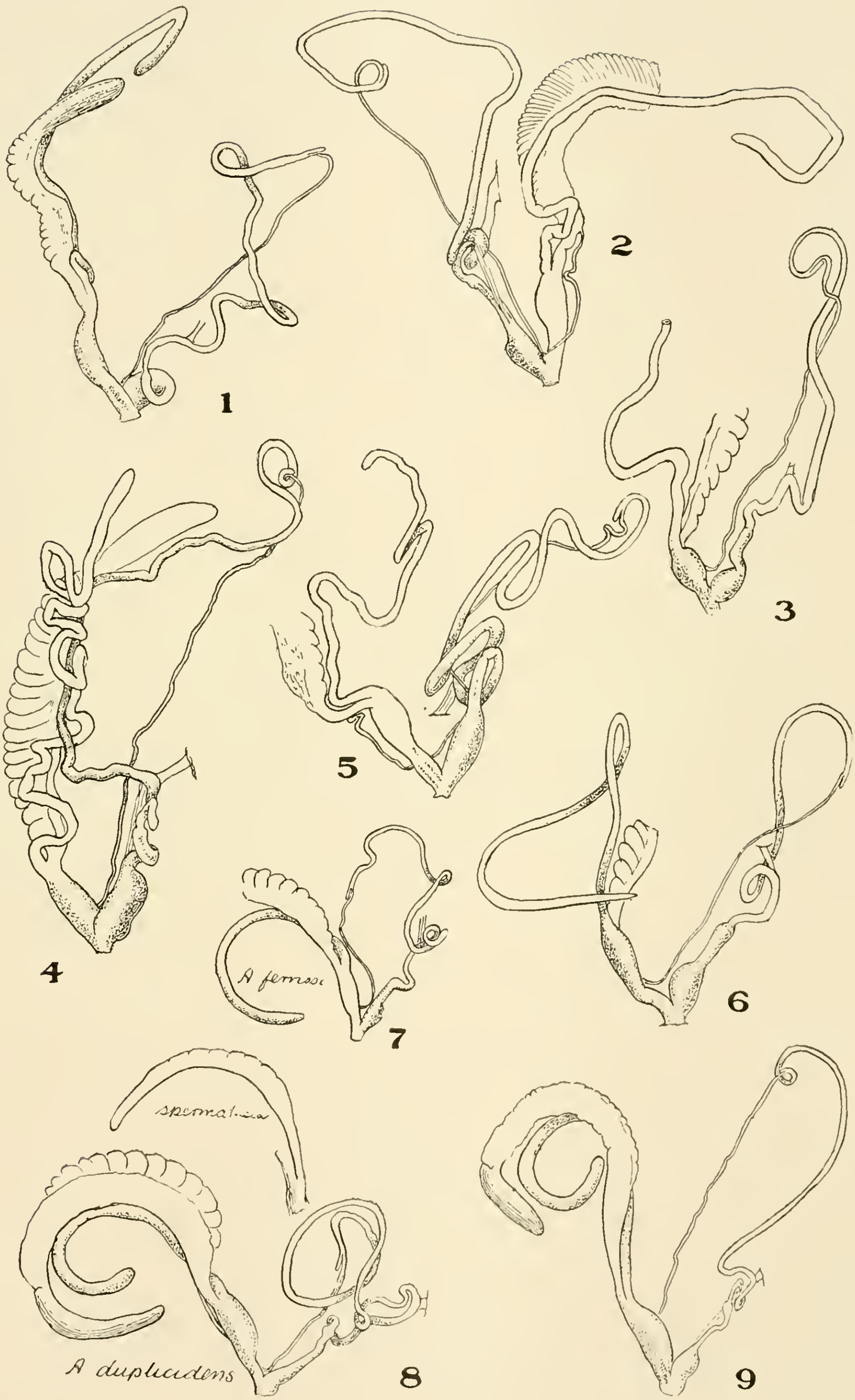

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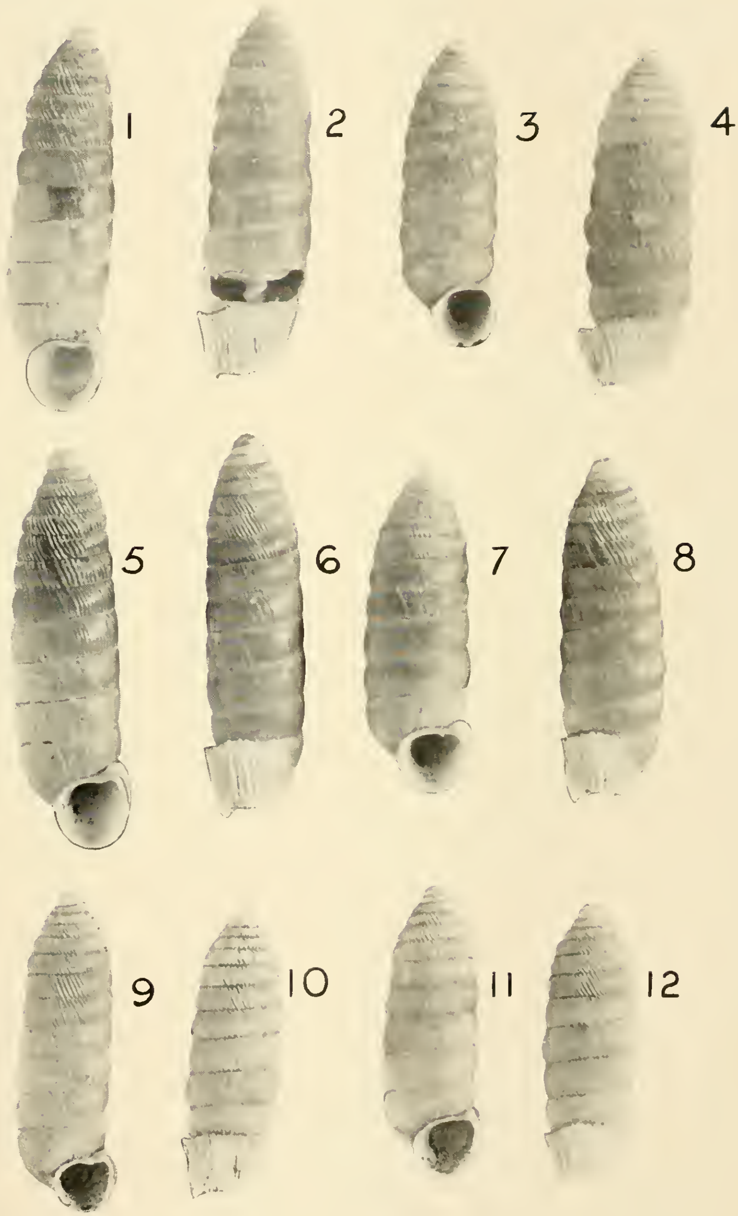

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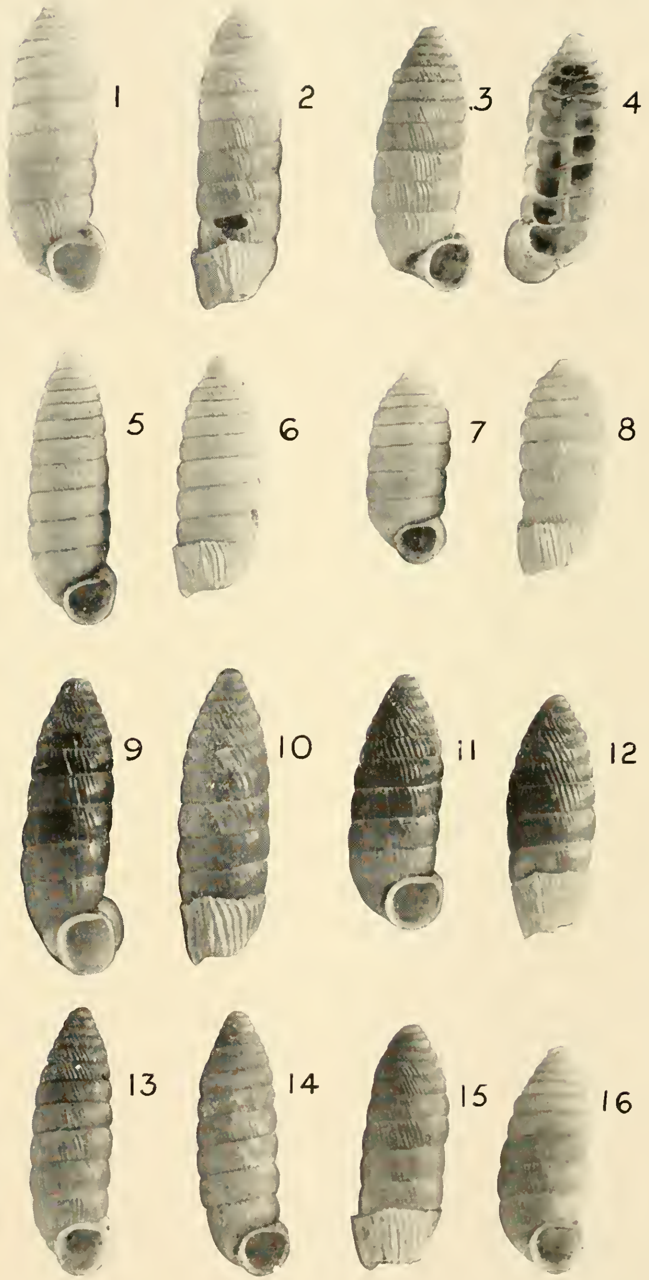

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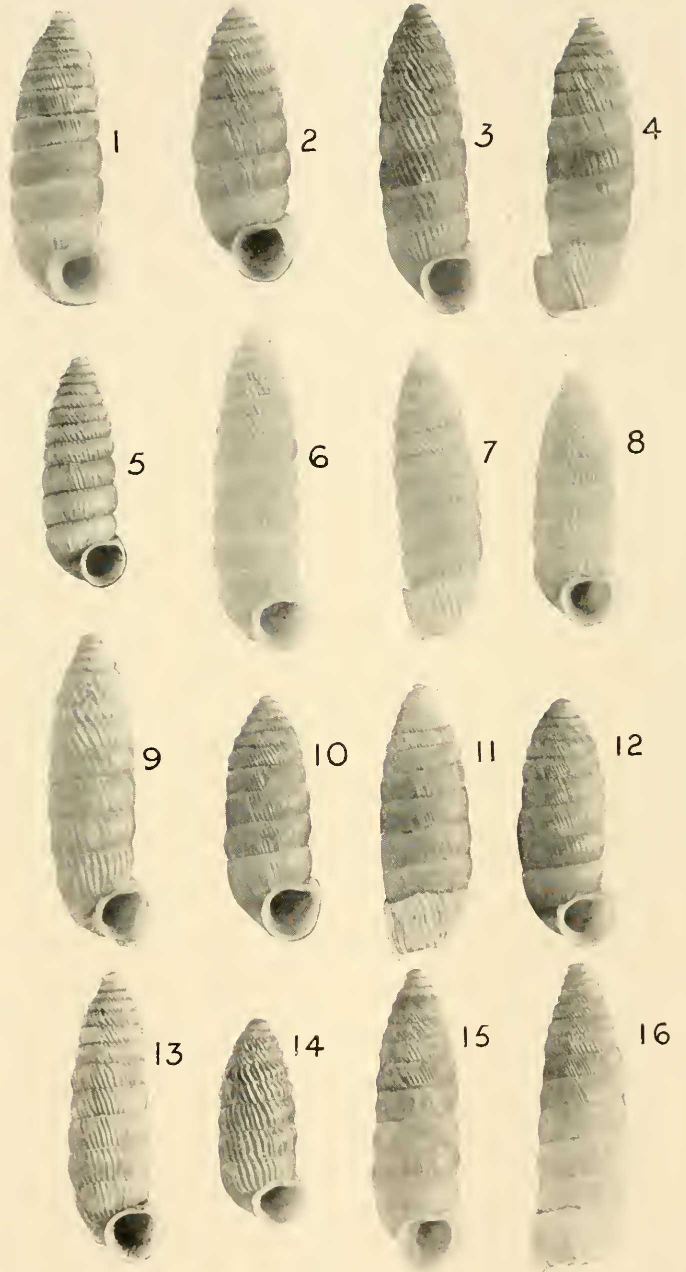

PILSBRY AND FERRISS: MOLLUSCA OF SOUTHWESTERN STATES.

PILSBRY AND FERRISS: MOLLUSCA OF SOUTHWESTERN STATES.

Henry C Chapman

A BIOGRAPHICAL NOTICE

OF

HENRY CADWALADER CHAPMAN, M.D., Sc.D.

BY

EDWARD J. NOLAN, M.D.

Visitors to the library of the Academy in 1868 were likely to encounter a little old man, dressed in gray. If it were a morning in winter he would be found reading the *Ledger* near the register before going on with the drawing of fossil shells on stone for the *American Journal of Conchology*.

He was an enthusiast in his specialty of fossil shells and his work will endure. His health was far from good, and he was wont to say that the compensations the years brought him were the recurring "songs of the birds and the perfume of new mown hay." It is evident, therefore, that he was a poet as well as a geologist.

His exceedingly frugal lunch would sometimes be eaten at his work table, but he frequently carried his provisions, often a few shellbarks and a pinch of red pepper, in a little basket on his arm to the Pennsylvania Hospital, where his brother was then apothecary. Here he met the young Chapman for whom he conceived a warm regard, heartily reciprocated, the friendship remaining unbroken until the death of the older man in 1877. It was a striking case of the attraction of opposites, their only traits in common being a love of Nature and an eager desire to explore her mysteries. Chapman was strongly influenced by the enthusiasm of the older naturalist. He declared, half seriously, in after years, "he is responsible for all the time I have wasted in the study of natural history." If that be true, Timothy Abbott Conrad is also indirectly responsible for the preparation of this notice, but it cannot be doubted that an important factor in determining Chapman's career, apart from his inherited bent for scientific investigation, was his devotion to Leidy.

Henry Cadwalader Chapman was born in Philadelphia in the house of his grandmother, Mrs. John Markoe, 1617 Walnut Street, August 17, 1845. He was the son of George W. Chapman, a lieutenant in the United States Navy, and grandson of Dr. Nathaniel Chapman, who, coming from Virginia in the autumn of 1797, had married Miss Rebecca Biddle, a daughter of Colonel Clement Biddle, Commissary General of the Continental Army. In 1813 Dr. Chapman became associated with the Medical Department of the University of Pennsylvania, with which he was connected continuously until 1853, as Professor of Materia Medica, the Theory and Practice of Medicine, and of Clinical Medicine.

Henry's mother was Miss Emily Markoe, the daughter of John Markoe, and granddaughter of Abraham Markoe, the first Captain of the Philadelphia City Troop. She and her family were remarkable for their wit and humor, and her son amply inherited both. His character in early life, and indeed up to the last, was somewhat of a contradiction. While thoroughly enjoying the diversions so liberally supplied by his social position, he early manifested an interest in chemistry and physics. His genial and joyous nature made him one of the most attractive of boys, and as a young man his society was sought by many older than himself. These attractive qualities persisted, with no sign of diminution, throughout his mature years.

His early education was received at the Faires Classical Institute, then located at No. 238 Dean Street, now officially Camac Street, but coming to be known popularly as Club Alley. The Institute was at the time the most exclusive, as well as one of the best, schools in Philadelphia.

The Rev. John W. Faires, Principal of the Institute, became an instructor of boys in 1831, his first pupils being William Cadwalader, later a member of the Academy, and his cousin J. Williams Biddle. During a period of more than fifty years Dr. Faires had a successful career as a teacher, his alumni including many of the most distinguished men of the city and state. He was a strict disciplinarian and he held unflinchingly to the doctrine that to spare the rod was to spoil the child. The daily floggings which took place in the presence of the higher classes, and of which Henry Chapman, because of his love of fun and impatience of discipline, received his full share as the penalty of his larks, would be regarded now, when the independence of "the little child" is held to be the paramount interest of society, as not far short of brutal. The master had a collection of rattans in his desk adapted to the size and age of the culprits, and as he made his selection for the particular one in hand and bent it to test its elasticity, the boy enjoyed a few moments of anticipation of what was coming to him. The punishment was, however, rarely or never resented, the master's sense of justice and his desire to make boys truthful and honest being fully recognized. While fighting and disorderly behavior, even at recess, were forbidden, the Doctor realized that the best way for the boys to settle some of their differences was for one or the other to secure a black eye or a bloody nose, before he descended in his wrath to stop the combat. The students of the school at the period referred to were the best prepared of those applying for admission to the University, to Princeton, or to other colleges, and for a time the first honor man in every class in the University was a Faires Boy. If the school could be said to have a specialty it was careful instruction in Latin and Greek.

These were the influences under which Chapman was prepared for the Department of Arts of the University of Pennsylvania. Those who knew him in after years will readily believe that Dr. Faires was sincere when he declared that he had never had a more brilliant scholar on the roll of the school. The originality and mental acuteness of the boy were early apparent. He was, however, far from being a diligent or attentive student, his tendency to regard the world from a humorous point of view leading him into the difficulties encountered by all such youths. They are nearly always loved, although sometimes dreaded, by the teacher.

The classes in the College, or the Department of Arts of the University of Pennsylvania, which he entered in 1860 from this preparatory school, occupied the upper of the two buildings on 9th Street between Chestnut and Market Streets, the site of the mansion built in 1800 as the residence of the Presidents of the United States. The faculty was small, as was also the attendance, which was quite local as compared with the present cosmopolitan enrollment in West Philadelphia. The men who filled the Chairs, however, were of the first rank in their specialties and it was a great advantage to the student to come into direct relation with the professors themselves, there being at that time no assistants or tutors. Henry Vethake, John F. Frazer, George Allen, Henry Coppée and Provost Goodwin, with the remarkable mathematician, E. Otis Kendall, were the equals, and in many respects the superiors, of the teachers in other institutions.

The students all lived in their own homes. The system of instruction practiced in the school was well adapted to produce educated, efficient and honorable men, provided with the requirements of active life as well as with the accomplishments of the scholar. Social grades were sharply marked, much more so than at present. The members of the college fraternities were thrown into the closest intimacy, and life-long friendships were formed through them. Chapman belonged to the Delta Phi, first established in the University in 1849. He never cared greatly about athletics, which occupied no such prominent place in University interests as they do now. Cricket was the game of the period, but Chapman never went in for it. He may have gone on the river, but he was not one of the College crew.[1]

Henry graduated from the Department of Arts in 1864. He almost immediately crossed the campus and matriculated in the Medical Department, by far the most distinguished medical school in America, under the preceptorship of Dr. Addinell Hewson. Here also the teaching force was small, consisting of but seven professors: Joseph Leidy, Joseph Carson, R. A. F. Penrose, Henry H. Smith, Robert E. Rogers, Alfred Stillé and Francis Gurney Smith, but these were the worthy successors of the men who had brought the school to its distinguished position and they more than maintained its brilliant record.

As in school and college, Chapman sustained the easiest relations to the medical curriculum, frequently missing lectures but always, after a few hours' reading, acquitting himself at quiz as well as the most studious of his classmates. He took his degree of Doctor of Medicine in 1867, the subject of his thesis being *Generation.*

He entered the Pennsylvania Hospital the same year, first as an attaché of the apothecary shop and later as a resident physician,

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[1] I am much indebted to Mr. John Cadwalader for these recollections of the young Chapman, of the Faires school, and of the College before the removal to West Philadelphia. In his reminiscences of the school Mr. Cadwalader tells one story which is now of more than local interest. "A big, well built boy of about fifteen years of age, named Irvine Stephens Bulloch, was then in the second class. It was unusual for the Doctor to flog a boy of this size, as he realized it imposed too severe a humiliation on him. Bulloch was usually a good student, but he sat behind a very offensive boy whom he felt it his duty to constantly chastise. This he did by giving him, from time to time, a loud smack in the face which could be heard throughout the school. The victim, quite as big as Bulloch, would set up a howl without attempting to resent the blow. The sympathies of the school were, as a matter of course, all with the aggressor. Dr. Faires had a warm regard for Bulloch, who was a boy after his own heart, but he had told him repeatedly his assaults must stop. Catching him one day in the act the Doctor became much enraged, as he sometimes would on due provocation. Seizing his heaviest cane he ran across the room. Bulloch escaped to another aisle, the boys guarding his retreat as effectively as possible until he reached the door, when, raising his hand, he cried: 'Dr. Faires, you cannot flog me and I do not want to fight with you. I know, of course, I will have to leave the school; so, good bye, fellows, I am awfully sorry to go.' This boy, who had come from Georgia, was the uncle of Theodore Roosevelt. He entered the Confederate Navy, was a distinguished officer, and was on the 'Alabama' in its battle with the 'Kearsage.' A portrait of him was published in the *Illustrated London News* soon after the battle."

which position he retained until 1869, when he went to Europe for a three years' course of study under Sir Richard Owen in London, Alphonse Milne Edward in Paris, Emile DuBois Reymond in Berlin, and Joseph Hyrtl in Vienna.

His beloved friends Leidy and Conrad being his sponsors, he had been elected a member of the Academy in 1868. For Dr. Leidy, especially, he entertained the most affectionate regard and he never lost an opportunity of acknowledging with impulsive generosity his indebtedness to the great naturalist for inspiration and encouragement. His championship of his friend, who never answered criticisms or decried injustice, was amusingly illustrated by a note to the *American Naturalist* in which he calls attention to the fact that Wyville Thomson, in his remarks on sponges, had neglected to state that Leidy was first to correctly describe the natural position of *Hyalonema, Euplectella* and *Pleuronema*, concluding with the remark: "We trust that Prof. Thomson will now gracefully throw up the sponge."

Immediately on his return from Europe he applied himself to the problems of evolution, in which he was deeply interested. The result of his reading, for the most part in the library of the Academy, was the publication of his first work, a volume of 193 pages entitled *The Evolution of Life*. It was issued from the press September 17, 1872, although the title page is dated the following year.

So assiduously had he devoted himself to the preparation of the work that his health broke down and he was compelled to go abroad immediately after placing the manuscript in the hands of his publishers, the preface being prepared in Paris. The proofs were corrected and the index prepared by the Librarian of the Academy to whom he had entrusted the pleasant duty of seeing the book through the press.

The introduction is an interesting resumé of the history of the doctrine of evolution. He acknowledges his special indebtedness to Prof. Hyrtl, Dr. Friedlowsky, Dr. Klein of Vienna, Prof. Owen, Mr. Flower of London, Prof. Gervais of Paris, and to his friends Drs. Leidy and James Aitkin Meigs, for encouragement and advice during the progress of the work.

Although the book gives evidence of extensive reading, it is believed that Dr. Chapman regretted later that he had not waited until his judgment was more mature. The work, in common with nearly everything published by the author subsequently, was written literally *currente calamo* and showed evidences of impatience of the restraints of composition, punctuation, especially, being regarded as an impertinent artificial device, which might for the time be safely ignored. His attention having been once called by the Editor of the PROCEEDINGS, to the absence of punctuation marks in his manuscripts, he replied, "Well! I will write a lot of commas, colons and semi-colons and you may scatter them about as you please."[2] Some revision of diction and careful proof-reading were always, in fact, necessary in connection with Chapman's literary work, not from mere carelessness, and still less, it is scarcely necessary to say, from incapacity, but because of a controlling desire to be rid of what was in hand as promptly as possible so as to be free to go on with some other task which had, in the meantime, established itself as of dominant interest.

Dr. Chapman's first contribution to the PROCEEDINGS of the Academy was a report of remarks made at the meeting of 1873 on a species of *Delphinus*. At the meeting of November 25 of the same year he acknowledges his indebtedness to the Directors of the Zoological Garden for the opportunity of dissecting a specimen of the Musanga, the results of which he communicates verbally.

Then in the third annual report of the Zoological Society of Philadelphia, it is stated that he had made dissections valuable to the comparative anatomist and pathologist and that as a result thereof papers on certain muscles in *Ateles geoffroyi* and *Macacus rheus* and on the blood-vessels in the *rete mirabile* of *Bradypus didactylus* had been published in the PROCEEDINGS of the Academy. Subsequently his work as Prosector of the Society, to which position he had been elected in 1874, supplied him with material for contributions to the PROCEEDINGS on the omentum of the Dog-faced Monkey, on the anatomy of the Giraffe, the Elephant, the Manatee, the Capybara, the Chimpanzee, the Amphiuma, the Macacus, the Ourang Outang, the Kangaroo, the Echidna, the Hyaena, the Cryptobranchus, the Gibbon, the Chiromys, and the Armadillo.

Some of these articles were original contributions to science while others were corroborations or corrections of the results obtained by earlier anatomists. They frequently give evidence of familiarity with the classics as well as with modern bibliography.

In a detailed report to the Zoological Society in 1876 he endorses

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[2] Dr. Chapman probably never heard of Lord Timothy Dexter, who, at the conclusion of his unpunctuated *A Pickle for the Knowing Ones or Plain Truths in a Homespun Dress*, supplies half a page of assorted marks with the note: ". . . . the Nowing ones complane of my book the fust edition had no stops I put in A nuf here and they may peper and salt it as they plese."

the position of the managers of other Zoological Gardens that drugs are of but small avail in treating the ailments of lower animals and records it as his experience as Prosector that the principal causes of deaths during the first six months of the existence of the Garden were improper food, badly regulated temperature and ill constructed cages. He attributes the greatly improved conditions to the effects of common sense hygienic treatment, the result of careful attention and watchfulness on the part of those having charge of the animals. He then enumerates the causes of death of 74 of the 113 animals lost during the year, intimating that the others were old and in poor condition when received and that they had gradually wasted away, this being more especially the case with the birds. It is evident that he took a deep interest in the condition of the Garden and that he was not sparing of labor to advance its prosperity.

He became a Director of the Society April 28, 1881, served as Secretary in 1884 and as Corresponding Secretary from Nov. 24, 1890 to Nov. 10, 1904.

From other sources he obtained the material for his elaborate studies of the Gorilla, the Hippopotamus, the Galeopithecus and the Hyrax.

As a contribution to the eighth volume of the quarto JOURNAL of the Academy, he published in 1881 his account of the placenta and generative apparatus of an elephant belonging to Cooper and Bailey's London Circus, then occupying winter quarters at 23d Street and Ridge Avenue in this city. A young female had been born at 2.30 A.M., March 9, 1880. The period of gestation was fixed at from 650 to 655 days, another corroboration by modern research of the statements of that accurate observer, Aristotle. This was the first circumstantial account of the pregnancy and delivery of an elephant and the article excited wide interest. It is, with the article on the placentation of the Kangaroo, published in the PROCEEDINGS of the Academy for 1881, the author's most important contribution to original research.[3]

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[3] "The observations of Prof. Chapman of America show that these bags [the yolk sacs and allantois] are all present in the Kangaroo, but that they are all small and arrested." W. Kitchen Parker *On Mammalian Descent*, p. 61.

Referring again to Dr. Chapman's paper "On the Embryo of the Kangaroo," and to one by Dr. Osborn on the same subject, Prof. Parker remarks: "The two papers just mentioned might, literally, be folded up and packed inside a nut-shell; and yet, if I am not greatly mistaken, they let in more light upon the incoming of both the Metatheria and the Eutheria than anything that has gone before.

"Of course, only the biological reader of such communications can value them properly, as he only can thoroughly understand their meaning and their bearing; and yet the patient and thoughtful general reader may come at the gist of the matter." Parker, *op. cit.* p. 83.

He accompanied Leidy, Willcox, and Porter to the West in 1872, and had an opportunity of observing the work of naturalists in the field. He served as Dr. Leidy's assistant in the University from 1873 to 1876, and lectured there on anatomy and physiology.

The position of Coroner's Physician was held by him under Dr. Kingston Goddard and Dr. William Kent Gilbert from 1874 to 1880.

Dr. Chapman was married to Hannah Naglee Megargee, daughter of Samuel Megargee, December 2, 1876. The union, characterized by a community of social interests, was a most happy one. The *Treatise on Human Physiology* is affectionately dedicated by the author to his wife "as a small acknowledgment of the interest evinced and encouragement extended in its completion." Their summers were spent in Bar Harbor where, in 1886, the house was purchased which they named *Mira Monte,* and in which Dr. Chapman died. Here for nearly thirty years he pursued his studies of the flora and fauna of Mt. Desert island, the latter in a little laboratory on the water's edge. Here the fishermen, all his devoted friends, brought whatever of interest they succeeded in securing from the waters.

The material progress of his summer home and the welfare of its citizens, among whom he was universally popular, were to him matters of active concern. He endeavored in every way in his power to minimize the distinctions between the summer colony and the permanent residents. He took an active interest in the local library which he served as a Director.

He succeeded George W. Tryon, Jr., as a Curator of the Academy, August 8, 1876. He held the office only until the end of the following year. He was elected a member of the Council in 1880, but finding, after the lapse of four months, that his other engagements interfered with the discharge of his duties, he resigned. Again elected a Curator in 1891, to fill the vacancy caused by the death of Dr. Leidy, he acted as Chairman of the Board until the close of 1904, when he declined a renomination. During his term of office he coöperated earnestly with his associates in the establishment of desirable administrative reforms.

Having served as Demonstrator of Physiology in association with Dr. James Aitken Meigs in the Jefferson Medical College for the sessions of 1877 to 1880, he lectured on experimental physiology in the summer course of 1878 and was Curator of the Museum in 1879–80. He was given a second degree of Doctor of Medicine by the College in 1878, his thesis being on *Persistence of Forces in Biology.*

Dr. Meigs died November 9, 1879, shortly after beginning his course of lectures for that term. At the request of the Board of Trustees it was continued and completed by Dr. Chapman. So acceptably was the engagement fulfilled that he was appointed by the Board to the vacant chair of Institutes of Medicine and Medical Jurisprudence in the spring of the following year. He secured from Paris as promptly as he could a collection of the most recent apparatus for physiological investigation. It was with the assistance of portions of this collection—Regnault and Reisert's instruments for the study of respiration and Helmolz's Ophthalmometer—that his fine papers on respiration and on the radius of the curve of the cornea were prepared, together with those on the general physiology of nerves and muscles, in conjunction with his assistant and successor in the chair, Dr. Albert P. Brubaker.

His introductory lecture to his first year's course was published by the Class. Considering the scope and purpose of physiology he dwells on the advantages of a study of pathology and insists on the importance of comparative anatomy, illustrating his position by reference to the action of the pancreatic juice in the beaver and the rabbit, the relation of the size of the brain to mental development in the lower animals, and to the nature of the bile as studied in *Doris*, one of the nudibranchiate mollusks. The limitations of the usefulness of vivisection in the prosecution of physiological research is frankly acknowledged, but the practical results secured up to that time were recounted and the opinion was expressed that, if vivisection should be banished from the laboratory, the physiologist would be deprived of one of his most fertile methods of research.

Dr. Chapman addressed the graduating class of the College in the Academy of Music, March 30, 1882, and again on April 2, 1890. On the latter occasion he advises the graduates to get married as soon as they can and dwells on the advantages to the young practitioner of the conjugal partnership. He considers the results of inductive and deductive reasoning, claims that the latter is essentially the feminine mode and assures his young hearers that matrimony will strengthen their inductive masculine minds.

He filled the chair in Jefferson College until the completion of last year's course when he resigned, with the intention of devoting his entire time to original research. His resignation was accepted with regret and he was made Emeritus Professor. His skill in adapting his physiological teaching to the practical needs of the physician was fully recognized by his students and associates in the Faculty. During the years of his connection with the College he never hesitated to express with characteristic frankness and force his views on questions relating to the conduct of the school. The feeling entertained for him by his students was one of personal affection.

A memoir of his predecessor, prepared for the College of Physicians, was published in the *Transactions* and is a well-expressed appreciation of the work of Dr. Meigs as a teacher and of the value of his contributions to anthropological science.

While acting as demonstrator to Dr. Meigs, he was elected in 1878 to the Professorship of Physiology in the Pennsylvania College of Dental Surgery. He retained the position until 1885, when, desirous of giving undivided attention to his educational work in Jefferson College, he resigned. Here, as elsewhere, the force and originality of his teaching secured the attention and interest of his class, and his resignation was regarded as inflicting a loss on the institution.

Europe was again visited in 1882 and 1887. During a stay in Paris in 1899, he was presented to the Academy of Sciences and he made a communication before the Society of Biology on the placentation of the elephant. An abstract of his remarks was published in the *Comptes Rendus* of the Society, where also appeared, in 1903, some notes on the placentation of mammals in general.

His attention while in Paris was by no means confined to scientific interests, the vast storehouses of literature and art so liberally administered there for the benefit of the public receiving a full share of his attention. He visits the Bibliothèque Nationale to look at one of the two complete copies in existence of the *Christianismi Restitutio* of Michael Servetus. It is easy to believe that he was more attracted by the rarity of the volume than by its contents. He is also shown Charlemagne's Bible and those of most of the kings of France; the memoirs of Louis XIV, written by himself in the intervals of his intrigues; the Bible of Catherine de Medicis bound at a cost of 60,000 francs; the great Mazarin Bible; the autographs of Montaigne, Rabelais, Molière (the only one in existence); the first books of travel printed; lots of Caxtons, letters of Columbus, Vespucci, Cortez, Pizarro, and hundreds of other treasures in which he revels. He spent another pleasant day at the Observatory with Simon Newcomb, when, because of the presence of the distinguished American astronomer, the resources of the establishment were courteously displayed.

The *History of the Discovery of the Circulation of the Blood* was published in 1884. The essay was given as a lecture in Jefferson College the year before. It makes a small volume of fifty-six pages, but it is, from a literary point of view, the author's most satisfactory work, showing erudition, thoroughness of research and clearness of statement. It forms, without much change, the 25th Chapter of the *Treatise on Human Physiology*, published in 1887, a second edition appearing in 1899.

A *Manual of Medical Jurisprudence and Toxicology*, designed, apparently, merely as an aid to the student in following the lectures, was published in 1892, subsequent editions appearing in 1896 and 1903.

He prepared an appreciative memoir of Dr. Joseph Leidy for the Academy in 1891. It is an adequate record of the work of his friend, to the value of whose encouragement and guidance he was always delighted to testify. Dr. Leidy's claims to public gratitude were again presented by him in an address delivered in the City Hall on the occasion of the dedication of Murray's statue of the great naturalist, October 30, 1907.

His paper on *The Interpretation of Certain Verses of the First Chapter of Genesis in the Light of Paleontology* was contributed to the PROCEEDINGS of the Academy in 1893. The article must be considered as a mere *tour de force*. It is not regarded as a contribution to our knowledge of the subject by either Biblical or Hebrew scholars, and is mainly interesting as illustrative of the range and diversity of Dr. Chapman's interests.

He was elected a member of the Board of Directors of the Library Company of Philadelphia, April 3, 1902. He took an active interest in the affairs of the Company, serving on the Book and Ridgway Branch Committees.

Again in Europe in 1902, he gave special attention to the collections in Florence under the guidance of Giglioli, the Director of the Museum, and to those of the Zoological Station of Naples, where he was cordially received by the late Prof. Dohrn, who assisted him in procuring for the Academy a fine collection of the invertebrates of the Bay of Naples. The specimens, prepared with the care characteristic of the Station, filled no less than 152 glass jars, and constitute a most valuable addition to the Museum, which had been enriched from time to time by the anatomical material of Dr. Chapman's studies, and by interesting collections from Bar Harbor.

A few months were spent in Paris in 1903, when he again addressed the Biological Society. He was back in Bar Harbor by the first of July. In 1905 he visited Egypt where he applied himself with characteristic energy to the study of hieroglyphics and Egyptian antiquities. He subsequently went to Rome and became intensely interested in the excavations of the Roman Forum. His devotion to this field of research continued unabated and he looked forward with eagerness to pursuing his studies in the Eternal City when the resignation of his professorship would leave him in complete control of his time.

He was much gratified by the reception in June, 1908, of the degree of Doctor of Science from his *Alma Mater* in recognition of the value of his contributions to original research.

Elected a Fellow of the College of Physicians in 1880 he served on the Library Committee from January, 1891, to June, 1892. He was a member of the American Philosophical Society, the American Physiological Society, and the Franklin Institute; but he devoted much more time to the Academy and the Zoological Society than to the other institutions with which he was connected.

His last visit to the Academy was made a week before his departure for Bar Harbor. He was then in his usual exuberant spirits, with but little appearance of impaired health. Shortly after his arrival at his summer home he complained of severe pain, which was supposed to be intercostal neuralgia, but which, in connection with some difficulty in swallowing, was doubtless symptomatic of grave digestive disturbance. He was, however, able to attend to his many social duties, and to keep up his interest in the work of his laboratory until September 6th, when he was taken with a severe hemorrhage from the stomach, probably the effect of a gastric ulcer. A copious repetition of the flow of blood the following day resulted in his death. Mrs. Chapman survives him, childless.

The funeral exercises were held at Bar Harbor in St. Saviour's Church on the 10th of September. The body was brought to Philadelphia and buried in Laurel Hill Cemetery in the presence of a few relatives and intimate friends who had assembled at his residence, No. 2047 Walnut Street, a few blocks from where he was born.

The qualities which endeared Dr. Chapman to his schoolmates persisted throughout his life. He remained to the end a boy, with a cultivated mind, an unquenchable desire for the acquisition of knowledge, an intense enjoyment of life, and an unvarying self-possession, the result of success, appreciation, and inheritance. His sense of humor, his mental acuteness, his generosity, his sympathy with all human endeavor, his possession of what his friend Weir Mitchell finely calls "a boundless charity of attention," secured for him the affectionate regard of many with whom he could not be supposed to have much community of interest.

In most intellectual centres, and characterizing almost every generation, certain men become famous as the authors of well told stories, sparkling witticisms and apt repartee. They are frequently credited by tradition with much more of that sort of achievement than they were really responsible for. In this connection President Lincoln, Emory Storrs, William B. Travers, Sam Ward and Paul B. Goddard will be recalled as worthy successors of Tom Hood, Charles Lamb, Sydney Smith and other historic humorists. In this class Nathaniel Chapman was given a place by his own generation and his fame endures to the present day, not only as an excellent teacher, but also as a man of great personal charm, an exuberant vitality, and an acute sense of humor. These qualities, transmitted to the son, were inherited in full measure by the grandson, coming, indeed, from both father and mother. It would not be hard to quote Dr. Chapman as the author of many a dr ll story and many a witty saying, always to the point and without malice. These would, without doubt, add greatly to the interest of this essay, but they would manifestly be out of place on the present occasion as being irrelevant. One of his Bar Harbor friends tells of his having once dissected an oyster in his laboratory, several distinguished men of science being interested spectators. Without looking up, or interrupting the manipulation of his scalpel for an instant, he told a story which was greeted with roars of laughter. This was an experience quite familiar to those associated with Dr. Chapman in his most serious scientific work, the character of which was not, however, damaged by his joyous interludes. It must be fresh in the recollection of many Academicians how the old library hall would ring with hilarity on the occasions of his frequent visits.

Nothing that was human was foreign to him; he was on good terms with all types of mankind except the Bore and the Sham. He would, not unlikely, eat an abstemious lunch with Madame Bubble, but he would certainly not devote a minute to the young woman whose name was Dull. He might exchange opinions, if time permitted, with Mr. Worldliwise, but he would frankly tell Mr. Facingbothways how he regarded him, without thinking it worth while to wait for an answer. As has been said of another, "it was his good fortune to be a man of the world without being frivolous, and a man of science, without being pedantic."

Although Dr. Chapman's mental equipment was entirely devoid of any recognition of authority except that which appealed to his reason within the bounds of what he himself recognized as its limitations, he was unalterably attached to the traditions and routine which had, actively or passively, moulded his character, and he was as intolerant as a Covenanter when his prejudices were combatted. In his reply to Dr. Horatio C. Wood's paper on medical education, published at the beginning of the movement which has been productive of such good results in the elevation of the medical profession, he quotes approvingly Huxley's statement concerning the men who had gone up for examination in the University of London, that he had been struck with "the singular unreality of their knowledge of physiology." He deprecates Dr. Wood's laudation of the courses of instruction in Europe as contrasted with our own: "To establish in this country a University of the German kind, we would first require to have their gymnasia, then their primary schools, then more taxation to support them, a national priesthood to regulate the ideas of the faculty, and finally a standing army to keep the dissatisfied quiet. A medical education is a good thing, but the privilege of saying what we please, doing what we like, and spending our money as suits us best, is better. If any American physician will give his lifetime to the study of a specialty, and will lecture on that, and that alone, I have no doubt he can make, like the German professor, a reputation and a living—if he chooses to live like one."

Years after, in considering the proposed act of the Legislature regulating the practice of medicine and surgery, he gives his reasons for believing that such an attempt would be rather to lower than to elevate the standard of medical education in the Commonwealth. Such opinions were expressed with a vigor and point which, while they might fail to convince, certainly relieved his printed arguments from dulness.

Possessed of a wonderfully retentive memory he was always able to illustrate his point of view and enforce his arguments by apt references and quotations characterized by incisiveness and force. While ardently devoted to scientific investigation, he was attentive to his many social obligations; but if either had to be held in abeyance, his work had always the precedence, a fact amply demonstrated by the varied and extensive results of his industry, as recorded in the accompanying bibliography. The value of his contributions to science was recognized on his retirement by the Carnegie Foundation for the Advancement of Teaching.

It is fitting that Dr. Chapman should be remembered as a devoted student of science who contributed liberally to the resources of the Academy and was always active in advancing its interests at home and abroad. He will dwell in the regard of his fellow members as a genial associate, an intellectual stimulus, and a loyal friend.

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April 19.

J. Cheston Morris, M. D., in the Chair.

Forty-seven persons present.

The Publication Committee reported the reception of papers under the following titles:

"Stauroneis terryi D. B. Ward," by T. Chalkley Palmer (April 11, 1910).

"A revision of the North American Species of the Genus Ischnoptera (Orthoptera)," by James A. G. Rehn and Morgan Hebard (April 12, 1910).

"A new Diatom," by T. Chalkley Palmer (April 19, 1910).

Under the auspices of the Biological and Microscopical Section the following communications were made:

Jelly-pores in the Diatomaceæ.—Mr. Charles S. Boyer discussed the observations of Otto Müller, George Karsten and others upon the occurrence and function of the *jelly pore* in the Diatomaceæ and described it as found in certain species not heretofore recorded. As has been stated, the production of a stipe or jelly cushion appears to be its function. A more minute study of the habitat in various motile and immotile species is requisite. The speaker dwelt upon the varying conditions in earlier and later cell growth, of the tube and thallus forming jelly, and of the relation between the raphé and the pore. Suggestions were made as to the relation between the forms producing the stipes and jelly cushions and those in which the protective devices of many pelagic species were found to be siliceous. Drawings, original, and from various authors, illustrated the remarks.

Dr. Thomas S. Stewart, on the Hook-worm, *Ankylostoma duodenale.* (No abstract.)

Unusual Forms of Myxomycetes.—Mr. Hugo Bilgram remarked that in the early stages of their existence Myxomycetes are composed of a slimy mass consisting of cells resembling amœbæ, and only in the last hours of their life do they assume the apparently organized form of the well-known beautiful sporangia.

The most simple species consist of a mass of spores enclosed in a sporangium wall. Others develop within the sporangium a capillitium often consisting of branching filaments, and in some genera, of isolated fibres. In many genera the capillitium bears characteristic markings, such as spines, warts or spiral ribs. In the process of maturation many species develop within the yet soft sporangium a stipe on which they creep up, so that the matured sporangium is stipitate, and when the stipe has a continuation within the sporangium, this is known as a columella.

The different species have more or less constant characters. Many are never found stipitate. Among the stipitate forms it often happens that a few of the sporangia of a gathering are sessile, especially sporangia maturing on the outside of the group.

Two rather extraordinary gatherings were shown under microscopes. The one was *Physarum pulcherrimum*, which is usually stipitate, sessile sporangia being rarely seen; but in the specimens shown all sporangia were sessile. The other exhibit was a specimen of *Perichæna chrysospora*. Not a single species of this genera is known to be stipitate, but in the gathering exhibited a number of the sporangia had a well-developed stipe, while others were normal and therefore sessile.

Mr. Silas Shumo, on the microscopic characters of the stems of Equisetum. (No abstract.)

Mr. Frank J. Keeley, on micrometry. (No abstract.)

Mr T. Chalkley Palmer, on *Navicula sociatis*, a new diatom. (See papers.)

Mr. William B. Davis, on fresh-water polyzoa. (No abstract.)

Mr. H. Van Sickel, on a new crystallization of platinum. (No abstract.)

The communications were illustrated by preparations under the microscopes.

Mr. John B. Henderson was elected a member.

The following were ordered to be printed:

NOTES ON THE VARIATION OF SOME SPECIES OF THE GENUS NOTROPIS.

BY HENRY W. FOWLER.

In this paper the results of the range of variation in the important or fundamental characters of a majority of the species of this genus are presented. Most all of the material examined in this connection is exclusive of that already published in my Synopsis of the Cyprinidæ of Pennsylvania, and is contained in the collections of the Academy of Natural Sciences of Philadelphia. Many of the specimens are the types of Girard and Cope and as the published accounts and figures are insufficient or incomplete, it is hoped that the notes and figures given upon each species will be of use in future determinations. Little, if any attention, in most cases, seems to have been paid to the extent of variation in the species of this genus, so that often dogmatic and compiled descriptions of some writers are very unsatisfactory, especially when based on the examination of a single example. The determination of the species is thus often very difficult, especially in such a large genus as the present, and where age, sex and the individual often vary greatly. No attempt is made in any way to alter the limits of the genus from those prescribed by Jordan and Evermann.

Notropis aztecus Woolman.

Head 4; depth $3\frac{2}{5}$; D. iii, 7, I; A. iii, 6, I; scales 46? + 2; 8 scales above l. l.; 6 scales below l. l.; 25 predorsal scales; snout $3\frac{3}{4}$ in head; eye 5; maxillary $3\frac{1}{3}$; interorbital $2\frac{7}{8}$; teeth 4–4; length $3\frac{3}{4}$ inches. One from L. Xochimilco, Mex.

Notropis bifrenatus (Cope). Pl. XV, fig. 1.

Head $3\frac{1}{4}$ to $4\frac{1}{8}$; depth $3\frac{2}{5}$ to $5\frac{3}{4}$; D. iii, 7, I, rarely iii, 6, I; A. iii, 6, I; scales 28 to 35 + usually 2, frequently 3, rarely 1; 5 or 6 scales above incomplete l. l.; 4 or 5 scales below l. l.; usually 12, frequently 11, sometimes 13, occasionally 10 or 14 predorsal scales; snout $3\frac{1}{8}$ to $4\frac{1}{4}$ in head; eye $2\frac{1}{3}$ to $3\frac{1}{3}$; maxillary $3\frac{1}{8}$ to $4\frac{1}{4}$; interorbital $2\frac{1}{8}$ to 3; teeth 4–4; length $1\frac{5}{16}$ to $2\frac{3}{8}$ inches. Very large series, of which 52 examined from Ridgewood, Budd's Lake, Trenton, Turnersville, Pensauken, Mantua, Florence, Crosswicks Creek. N. J.

Notropis cayuga Meek. Pl. XV, fig. 2.

Two from Silver Lake and one from Brook River, Ia., the latter long ago named as new by Cope in MS.

Notropis cayuga atrocaudalis Evermann.

Head $3\frac{4}{5}$ to $4\frac{1}{8}$; depth $3\frac{1}{4}$ to 4; D. iii, 7, I; A. iii, 6, I; scales usually 35, frequently 34, often 36 + usually 2, seldom 3; 6 scales above l. l.; usually 5 scales below l. l., rarely 4 or 6; usually 15 predorsal scales, often 16; snout $3\frac{1}{4}$ to 4 in head; eye $3\frac{1}{4}$ to 4; maxillary $3\frac{1}{5}$ to $3\frac{4}{5}$; interorbital $2\frac{1}{4}$ to 3; teeth 4–4; length 2 to 3 inches. Thirteen from Palestine, Tex.

Notropis fretensis (Cope). Pl. XV, fig. 3.

Hybopsis fretensis Cope, Tr. Am. Philos. Soc. Phila., (2) XIII, 1866, p. 382. Near Detroit, Mich.

Type of *H. fretensis*. It is not at all likely this species may be identical with *N. cayuga*, as suggested by Jordan and Evermann.

Notropis deliciosus (Girard). Pl. XV, figs. 4–6.

Moniana deliciosa Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 199. Leon River, trib. Rio San Antonio, Tex.
Hybognathus stramineus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 283. Grosse Isle, Mich.
Hybopsis missuriensis Cope, Prelim. Rep. U. S. Geol. Sur., 1870 (1871), p. 437. St. Joseph, Mo.

Head $3\frac{2}{7}$ to $4\frac{1}{5}$; depth $3\frac{7}{8}$ to 5; D. iii, 7, I, rarely iii, 5, I; A. iii, 6, I; scales usually 33 or 35, frequently 34, seldom 30 or 32, rarely 36 or 37 + usually 2, rarely 3; usually 5 scales above l. l., seldom 6; 4 scales below l. l.; usually 16 predorsal scales, frequently 15, often 14, occasionally 17, seldom 18, rarely 13; snout 3 to $3\frac{7}{8}$ in head; eye $2\frac{3}{4}$ to $3\frac{2}{5}$; maxillary $2\frac{7}{8}$ to $3\frac{3}{4}$; interorbital $2\frac{2}{3}$ to $3\frac{4}{5}$; teeth 4–4; length $1\frac{1}{4}$ to $2\frac{3}{4}$ inches. Cotype of *M. deliciosa*, 6 of *H. stramineus* (type No. 4, 131, A. N. S. P.) and 4 of *H. missuriensis* (type No. 4,374, A. N. S. P.). Also 123 examples, from Grosse Isle and Haughton Lake, Mich.; Calhoun and Chariton, Mo.; Wichita River, Tex.

Notropis volucellus (Cope). Pl. XV, fig. 7.

Head $3\frac{1}{2}$ to $3\frac{7}{8}$; depth $4\frac{1}{5}$ to $4\frac{7}{8}$; D. iii, 7, I; A. iii, 7, I, rarely iii, 8, I; scales usually 32, often 33 or 34, rarely 30 or 31 + usually 2, rarely 3; usually 5 scales above l. l., rarely 6; usually 4 scales below l. l., rarely 5; usually 13 or 14 predorsal scales, frequently 12 or 15; snout $3\frac{1}{8}$ to $4\frac{1}{8}$ in head; eye $3\frac{1}{8}$ to $3\frac{3}{4}$; maxillary $3\frac{3}{4}$ to 4; interorbital $2\frac{1}{2}$ to 3; teeth 4–4; length $2\frac{1}{4}$ to $2\frac{7}{16}$ inches. Ten from Hicksville, O.

Notropis procne (Cope). Pl. XV, fig. 8.

Hybognathus procne Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 283. Conestoga Creek, Pa.

Cotypes of *H. procne* 11, and an example from Stony Run in Cecil County, Md.

Notropis procne longiceps (Cope). Pl. XVI, fig. 9.

Hybopsis longiceps Cope, Journ. Acad. Nat. Sci. Phila., (2) VI, 1868 (December), p. 231. Headwaters of Roanoke and James Rivers, Va.

Head $3\frac{2}{3}$ to $4\frac{3}{7}$; depth $4\frac{1}{4}$ to $5\frac{3}{4}$; D. iii, 7, I; A. usually iii, 6, I, occasionally iii, 7, I; scales usually 32, frequently 33, occasionally 31, seldom 34, rarely 29 or 30 + usually 2, rarely 1 or 3; 5 scales above l. l., rarely 4; 4 scales below l. l.; usually 12 or 13 predorsal scales, often 14, occasionally 15; snout $3\frac{1}{8}$ to $3\frac{3}{4}$ in head; eye $2\frac{3}{5}$ to $3\frac{1}{3}$; maxillary $2\frac{7}{8}$ to $3\frac{3}{4}$; interorbital $2\frac{1}{3}$ to $3\frac{1}{4}$; teeth 4–4; length $1\frac{11}{16}$ to $2\frac{15}{16}$ inches. Cotypes of *H. longiceps* 18 (type No. 4,108, A. N. S. P.). Also 52 examples, from Coal Creek and S. Fork of Cumberland River, Tenn.; Yadkin River, N. C.; James River ?, Va. This form has generally been identified with the preceding, but seems to differ somewhat in its more slender body.

Notropis spectrunculus (Cope).

Hybopsis spectrunculus Cope, Journ. Acad. Nat. Sci. Phila. (2), VI, 1868 (December), p. 231, Pl. 22, figs. 3–3*a*. Bear Creek, Holston River basin, Va.

Head $3\frac{3}{7}$ to $4\frac{1}{8}$; depth $4\frac{2}{5}$ to (6?) $5\frac{4}{5}$; D. iii, 7, I; A. usually iii, 7, I, seldom iii, 8, I; scales usually 36, frequently 35, seldom 34 + usually 2, rarely 1; 5 scales above l. l.; 4 scales below l. l.; usually 13 predorsal scales, often 15, sometimes 16, rarely 14 or 17?; snout $3\frac{1}{6}$ to $3\frac{4}{5}$ in head; eye $2\frac{1}{2}$ to 3; maxillary $2\frac{4}{5}$ to $3\frac{1}{3}$; interorbital $2\frac{1}{4}$ to $3\frac{1}{5}$; teeth 4–4; length 2 to $2\frac{1}{2}$ inches. Cotypes of *H. spectrunculus* 11 (type No. 4,363, A. N. S. P.). Also 10 examples, from French Broad River and Henderson County, N. C.; Kanawha basin (?), Va. Cope's figure shows only 6 developed branched rays.

Notropis blennius (Girard). Pl. XVI, fig. 10.

Alburnops blennius Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 194. Arkansas River near Ft. Smith.

Cotype of *A. blennius*, agreeing in most particluars with Girard's accounts, and is unquestionably the fish he calls *A. blennius*, whatever others may be confused, as he mentions 18 examples. Jordan gives[1] the teeth of one of Girard's examples as 1, 4–4, 0, which, if not broken, would suggest something different.

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[1] *Proc. U. S. Nat. Mus.*, 1885, p. 123.

Head $3\frac{5}{7}$ to $3\frac{2}{3}$; depth 4 to $4\frac{1}{2}$; D. iii, 7, I; A. iii, 6, I; scales 32 to 35 + 2; 5 or 6 scales above l. l.; 3 or 4 scales below l. l.; 13 or 14 predorsal scales; snout $3\frac{3}{5}$ to $3\frac{3}{4}$ in head; eye $3\frac{1}{8}$ to $3\frac{1}{4}$; maxillary $2\frac{3}{5}$ to 3; interorbital 3 to $3\frac{1}{10}$; teeth 2, 4–4, 2; length $2\frac{1}{8}$ to $2\frac{7}{16}$ inches. Two examples from Blue River, Indiana.

Notropis illecebrosus (Girard). Pl. XVI, fig. 11.

Alburnops illecebrosus Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 194. Arkansas River, near Fort Smith.

Cotype of *A. illecebrosus*. The fish called *N. illecebrosus* by Jordan and Evermann[2], to which is added "description here drawn up from the types" is confusing, as they give: A. 8; scales 7–35; 11 predorsal scales; teeth 1,4–4,1; all of which is not in agreement with my example, as may be seen by Meek's notes. This latter may be considered unquestionably the type of the present species, as Meek is the first to restrict it, therefore, while specimens of *A. shumardi* may be identical as suggested by Jordan and Gilbert,[3] it is not possible to so determine, as Jordan had already stated that the types of *A. shumardi* were lost. However, if the two are ever demonstrated to be identical, the name *shumardi* has precedence.

Notropis gilberti Jordan and Meek. Pl. XVI, fig. 12.

Proc. U. S. Nat. Mus., 1885, p. 4. Village Creek, Ia.

Head $3\frac{1}{5}$ to $3\frac{4}{5}$; depth $3\frac{4}{7}$ to $4\frac{2}{5}$; D. iii, 7, I, rarely iii, 6, I; A. usually iii, 7, I, seldom iii, 6, I, rarely iii, 8, I; scales usually 30 or 33, seldom 31, 32, 34 or 35 + usually 2, rarely 1; usually 6 scales above l. l., occasionally 5, rarely 7; 5 scales below l. l.; usually 15 or 17 predorsal scales, sometimes 16, rarely 13, 14 or 18; snout $3\frac{1}{10}$ to $3\frac{1}{4}$ in head; eye $3\frac{1}{10}$ to $3\frac{4}{5}$; maxillary $2\frac{2}{3}$ to $3\frac{1}{10}$; interorbital $2\frac{3}{4}$ to $3\frac{1}{2}$; teeth 1, 4–4, 1; length $2\frac{1}{16}$ to $2\frac{9}{16}$ inches. Seven cotypes of *N. gilberti*, besides 5 examples from Adel and Chariton, Ia.

Notropis nux Evermann.

Head $3\frac{1}{3}$ to 4; depth $3\frac{1}{2}$ to $4\frac{1}{3}$; D. iii, 7, I; A. iii, 6, I; scales usually 33, occasionally 32 or 34 + 2; 6 scales above l. l., rarely 5; 4 scales below l. l., rarely 5; 13 or 14 predorsal scales; snout 3 to $3\frac{3}{5}$ in head; eye $3\frac{1}{4}$ to $3\frac{7}{8}$; maxillary $2\frac{7}{8}$ to $3\frac{2}{5}$; interorbital $2\frac{1}{2}$ to $3\frac{1}{8}$; teeth 1, 4–4,1, rarely 1, 3–4, 1; length $2\frac{3}{16}$ to $2\frac{15}{16}$ inches. Thirty examples from Beaumont and Del Rio, Tex. The latter wrongly called *N. blennius* by me.[4]

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[2] *Bull. U. S. Nat. Mus.*, No. 47, I, 1896, p. 268.
[3] *L. c.*, No. 16, 1882, p. 193.
[4] *Proc. Acad. Nat. Sci. Phila.*, 1904, p. 244.

Notropis boops Gilbert. Pl. XVI, fig. 13.

Head $3\frac{3}{4}$ to 4; depth 4 to $4\frac{2}{5}$; D. iii, 7, I; A. iii, 7, I; scales usually 32, sometimes 34, rarely 33, 35 or 36 + 2, rarely 3; usually 5 scales above l. l., rarely 6; usually 3 scales below l. l., occasionally 4; 13 to 15 predorsal scales, rarely 12; snout $3\frac{1}{4}$ to 4 in head; eye $2\frac{3}{5}$ to $3\frac{1}{2}$; maxillary $2\frac{3}{4}$ to $3\frac{1}{3}$; interorbital $2\frac{1}{4}$ to $3\frac{1}{3}$; teeth usually 0, 4–4, 0, occasionally 1, 4–4, 1, rarely 0, 4–4,1; length $1\frac{5}{8}$ to $2\frac{5}{8}$ inches. Twenty-eight examples from Blue River, Ind., and Limestone Gap, Indian Ter. The former in some cases show inner edges of grooves on pharyngeal teeth crenate, but differ from Gilbert's account in that 23 show uniserial teeth and all have 8 (iii, 7, I) branched anal rays. There are mostly 3 scales below l. l. Limestone Gap examples show smooth pharyngeal teeth, dorsal origin distinctly behind ventral origin or midway between snout tip and caudal base, l. l. very slightly decurved, and 14 or 15 predorsal scales. I do not now think these examples can be identical with *Alburnnops shumardi* Girard,[5] though previously listed them so, as it was virtually supposed to have teeth 2,4–4,2 or 1,4–4,2, besides minor characters. The figure[6] is faulty, showing maxillary to eye center, mandible included, breast naked, 7 scales above l. l. (his description says 5), 5 scales below l. l. (his description says 3).

Notropis hudsonius (Clinton).

Head $3\frac{2}{3}$ to $4\frac{1}{4}$; depth $3\frac{3}{4}$ to 5; D. iii, 7, I, rarely iii, 8, I; A. iii, 7, I, rarely iii, 6, I or iii, 8, I; scales usually 37, often 36, sometimes 35, seldom 34 or 38, rarely 39 or 40 + usually 2, seldom 3; usually 6 scales above l. l., seldom 5; usually 4 scales below l. l., frequently 5; usually 16 predorsal scales, frequently 14 or 15, seldom 17, rarely 13 or 18; snout $3\frac{1}{8}$ to $3\frac{7}{8}$ in head; eye $2\frac{1}{3}$ to $3\frac{2}{3}$; maxillary $2\frac{2}{3}$ to 4; interorbital $2\frac{2}{5}$ to $3\frac{1}{8}$; teeth usually 2, 4–4, 1, sometimes 0, 4–4, 1, occasionally 1, 4–4, 2, seldom 1,4–4, 1, rarely 2, 4–4, 0 or 1, 4–4, 0 or 2, 5–4, 1; length $1\frac{1}{2}$ to $3\frac{1}{2}$ inches. Seventy examples, from Berkshire Hills, Mass.; Holston River, Va.; Port Clinton, O.; Lake Michigan, Detroit, Grosse Isle, Mich.; Blue River, Ind.; Clear Lake, Ia.; "Togus Lake, Mt. Denver"?

Notropis hudsonius selene (Jordan). Pl. XVI, fig. 14.

Head $3\frac{7}{8}$ to $4\frac{1}{5}$; depth $3\frac{3}{4}$ to $4\frac{1}{8}$; D. iii, 7, I; A. iii, 7, I; scales usually about 37, often 38, seldom 36 + 2; 6 scales above l. l.; 5 scales below

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[5] *L. c.*, 1856, p. 190. Arkansas River, near Fort Smith.

[6] *Rep. Expl. Sur. Pac. R.R., Zool.* X, Fishes, 1858, p. 261, Pl. 58, figs. 1–4 (types).

l. l.; usually 15 predorsal scales, occasionally 14, 16 or 17; snout $3\frac{2}{5}$ to $3\frac{3}{4}$ in head; eye $3\frac{1}{10}$ to $3\frac{3}{4}$; maxillary 3 to $3\frac{3}{4}$; interorbital $2\frac{2}{7}$ to 3; teeth 2, 4–4, 2; length $3\frac{9}{16}$ to $4\frac{3}{8}$ inches. Ten examples from Sparrow Lake in Simcoe County, Ontario.

Originally this form was thought allied with *N. cornutus*, but its dark caudal spot, slightly imbricated lateral scales and fewer anal rays point to its present location. The original account[7] differs in giving the depth $4\frac{1}{2}$, 4 scales above l. l. and 3 below. Dr. B. W. Evermann kindly examined examples from Garden Isle in Lake of the Woods and Rapid River, Minn. They show the head about $4\frac{1}{10}$ to $4\frac{1}{2}$, depth about $3\frac{9}{10}$ to $4\frac{3}{10}$, 5 scales above l. l., 4 scales below l. l., snout about 3 to $3\frac{1}{2}$, eye about 3 to $3\frac{1}{4}$, teeth (in 2 examples) 2, 4–4, 1, and length of largest about $3\frac{3}{4}$ inches. He writes "the only tangible difference, so far as these measurements show [from the typical *hudsonius*], is the length of the head, the *selene* type having a considerably shorter head than the others. There is no difference in the fins or scales." I have since examined several of these Lake of the Woods examples, now in the Academy, and think they are younger examples of *selene*, and that the size of the head is largely due to age.

Notropis hudsonius amarus (Girard). Pl. XVI, fig. 15.

Hybopsis phaënna Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 279. Trenton N. J.

Head $3\frac{3}{4}$ to $4\frac{3}{5}$; depth $3\frac{5}{6}$ to $4\frac{4}{5}$; D. iii, 7, I; A. iii, 7, I, rarely iii, 8, I; scales usually 36, sometimes 38, seldom 34, rarely 37 or 39 + 2; scales usually 6 above l. l., occasionally 7; usually 5 scales below l. l., often 4; usually 15 predorsal scales, frequently 16, occasionally 14 or 18, seldom 17; snout $3\frac{1}{5}$? to $3\frac{3}{4}$ in head; eye $2\frac{1}{2}$ to $3\frac{2}{5}$; maxillary $2\frac{7}{8}$ to $3\frac{1}{5}$; interorbital $2\frac{1}{3}$ to 3; teeth usually 1, 4–4, 1, often 2, 4–4, 2, seldom 1, 4–4, 2, rarely 1, 4–5, 2 or 0, 4–4, 1; length $1\frac{13}{16}$ to $5\frac{5}{16}$ inches. Cotypes of *H. phaënna* 3 (type No. 4, 389, A. N. S. P.). Also 58 examples, from Trenton, Haddonfield, Ridgewood, Newbold's I., Bordentown, Duck I., N. J.; Baltimore, Charles County, Washington, Md.

Notropis hudsonius saludanus (Jordan and Brayton).

Head $3\frac{3}{4}$ to 4; depth $4\frac{1}{6}$ to 5; D. iii, 7, I; A. iii, 7, I, rarely iii, 6, I; scales usually 36, sometimes 33, 34, 35 or 37 + 2; usually 6 scales above l. l., often 5; 4 scales below l. l.; usually 14 predorsal scales, occasionally 12; snout 3 to $3\frac{1}{3}$ in head; eye $2\frac{1}{5}$ to $3\frac{1}{8}$; maxillary $2\frac{7}{8}$ to $3\frac{1}{8}$; interorbital $2\frac{1}{2}$ to $3\frac{1}{5}$; teeth 1, 4–4, 1; length $2\frac{1}{2}$ to $3\frac{5}{8}$

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[7] *Luxilus selene* Jordan, *Bull. U. S. Nat. Mus.*, No. 10, 1877, p. 60. Lake Superior, Bayfield, Wisconsin.

inches. Six examples from the Catawba River, N. C. Cope records these as *Hybopsis amarus*. Comparing his key, the head is given as 4, that of *N. hudsonius amarus* as $4\frac{1}{2}$, a character of no importance. He gives teeth for *saludanus* 1, 4–4, 1, and for *amarus* 2, 4–4, 2, stating that only the upper outer tooth is hooked and furnished with a grinding-surface and the others are obtuse. I find these characters to vary in most all degrees in both forms, except the number of teeth in the inner row, which seems to be constantly 1 in *saludanus*, though other material may show variation. Some of these latter show all the larger teeth hooked. I find it differs from *amarus* in the rather shorter thicker body, rather fewer predorsal scales, inner pharyngeal tooth either absent or only 1, and usually only upper tooth hooked and with grinding-surface as the others often obtuse, though this apparently a condition of age as in the smaller examples all have been found hooked.

Notropis formosus (Girard).

Moniana formosa Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 201. Rio Membres, Mex.

Head $3\frac{3}{4}$; depth $3\frac{1}{2}$; D. iii, 7, I; A. iii, 7, I; scales 44 + 2; 8 scales above l. l.; 5 scales below l. l.; 21 predorsal scales; snout $3\frac{1}{2}$ in head; eye $3\frac{1}{2}$; maxillary $2\frac{9}{10}$; interorbital $2\frac{2}{5}$; teeth hooked, grinding-surfaces moderate, 4–4; length $2\frac{1}{16}$ inches. Cotype of *M. formosa*.

Notropis frigidus (Girard).

Moniana frigida Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 200. Trib. Rio San Antonio and Rio Neuces.

Head $3\frac{3}{5}$ to $3\frac{1}{5}$; depth $2\frac{7}{8}$ to $3\frac{2}{5}$; D. iii, 7, I; A. iii, 8, I; scales 33 to 36 + 2 or 3; 7 scales above l. l.; 4 or 5 scales below l. l.; 16 predorsal scales; snout $3\frac{1}{6}$ to $3\frac{2}{5}$ in head; eye $3\frac{4}{5}$ to 4; maxillary $2\frac{4}{5}$ to $3\frac{2}{5}$; interorbital $2\frac{1}{4}$ to $2\frac{4}{7}$; teeth ?–4, grinding-surfaces rather narrow; length $2\frac{1}{2}$ to $2\frac{5}{8}$ inches. Two cotypes? of *M. frigida*. Rio Salado (Clark?), Tex.? S. I. "2978." Very likely these are from the lot of 100 obtained in the Rio Salado, though no number is given by Girard.

Notropis lutrensis (Baird and Girard). Pl. XVI, fig. 16; Pl. XVII, figs. 17–21.

Cyprinella sauvis Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 197. Near San Antonio, Tex.
Moniana latabilis Girard, *l. c.*, p. 200. Hurrah Creek, trib. Rio Grande.
M. pulchella Girard, *l. c.* Sugar Loaf Creek, Tex.
M. rutila Girard, *l. c.*, p. 210. Cadereita, Mex.
M. couchi Girard, *l. c.* Near China, New Leon, Mex.
M. gracilis Girard, *l. c.* Near Monterey, Mex.
Cyprinella billingsiana Cope, Rep. U. S. Geol. Sur., 1870 (1871), p. 439. St. Joseph, Mo.
Moniana jugalis Cope, *l. c.* St. Joseph, Mo.
Cliola montiregis Cope, Proc. Am. Philos. Soc. Phila., XXII, 1885, p. 168. Monterey, Mex.

Head $3\frac{1}{5}$ to 4; depth $2\frac{5}{6}$ to 4; D. iii, 7, I, rarely iii, 8, I; A. iii, 8, I, seldom iii, 7, I, rarely iii, 9, I; scales usually 33, frequently 30 or 34, often 31 or 32, seldom 35, rarely 29 or 36 + usually 2, seldom 3, rarely 1; usually 6 scales above l. l., frequently 7, rarely 8; usually 4 scales below l. l., seldom 5; usually 14 predorsal scales, frequently 15, occasionally 13, often 16, seldom 17; snout $2\frac{4}{5}$ to 4 in head; eye $2\frac{3}{4}$ to 5; maxillary $2\frac{7}{8}$ to $3\frac{1}{2}$; interorbital $2\frac{1}{5}$ to 3; teeth usually 0, 4–4, 0, frequently 1, 4–4, 1, occasionally 1, 4–4, 0 or 0, 4–4, 1; length $1\frac{5}{16}$ to $2\frac{15}{16}$ inches. Cotypes, of *C. sauris* 2, *M. lætabilis* 1, *M. pulchella* 1, *M. rutila* 1 (nearly dessicated), *M. couchi* 1 (labelled "Arkansas River near Fort Smith. Dr. George E. Shumard. Smiths. Inst. 2982" evidently erroneously), *M. gracilis* 1, *C. billingsiana* 40 (type No. 2,952, A. N. S. P.), *M. jugalis* 7 (type No. 3,144, A. N. S. P.), and type of *C. montiregis* (type No. 19,344, A. N. S. P.). Also 121 examples, from Chariton, Ia.; Clinton, Osage River, Brownsville, Sedalia, Marshfield, Greenfield, Mo.; Dallas, Palestine?, Devil's River, Del Rio, Graham, Wichita River, Tex.; Fort Riley, Kan.

Notropis proserpina (Girard). Pl. XVII, fig. 22.

> *Moniana proserpina* Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 200. Devil's River, Tex.
> *M. aurata* Girard, *l. c.* Piedra Painte, New Mex.

Head $3\frac{3}{5}$ to 4; depth 4 to $4\frac{2}{5}$; D. iii, 7, I; A. iii, 7, I; scales usually 34 or 35, sometimes 33 or 36 + usually 2, rarely 4; usually 6 scales above l. l., occasionally 7; 4 scales below l. l.; usually 16 predorsal scales, occasionally 15, 17 or 19; snout 3 to $3\frac{1}{2}$ in head; eye $3\frac{1}{2}$ to 4; maxillary $3\frac{1}{5}$ to $3\frac{4}{5}$; interorbital 3 to $3\frac{1}{5}$; teeth 4–4; length $2\frac{1}{16}$ to $2\frac{5}{8}$ inches. Cotypes of *M. proserpina* 1, and *M. aurita* 2. Also 52 examples from Del Rio, Tex.

Notropis bubalinus (Baird and Girard).

> *Cyprinella umbrosa* Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 197. Coal Creek, Canadian River, Ark.
> *C. beckwithi* Girard, *l. c.* Arkansas River near Fort Makee.

Head $3\frac{4}{5}$; depth 3; D. iii, 7, I; A. iii, 9, I; scales 33 + 2; 7 scales above l. l.; 5 scales below l. l.; 16 predorsal scales; snout $3\frac{3}{4}$ in head; eye 4; maxillary 3; interorbital $2\frac{2}{5}$; teeth 1, 4–?, ?, hooked, grinding-surfaces, edges apparently crenulated. Cotype of *C. umbrosa*. Cotype of *C. beckwithi*, nearly dissolved.

Notropis ludibundus (Girard). Pl. XVII, fig. 23.

> *Cyprinella ludibunda* Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 199. No locality.

Cotype of *C. ludibunda*.

Notropis texanus (Girard).

Cyprinella texana Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 198. Rio Salado and Turkey Creek, Tex.

Head $3\frac{7}{8}$; depth $4\frac{1}{8}$; D. iii, 7, I; A. iii, 7, I; scales 36 + 2; 5 scales above l. l.; 4 scales below l. l.; about 15 predorsal scales; snout $3\frac{2}{5}$ in head; eye 3; maxillary $2\frac{7}{8}$; interorbital 3; teeth 4–4, grinding-surfaces narrow; length $1\frac{5}{8}$ inches (caudal damaged). Cotype of *C. texana*.

Notropis venustus (Girard).

Cyprinella venusta Girard. Proc. Acad. Nat. Sci. Phila., 1856, p. 198. Rio Sabinal, Tex.

Head $3\frac{7}{8}$ to 4; depth 3 to $4\frac{1}{4}$; D. iii, 7, I, rarely iii, 6, I; A. iii, 7, I, rarely iii, 6, I; scales usually 32, frequently 33, seldom 30, rarely 34 or 35 + usually 2, seldom 3; usually 6 scales above l. l., often 7; usually 4 scales below l. l., seldom 5; usually 15 predorsal scales, often 14 or 17; snout $3\frac{1}{10}$ to $3\frac{2}{3}$ in head; eye $3\frac{1}{3}$ to 4; maxillary 3 to $3\frac{2}{5}$; interorbital $2\frac{1}{4}$ to 3; teeth usually 1, 4–4, 1, rarely 0, 4–4, 1 or 1, 4?–4, 0; length $1\frac{3}{4}$ to $3\frac{1}{4}$ inches. Cotypes of *C. venusta* 2. Also 7 examples from Johnson's Fork of Llano River and the Rio Colorado at Austin, Tex.

Notropis stigmaturus (Jordan). Pl. XVII, fig. 24.

Photogenis stigmaturus Jordan, Ann. Lyc. N. Hist. N. Y., XI, 1876, p. 337. Trib. Etowah, Coosa and Oostanaula Rivers, Ga.

Head 4 to $4\frac{1}{8}$; depth 4 to 5; D. iii, 7, I; A. iii, 7, I, rarely iii, 8, I; scales usually 40, sometimes 42, rarely 46 + usually 3, frequently 2; 7 scales above l. l.; 5 scales below l. l.; usually 19 predorsal scales, rarely 18, 20 or 22; snout $3\frac{1}{10}$ to $3\frac{2}{5}$ in head; eye $3\frac{1}{4}$ to 4; maxillary 3 to $3\frac{1}{2}$; interorbital $2\frac{2}{5}$ to $2\frac{7}{8}$; teeth usually 1, 4–4, 1, rarely 0, 4–4, 0; length $2\frac{7}{16}$ to $3\frac{3}{4}$? inches. Cotypes of *P. stigmaturus* 8, from the Etowah River.

Notropis callistius (Jordan). Pl. XVIII, fig. 25.

Photogenis callistius Jordan, Ann. Lyc. N. Hist. N. Y., XI, 1876, p. 337. Etowah and Oostanaula Rivers, Ga.

Head 4; depth $4\frac{1}{2}$; D. iii, 7, I; A. iii, 8; scales 38 + 2; 6 scales above l. l.; 4 scales below l. l.; 17 predorsal scales; snout $3\frac{1}{3}$ in head; eye $3\frac{1}{4}$; maxillary $2\frac{3}{4}$; interorbital $2\frac{2}{5}$; teeth?, 4?–4?, 1?, grinding-surfaces entire; length $2\frac{5}{8}$ to $3\frac{1}{8}$ inches. Cotypes of *P. callistius* 3, from the Etowah, the largest figured. Said to differ from the preceding in red fin-pigment and more obscure dark caudal spot.

Notropis cæruleus (Jordan). Pl. XVIII, fig. 26.

Photogenis cœruleus Jordan, Ann. Lyc. N. Hist. N. Y., XI, 1876, p. 338. Oostanaula River above Rome, Ga.

Head 4; depth 4 to $4\frac{1}{4}$; D. iii. 7, I; A. iii. 7, I or iii. 8, I; scales 34 or 35 + 2 or 3; 6 scales above l. l.; 4 scales below l. l.; 14 predorsal scales; snout $3\frac{1}{3}$ in head; eye $3\frac{1}{5}$ to $3\frac{1}{2}$; maxillary 3 to $3\frac{1}{5}$; interorbital $2\frac{2}{5}$ to $2\frac{1}{2}$; teeth 1, 4–4, 1 or 0, 4–4, 1; length $2\frac{3}{16}$ to 3 inches. Cotypes of *P. cœruleus* 3, medium sized example figured.

Notropis niveus (Cope). Pl. XVIII, fig. 27.

Hybopsis niveus Cope, Proc. Am. Philos. Soc. Phila., XI, 1869–70, p. 460. Upper Catawba River, N. C.

Head $3\frac{1}{2}$ to 4; depth $3\frac{1}{5}$ to $4\frac{2}{5}$; D. iii. 7, I; A. usually iii. 7, I, sometimes iii. 8, I, rarely iii. 6, I; scales usually 34, often 32, 33 or 35 + usually 2, seldom 3; usually 6 scales above l. l., rarely 5; usually 4 scales below l. l., seldom 3; usually 15 predorsal scales, often 16, sometimes 14 or 17, rarely 18 or 19; snout 3 to $3\frac{2}{3}$ in head; eye $2\frac{7}{8}$ to 4; maxillary $2\frac{7}{8}$ to $3\frac{1}{5}$; interorbital $2\frac{2}{5}$ to 3; teeth usually 1, 4–4, 1, rarely 1, 4–4, 0; length $1\frac{11}{16}$ to $2\frac{15}{16}$ inches. Cotypes of *H. niveus* 19 (type No. 2,930, A. N. S. P.). Also 48 examples from Catawba, Neuse and Yadkin Rivers, N. C.

Notropis whipplii (Girard). Pl. XVIII, fig. 28.

Photogenis spilopterus Cope, Tr. Am. Philos. Soc. Phila., (2) XIII, 1865, p. 378. St. Josephs River, Mich.

Head $3\frac{1}{3}$ to $4\frac{1}{4}$; depth $3\frac{1}{5}$ to 5; D. iii, 7, I; A. usually iii, 7, I, sometimes iii, 8, I, rarely iii. 5, I or iii, 6, I; scales usually 33, frequently 34 or 35, often 36, sometimes 31 or 32, occasionally 30 or 38, seldom 29, rarely 26, 28 or 37 + usually 2, frequently 3; usually 6 scales above l. l., frequently 7; usually 4 scales below l. l., seldom 5; usually 16 predorsal scales, frequently 14 or 15, often 17, sometimes 18, occasionally 13, rarely 20; snout 3 to $3\frac{7}{8}$ in head; eye $2\frac{2}{3}$ to $4\frac{4}{5}$; maxillary $2\frac{2}{3}$ to $3\frac{3}{4}$; interorbital $2\frac{2}{7}$ to 3; teeth usually 1, 4–4, 1, rarely 0, 4–4, 1 or 1, 4–4, 0; length $1\frac{1}{2}$ to $3\frac{7}{8}$ inches. Cotype of *P. spilopterus*. Also 186 examples, from Ottumwa and Anamosa, Ia.; Carthage, Mo.; Wabash River, Ind.; Creek in Kanawha basin, Walker's Creek and Sinking Creek, Va.; Grosse Isle, Mich.

Notropis whipplii analostanus (Girard).

Head $3\frac{1}{3}$ to 4; depth $3\frac{1}{6}$ to $4\frac{3}{4}$; D. iii, 7, I; A. usually iii, 8, I, rarely iii, 7, I; scales usually 34, frequently 35, often 32 or 33, sometimes 36, rarely 30 or 31 + usually 2, seldom 3; usually 6 scales above l. l., rarely 5 or 7; usually 4 scales below l. l., rarely 3 or 5; usually 15 predorsal scales, often 14 or 16, seldom 13, rarely 17;

snout $3\frac{1}{10}$ to $3\frac{4}{5}$ in head; eye $2\frac{3}{4}$ to $4\frac{1}{3}$; maxillary $2\frac{4}{5}$ to $3\frac{1}{2}$; interorbital $2\frac{1}{8}$ to 3; teeth usually 1, 4–4, 1, rarely 1, 4–4, 0; length $1\frac{3}{16}$ to 3 inches. Specimens 104, from Trenton, Duck I., Newbold's I., Kinkora Creek, Trenton Junction, Burlington, Pensauken, Sewell, Mantua, N. J.; Stony Run in Cecil County, Gyn Oak in Baltimore County, Md.; James River and head of Roanoke River, Va.

Notropis galacturus (Cope).

Hypsilepis galacturus Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 160. Holston River, Va.

Head 3 to $4\frac{1}{4}$; depth $3\frac{7}{8}$ to 5; D. iii, 7, I; A. usually iii, 8, I, seldom iii, 7, I or iii, 9, I; scales usually 30, frequently 29, often 31 or 32, sometimes 27 or 33, seldom 26, 34 or 36, rarely 24, 25, 28 or 38 + usually 3, rarely 4, seldom 2; usually 6 scales above l. l., sometimes 7; usually 4 scales below l. l., rarely 5; usually 15 or 16 predorsal scales, frequently 17, often 14, seldom 13, rarely 17 or 18; snout 3 to $3\frac{2}{3}$ in head; eye $3\frac{1}{4}$ to 5; maxillary $2\frac{7}{8}$ to $3\frac{9}{10}$; interorbital $2\frac{3}{7}$ to 3; teeth 1, 4–4, 1; length $2\frac{1}{2}$ to 5 inches. Cotypes of *H. galacturus* Cope 64 also 66 examples, from Catawba River and French Broad River, N. C.; S. Fork Cumberland River and Coal Creek, Tenn.; Eureka Springs, Ark.

Notropis pyrrhomelas (Cope). Pl. XVIII, fig. 29.

Photogenis pyrrhomelas Cope, Proc. Am. Philos. Soc. Phila., XI, 1870, p. 463. Upper Catawba River, N. C.

Head $3\frac{1}{2}$ to $3\frac{7}{8}$; depth $3\frac{2}{7}$ to $4\frac{1}{8}$; D. iii, 7, I; A. usually iii, 9, I, rarely iii, 8, I or iii, 10, I; scales usually 30 or 33, seldom 32 or 34, rarely 28, 31 or 35 + usually 2, frequently 3; usually 6 scales above l. l., rarely 7; 4 scales below l. l.; usually 14 predorsal scales, often 13, seldom 15, rarely 12; snout $3\frac{1}{3}$ to $3\frac{3}{4}$ in head; eye 3 to $3\frac{1}{2}$; maxillary $2\frac{1}{2}$ to $2\frac{7}{8}$; interorbital $2\frac{3}{4}$ to $3\frac{1}{8}$; teeth usually 1, 4–4, 1, rarely 1, 5–4, 1; length $2\frac{11}{16}$ to $3\frac{7}{16}$ inches. Cotypes of *P. pyrrhomelas* 95 (type No. 2,631, A. N. S. P.). Cope says the teeth are without masticatory surface, which is not in agreement with my examination of his material, as they have well-developed grinding-surfaces. He further disagrees in stating ventrals reach the anal.

Notropis cornutus (Mitchill). Pl. XVIII, fig. 30.

Plargyrus bowmani Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 196. Sweetwater, trib. of Platte.

Alburnops plumbeolus Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 282. Flint, Mich.

Head $3\frac{1}{3}$ to $4\frac{1}{5}$; depth $2\frac{7}{8}$ to 5; D. iii, 7, I, very rarely iii, 8, I; A. usually iii, 8, I, seldom iii, 9, I, rarely iii, 7, I; scales usually 34, frequently 32 or 35, often 33, sometimes 30, 31, 36, 37 or 38, occasionally

39, seldom 29 or 40, rarely 25, 27 or 28 + usually 3, frequently 2; usually 7 or 8 scales above l. l., seldom 6, rarely 9; usually 5 scales below l. l., occasionally 4, seldom 6, rarely 7; predorsal scales usually 17 or 19, frequently 15 or 18, often 16 or 20, sometimes 23, occasionally 14, 21 or 22, seldom 25, rarely 13, 24 or 26; snout $2\frac{4}{5}$ to 4 in head; eye $2\frac{1}{3}$ to 5; maxillary $2\frac{1}{2}$ to $3\frac{7}{8}$; interorbital $2\frac{2}{5}$ to $3\frac{4}{5}$; teeth 2, 4–4, 2; length $1\frac{1}{4}$ to 7 inches. "Type of *P. bowmani* Girard" (No. 3,236, A. N. S. P.) may not be Girard's type, as he shows an only example a little over 4 inches and mine measures only $2\frac{13}{16}$. Cotypes of *A. plumbeolus* 7 (type No. 2,055, A. N. S. P.). Also 332 examples, from Halifax, N. S.; Berkshire Hills, Mass.; Salamanca, N. Y.; Trenton, Oliphant's Mill, Pitman, Sewell, Mantua, N. J.; Stony Run, Gyn Oak Falls, Md.; head of James River, Holston River, Va.; Neuces River, N. C.; Coal Creek, Tenn.; Hicksville, O.; Miami River, Wabash River, Ind.; Pine Lake, Grosse Isle, Flint, Belle Isle, Mich.; Michigan City, Anamosa, Ia.; Marshfield, Sedalia, Carthage, St. Joseph River, Greenfield, Mo.; Lake Whittlesey, Minn.; Fort Riley, Kan.

Notropis cornutus cerasinus (Cope). Pl. XVIII, fig. 31.

Hypsilepis cornutus cerasinus Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 159. Head of Roanoke River.

Cotypes of *H. cornutus cerasinus* 42 (type No. 3,791, A. N. S. P.). Only the color given in Cope's account would point to the possibility of it being distinct. He says "it is entirely deep rose the inferior fins crimson." Jordan and Evermann state[8] that it is never more than 4 inches long and yet the type, figured here, is 5. I cannot distinguish *Leuciscus frontalis* Agassiz and *L. gracilis* Agassiz, as a distinct subspecies of *N. cornutus*. His figure shows about 23? predorsal scales and 8 branched anal rays. Under *Hypsilepis frontalis* Cope distinguishes a number of Michigan examples. Later he notes others as *H. cornutus frontalis*, which I have partly examined, and find them to be within the variation of our common *cornutus*. The strikingly large predorsal scales would suggest a possible distinction were it not that other examples, from remote points in the range of the species, show this character equally well. All of the variations in structure are covered in *cornutus*.

Notropis cornutus cyaneus (Cope). Pl. XVIII, fig. 32.

Hypsilepis cornutus cyaneus Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 160. Montreal Run, Keeweenaw Point on Lake Superior.

Head $3\frac{3}{4}$ to $4\frac{1}{8}$; depth $3\frac{1}{2}$ to $4\frac{1}{5}$; D. iii, 7, I; A. usually iii, 8, I,

[8] *Bull. U. S. Nat. Mus.*, No. 47, I, 1896, p. 283.

seldom iii, 9, I; scales usually about 31, sometimes 32, rarely 29, 33, 34 or 38 + usually 3, rarely 4; usually 9 scales above l. l., seldom 8; usually 5 scales below l. l., seldom 6; usually 28 predorsal scales seldom 30, rarely 25, 27, 29 or 32; snout $3\frac{1}{5}$ to $3\frac{1}{2}$ in head; eye $3\frac{2}{5}$ to $4\frac{2}{7}$; maxillary 3 to $3\frac{1}{4}$; interorbital 3 to $3\frac{1}{6}$; teeth 2, 4–4, 2; length $3\frac{1}{2}$ to 5 inches. Cotypes of *H. c. cyaneus* 10 (type No. 3,950, A. N. S. P.).

Notropis lacertosus (Cope). Pl. XIX, fig. 33.

Hybopsis lacertosus Cope, Journ. Acad. Nat. Sci. Phila., (2) VI, 1868, p. 232. Bear Creek, Va.

Head $3\frac{3}{5}$ to 4; depth $4\frac{1}{3}$ to $4\frac{3}{4}$; D. iii, 7, I; A. usually iii, 8, I, rarely iii, 7, I or iii, 9, I; scales usually 39 or 40, sometimes 36 or 38 + usually 2, seldom 3; usually 7 scales above l. l., seldom 6, rarely 8?; 4 scales below l. l.; usually 17 predorsal scales, seldom 16 or 18; snout $3\frac{1}{10}$ to $3\frac{1}{3}$ in head; eye $2\frac{4}{5}$ to $3\frac{1}{3}$; maxillary $2\frac{1}{4}$ to $2\frac{1}{2}$; interorbital $2\frac{1}{2}$ to $3\frac{1}{6}$; teeth 2, 4–4, 2; length $1\frac{7}{8}$ to $4\frac{3}{8}$ inches. Cotypes of *H. lacertosus* 5 (type No. 2,835, A. N. S. P. figured) all in poor preservation. Also 6 examples from the Holston River, Va. The accompanying figure of the type is largely restored.

Notropis coccogenis (Cope).

Hypsilepis coccogenis Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 160. Holston River, Va.

Head $3\frac{1}{2}$ to $4\frac{1}{10}$; depth $3\frac{3}{4}$ to 5; D. iii, 7, I, rarely iii, 8, I, abnormally iii, 5, I; A. usually iii, 8, I, frequently iii, 7, I or iii, 9, I, rarely iii, 10, I; scales usually 34, often 41, sometimes 36 or 40, occasionally 33, 35, 38 or 39, seldom 30 or 32, rarely 31 or 37 + usually 3, sometimes 2, occasionally 4; usually 7 scales above l. l., seldom 6; usually 5 scales below l. l., seldom 4; usually 17 predorsal scales, frequently 16, often 15, 18 or 19, occasionally 14, seldom 20, rarely 13; snout $3\frac{1}{10}$ to $3\frac{3}{4}$ in head; eye $2\frac{3}{5}$ to 4; maxillary $2\frac{1}{4}$ to $2\frac{4}{5}$; interorbital $2\frac{1}{3}$ to $3\frac{2}{5}$; teeth usually 2, 4–4, 2, rarely 1, 4–4, 2; length $2\frac{1}{16}$ to 5 inches. Cotypes of *H. coccogenis* Cope 100 (type No. 3,561, A. N. S. P.). Also 42 examples, from Holston River and S. Fork, Va.; French Broad River and "Neuce River," N. C.; Coal Creek, Tenn.

Notropis zonatus (Putnam).

Head $3\frac{1}{2}$ to $4\frac{1}{4}$; depth $3\frac{3}{5}$ to $5\frac{1}{4}$; D. iii, 7, I; A. usually iii, 8, I, frequently iii, 7, I, sometimes iii, 9, I, seldom iii, 10, I, rarely iii, 6, I; scales usually 34, frequently 38, often 33 or 40, occasionally 32, 35, 37 or 39, rarely 31, 36 or 41 + usually 3, seldom 2; usually 6 scales above l. l., sometimes 7, seldom 5, rarely 4; usually 4 or 5 scales below l. l., seldom 3 or 6; usually 13 predorsal scales, frequently 15, often 14 or 16, sometimes 17; snout $3\frac{2}{7}$ to $3\frac{3}{4}$ in head; eye $2\frac{1}{5}$ to

$3\frac{4}{5}$; maxillary $2\frac{2}{5}$ to $3\frac{1}{4}$; interorbital $2\frac{4}{5}$ to $3\frac{2}{3}$; teeth usually 2, 4–4, 2, seldom 1, 4–4, 2, rarely 0, 3–4, 1 or 1?, 4–4, 1 or 0, 4–4, 2 or 2, 3?–4, 0? or 1, 3–4, 2; length $1\frac{3}{16}$ to 4 inches. Eighty examples, from Eureka Springs and White River, Ark.; Marshfield, Greenfield, Carthage and James River, Mo.

Notropis rubricroceus (Cope). Pl. XIX, fig, 34.

Hybopsis rubricroceus Cope, Journ. Acad. Nat. Sci. Phila., (2) VI, 1868, p. 231, Pl. 24, fig. 4. Tumbling Creek, N. Fork Holston River, Va.

Head $3\frac{2}{5}$ to 4; depth 4 to $4\frac{3}{4}$; D. iii, 7, I; A. usually iii, 7, I, rarely iii, 8, I; scales usually 35, often 32, 34, 35 or 39, seldom 37 + 2 or 3; usually 6 scales above l. l., occasionally 7; usually 4 scales below l. l., rarely 3; predorsal scales 13 to 17, rarely 18; snout $3\frac{1}{3}$ to $3\frac{3}{4}$ in head; eye $2\frac{7}{8}$ to $3\frac{3}{5}$; maxillary $2\frac{1}{3}$ to 3; interorbital $2\frac{2}{7}$ to $3\frac{1}{4}$; teeth 2, 4–4, 2; length $1\frac{1}{2}$? to $2\frac{9}{16}$ inches. Cotypes of *H. rubricroceus* 14 (type No. 2,907, A. N. S. P.).

Notropis chlorocephalus (Cope). Pl. XIX, fig. 35.

Hybopsis chlorocephalus Cope, Proc. Am. Philos. Soc. Phila., XI, 1870, p. 461. Trib. Catawba River, N. C.

Head $3\frac{4}{7}$ to $3\frac{7}{8}$; depth $4\frac{1}{4}$ to 5; D. iii, 7, I; A. iii, 7, I; scales usually 32, 33 or 37, sometimes 30?, 31?, 35 or 36 + usually 3, rarely 2; 6 scales above l. l.; 4 scales below l. l.; predorsal scales usually 16, often 15, sometimes 10 to 14, 17, 19 or 20; snout $3\frac{1}{3}$ to $3\frac{4}{5}$ in head; eye $2\frac{3}{4}$ to 3; maxillary $2\frac{2}{5}$ to $3\frac{2}{7}$; interorbital $2\frac{1}{2}$ to $3\frac{1}{8}$; teeth usually 1, 4–4, 1, rarely 1?, 3–4, 1 or 1, 4–4, 0; length $1\frac{7}{16}$ to $2\frac{1}{8}$ inches. Cotypes of *H. chlorocephalus* 41 (type No. 2,755, A. N. S. P.).

Notropis chiliticus (Cope). Pl. XIX, fig. 36.

Hybopsis chiliticus Cope, Proc. Am. Philos. Soc. Phila., XI, 1870, p. 462. Yadkin River, N. C.

Head $3\frac{2}{3}$ to $3\frac{4}{5}$; depth $4\frac{1}{4}$ to $4\frac{3}{4}$; D. iii, 7, I; A. iii, 7, I; scales usually 36, seldom 35? or 38 + usually 2, sometimes 3; 7 scales above l. l.; usually 4 scales below l. l., seldom 3; usually 15 or 16 predorsal scales, seldom 17; snout $3\frac{1}{3}$ to $3\frac{4}{5}$ in head; eye $2\frac{4}{5}$ to $3\frac{1}{5}$; maxillary $2\frac{4}{5}$ to 3; interorbital $2\frac{3}{4}$ to $3\frac{1}{8}$; teeth 2, 4–4, 2; length $1\frac{9}{16}$ to $2\frac{1}{4}$ inches. Cotypes of *H. chiliticus* Cope 11 (type No: 4,378, A. N. S. P.).

Notropis altipinnis (Cope). Pl. XIX, fig. 37.

Alburnellus altipinnis Cope, Proc. Am. Philos. Soc. Phila., XI, 1870, p. 464. Yadkin River, Roane County, N. C.

Head 4; depth $5\frac{1}{5}$; D. iii, 7, I; A. iii, 8, I; scales 32 + 2; 6 scales above l. l.; 4 scales below l. l.; 16 predorsal scales; snout $3\frac{1}{3}$ in head; eye $2\frac{2}{5}$; maxillary $3\frac{1}{10}$; interorbital 3; teeth 2, 4–4, 2; length $2\frac{1}{16}$ to $2\frac{1}{8}$

inches. Cotypes of *A. altipinnis* 3 (type No. 2,846, A. N. S. P.). One example in poor preservation.

Notropis roseus (Jordan). Pl. XIX, fig. 38.

One from Taylor's Creek, northeast trib. Lake Okeechobe (Heilprin), Fla.

Notropis chalybæus (Cope). Pl. XIX, fig. 39.

Head $3\frac{1}{2}$ to 4; depth $3\frac{7}{8}$ to $4\frac{4}{5}$; D. iii, 7, I; A. usually iii, 7, I, rarely iii, 8, I; scales usually 31, often 30 or 28, seldom 29 or 33 + usually 3, sometimes 2; usually 6 scales above l. l., sometimes 7; usually 4 scales below l. l., rarely 3; usually 15 predorsal scales, sometimes 16 or 17, seldom 13, 14 or 18; snout $3\frac{1}{10}$ to 4 in head; eye $2\frac{1}{3}$ to 3; maxillary 3 to $3\frac{2}{7}$; interorbital $2\frac{1}{4}$ to 3; teeth 2, 4–4, 2; length 1 to $1\frac{7}{8}$ inches. Very many examples, of which 52 were examined from Pensauken, Turnersville and Kinkora, N. J. Example figured from Bristol, Pa.

Notropis chalybæus abbotti Fowler. Pl. XIX, fig. 40.

Proc. Acad. Nat. Sci. Phila., 1904, p. 339, Pl. 17, upper fig. Batsto River, N. J.

Head $3\frac{3}{4}$ to 4; depth $3\frac{1}{3}$ to $4\frac{4}{5}$; D. iii, 7, I; A. usually iii, 7, I, rarely iii, 8, I; scales usually 29, 30 or 31, sometimes 26 or 34, seldom 27, 32 or 36 + usually 2, often 3, rarely 1; 6 or 7 scales above l. l.; usually 4 scales below l. l., rarely 3; usually 15 predorsal scales, frequently 16, often 17, sometimes 18, seldom 14; snout $3\frac{1}{4}$ to 4 in head; eye $2\frac{1}{3}$ to 3; maxillary 3 to $3\frac{1}{2}$; interorbital $2\frac{1}{4}$ to $2\frac{7}{8}$; teeth 2, 4–4, 2; length $1\frac{7}{16}$ to $2\frac{5}{16}$ inches. Type and paratypes of *N. c. abbotti* 19. Also very large series of examples, of which 425 examined, from Brown's Mills, Mare Run, New Lisbon, Porchtown, Oliphant's Mill and Newton's Bridge, N. J.

Notropis chrosomus (Jordan). Pl. XX, fig. 41.

Hybopsis chrosomus Jordan, Ann. Lyc. N. Hist. N. Y., XI, 1876, p. 333. Etowah, Oostanaula and Coosa Rivers, Ga.

Head $3\frac{7}{8}$ to 4; depth $4\frac{1}{2}$ to 5; D. iii, 7, I; A. iii, 9, I; scales 38 or 39 + 2; 7 scales above l. l.; 4 scales below l. l.; 20 or 23 predorsal scales; snout $3\frac{1}{3}$ in head; eye $2\frac{4}{5}$ to $2\frac{7}{8}$; maxillary $2\frac{4}{5}$ to $2\frac{7}{8}$; interorbital $2\frac{4}{5}$; teeth 2, 4–4, 2; length $1\frac{13}{16}$ to $1\frac{7}{8}$ inches. Cotypes of *H. chrosomus* 3, from the Etowah River.

Notropis xænocephalus (Jordan). Pl. XX, fig. 42.

Hybopsis xænocephalus Jordan, Ann. Lyc. N. Hist. N. Y., XI, 1876, p. 334. Etowah, Oostanaula and Coosa Rivers, Ga.

Head $3\frac{7}{8}$ to $4\frac{1}{5}$; depth $4\frac{1}{3}$ to 5; D. iii, 7, I; A. usually iii, 7, I, seldom iii, 6, I; scales usually 29, sometimes 28, 31, 32 or 33 + usually

2, often 1; 5 scales above l. l.; usually 4 scales below l. l., rarely 5; usually 12, 13 or 15 predorsal scales, sometimes 14; snout $3\frac{1}{8}$ to $3\frac{3}{7}$ in head; eye $2\frac{4}{7}$ to $3\frac{2}{5}$; maxillary $2\frac{1}{5}$ to $3\frac{1}{3}$; interorbital $2\frac{3}{7}$ to 3; teeth 2, 4–4, 2; length 2 to $2\frac{7}{16}$ inches. Cotypes of *H. xænocephalus* 9, from the Etowah River.

Notropis ariommus (Cope). Pl. XX, fig. 43.

> *Photogenis ariommus* Cope, Tr. Am. Philos. Soc. Phila., (2) VI, 1869, p. 378. No locality given (White River Indianapolis, Ind.)

Type of *P. ariommus*.

Notropis scabriceps (Cope).

> *Photogenis scabriceps* Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 166. Sinking Creek, Walker's Creek and near Austinville, Va.

Head $3\frac{1}{4}$ to 4; depth 4 to $5\frac{2}{7}$; D. iii, 7, I; A. usually iii, 7, I, seldom iii, 8, I; scales usually 32, often 33 or 34, seldom 30 or 31, rarely 36 + usually 2, sometimes 3; usually 6 scales above l. l., rarely 5; 4 scales below l. l.; usually 14 predorsal scales, often 13 or 15, seldom 12, rarely 17; snout $3\frac{1}{6}$ to $3\frac{4}{5}$ in head; eye $2\frac{1}{4}$ to $3\frac{1}{4}$; maxillary $2\frac{3}{4}$ to $3\frac{1}{3}$; interorbital $2\frac{2}{3}$ to 4; teeth 2, 4–4, 2; length $1\frac{7}{16}$ to $2\frac{13}{16}$ inches. Cotypes of *P. scabriceps* 33 (type No. 7,588, A. N. S. P., from Sinking Creek).

Notropis swaini Jordan. Pl. XX, fig. 44.

> Proc. U. S. Nat. Mus., 1885, p. 123. (Based on cotype of *Alburnus megalops* Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 193. San Felipe Creek, Tex. Name preoccupied in *Notropis*.)

Cotype of *A. megalops* and thus of *N. swaini*.

Notropis amabilis (Girard).

> *Alburnus amabilis* Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 193. Rio Leona, affluent of Rio Nueces, Tex.

Head $3\frac{4}{5}$; depth $4\frac{1}{5}$; D. iii, 7, I; A. iii, 8, I; scales 33 + 2; 5 scales above l. l.; 4 scales below l. l.; 16 predorsal scales; snout $3\frac{1}{2}$ in head; eye 3; maxillary $2\frac{3}{4}$; interorbital $2\frac{7}{8}$; length $2\frac{1}{4}$ inches. Cotype of *A. amabilis*.

Notropis luciodus (Cope) Pl. XX, fig. 45.

> *Photogenis luciodus* Cope, Proc. Acad. Nat. Sci. Phila., 1867, pp. 164, 165. Trib. of Holston River, Va.

Head $3\frac{3}{4}$ to $4\frac{1}{2}$; depth 4 to $5\frac{3}{4}$; D. iii. 7, I; A. usually iii, 7, I, occasionally iii, 8, I, rarely iii, 6, I; scales usually 36, frequently 35, often 38, seldom 37 or 39, rarely 40; usually 6 scales above l. l., seldom 5; 4 scales below l. l.; usually 15 predorsal scales, frequently 14, often 16, seldom 13, rarely 17; snout 3 to $3\frac{7}{8}$ in head; eye $2\frac{3}{4}$ to $3\frac{1}{2}$; maxillary $2\frac{2}{3}$ to $3\frac{2}{3}$; interorbital $2\frac{2}{5}$ to $3\frac{1}{8}$; teeth 1, 4–4, 1; length $1\frac{3}{4}$ to $3\frac{3}{8}$ inches. Cotypes of *P. luciodus* 23 (type No. 2,336, A. N. S. P.). Also 45 examples, from French Broad River, N. C.; Cumberland River, Tenn.; Holston River, Va.

Notropis telescopus (Cope).

Photogenis telescopus Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 165. Holston River, Va.

Head $3\frac{3}{4}$ to $4\frac{1}{8}$; depth $4\frac{1}{8}$ to $5\frac{3}{4}$; D. iii, 7, I; A. usually iii, 9, I, sometimes iii, 10, I, occasionally iii, 8, I, very rarely iii, 11, I; scales usually 33, frequently 35, often 34, sometimes 36, occasionally 32 or 37, rarely 31, 38 or 39 + usually 2, frequently 3; usually 5 scales above l. l., often 6, rarely 7; usually 4 scales below l. l., sometimes 3; usually 14 predorsal scales, frequently 13, often 15, rarely 16 or 17; snout $3\frac{1}{8}$ to 4 in head; eye $2\frac{1}{4}$ to 3; maxillary $2\frac{1}{3}$ to $3\frac{1}{8}$; interorbital $2\frac{7}{8}$ to $3\frac{1}{5}$; teeth 2, 4–4, 2; length $1\frac{15}{16}$ to $3\frac{3}{8}$ inches. Cotypes of *P. telescopus* 104 (type No. 2,157, A. N. S. P.). Also 167 examples, from Holston River, Va.; French Broad River and Henderson County, N. C.; Cumberland River and Coal Creek, Tenn.

Notropis socius (Girard).

Alburnus socius Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 193. Live Oak Creek, Tex.

Head $3\frac{1}{3}$ to $3\frac{4}{5}$; depth $3\frac{3}{4}$ to 5; D. iii, 7, I; A. usually iii, 9, I, often iii, 8, I, seldom iii, 7, I or iii, 10, I; scales usually 34, sometimes 36 or 37, occasionally 32, 33 or 35 + usually 2, seldom 3; usually 6 scales above l. l., rarely 5 or 7; usually 4 scales below l. l., seldom 3; usually 15 predorsal scales, often 13 or 16, sometimes 14 or 18, seldom 17; snout $3\frac{1}{3}$ to 4 in head; eye $2\frac{3}{7}$ to $3\frac{1}{2}$; maxillary $2\frac{1}{4}$ to 3; interorbital $2\frac{7}{8}$ to $3\frac{1}{3}$; teeth 2, 4–4, 2; length $1\frac{7}{16}$ to $2\frac{13}{16}$ inches. Cotype of *A. socius*. Also 54 examples, from Del Rio and Wichita River, Tex.

Notropis notemigonoides Evermann.

Head $3\frac{7}{8}$ to $4\frac{1}{5}$; depth $3\frac{3}{5}$ to $4\frac{1}{2}$; D. usually iii, 7, I, rarely iii, 6, I; A. usually iii, 9, I or iii, 10, I, sometimes iii, 11, I; scales usually 39 to 41, sometimes 36, 37 or 38 + usually 2, rarely 3; usually 8 scales above l. l., rarely 7 or 9; usually 4 scales below l. l., seldom 5; predorsal scales sometimes 22, 26 or 27, seldom 23, 24 or 29; snout 3 to $3\frac{2}{5}$ in head; eye 3 to $3\frac{2}{5}$; maxillary $2\frac{3}{5}$ to 3; interorbital $2\frac{2}{7}$ to 3; teeth 2, 4–4, 2; length $1\frac{3}{4}$ to $2\frac{9}{16}$ inches. Nine examples from Hartford, Ark., and Beaumont, Tex.

Notropis stilbius (Jordan). Pl. XX, fig. 46.

Nototropis stilbius Jordan, Ann. Lyc. N. Hist. N. Y., XI, 1876, p. 343. Etowah River basin, Ga.

Head $3\frac{7}{8}$; depth $4\frac{1}{2}$; D. iii, 7, I; A. iii, 10, I; scales 33 + 3; 5 scales above l. l.; 3 scales below l. l.; 17 predorsal scales; snout $3\frac{1}{4}$ in head; eye $2\frac{7}{8}$; maxillary $2\frac{2}{5}$; interorbital $3\frac{1}{4}$; teeth 2, 4–4, 2; length $2\frac{1}{2}$ inches. Cotypes of *N. stilbius* 2, larger figured.

Notropis atherinoides Rafinesque. Pl. XX, fig. 47.

Alburnellus jaculus Cope, Tr. Am. Philos. Soc. Phila., (2) XIII, 1866, p 387. St. Josephs River, Mich.

Head $3\frac{1}{5}$ to $4\frac{1}{2}$; depth $4\frac{1}{3}$ to 6; D. usually iii, 7, I, rarely iii, 6, I; A. usually iii, 9, I, frequently iii, 10, I, seldom iii, 11, I; scales usually 36, frequently 37, often 34, sometimes 38 or 39, occasionally 32 or 33, rarely 35 or 40 + usually 2, often 3; usually 6 scales above l. l., often 7; usually 4 scales below l. l., sometimes 3, seldom 5; usually 20 predorsal scales, frequently 19, often 16, sometimes 17, 18 or 21, seldom 15, 22 or 23, rarely 24; snout $3\frac{1}{5}$ to $3\frac{4}{5}$ in head; eye $2\frac{4}{5}$ to $3\frac{3}{4}$; maxillary $2\frac{1}{3}$ to $3\frac{2}{7}$; interorbital $2\frac{1}{2}$ to $3\frac{3}{5}$; teeth usually 2, 4–4, 2, rarely 2, 4–4, 1; length $1\frac{3}{4}$ to 4 inches. Cotype of *A. jaculus*. Also 135 examples, from Lake Winnetonka, Minn.; Joliet, Ill.; Blue River and Wabash River, Ind.; Sinking Creek. Walker's Creek, and head of James and Roanoke Rivers, Va.; "Togus Lake near Denver, Col."

Notropis dilectus (Girard). Pl. XX, fig. 48.

Alburnus oligaspis Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 282. Kansas.

Head $3\frac{5}{7}$ to 4; depth $3\frac{7}{8}$ to $5\frac{4}{7}$; D. iii, 7, I; A. usually iii, 9, I, seldom iii, 8, I, rarely iii, 10, I; scales often 33, 37 to 39, sometimes 31, 32, 34, 35 or 40 + usually 2, seldom 3; usually 7 scales above l. l., seldom 6, rarely 8; 4 scales below l. l.; usually 17 or 19 predorsal scales, seldom 18 or 21; snout $3\frac{1}{4}$ to $3\frac{7}{8}$ in head; eye 3 to $3\frac{7}{8}$; maxillary $2\frac{4}{5}$ to $3\frac{1}{8}$; interorbital $2\frac{7}{8}$ to $3\frac{1}{2}$; teeth 2, 4–4, 2; length $1\frac{13}{16}$ to $2\frac{7}{8}$ inches. Cotypes of *A. oligaspis* 2 (type No. 2,753, A. N. S. P.). Also 14 examples, from Chester, Ia. and Greenfield, Mo.

Notropis rubrifrons (Cope). Pl. XXI, figs. 49-50.

Alburnus rubrifrons Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 85. Kiskiminitas River, Pa.

Alburnellus percobromus Cope, Rep. U. S. Geol. Sur. Wyom. Hayden, 1870, p. 440. St. Joseph, Mo.

Head $3\frac{3}{5}$ to $3\frac{7}{8}$; depth $3\frac{3}{4}$ to $5\frac{1}{3}$; D. iii, 7, I; A. usually iii, 9, I, often iii, 10, I, seldom iii, 8, I; scales usually 34, often 33 or 35, sometimes 30 or 32, rarely 31, 36, 37 or 39 + usually 2, often 3; usually 6 scales above l. l., sometimes 7; usually 4 scales below l. l., rarely 3; usually 18 predorsal scales, often 17, sometimes 15 or 19, seldom 16; snout $3\frac{1}{6}$ to $3\frac{1}{2}$ in head; eye $2\frac{7}{8}$ to $3\frac{1}{2}$; maxillary $2\frac{1}{4}$ to $2\frac{7}{8}$; interorbital $2\frac{3}{4}$ to $3\frac{1}{3}$; teeth 2, 4–4, 2; length $1\frac{9}{16}$ to $2\frac{5}{8}$ inches. Cotypes of *A. rubrifrons* 5 and *A. percobromus* 17 (type No. 2,993, A. N. S. P.). Also 7 examples, from Carthage, Mo.; Graham, Tex.; Kanawha River, Va.

Notropis photogenis (Cope). Pl. XXI, figs. 51–52.

Squalius photogenis Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 280. Youghiogheny River, Pa.
Photogenis leucops Cope, *l. c.*, 1867, p. 164. Sinking Creek and near Austinville, Va.
P. leucops engraulinus Cope, *l. c.* Kanawha River, Austinville, Va.

Head $3\frac{1}{3}$ to $4\frac{1}{3}$; depth $4\frac{2}{5}$ to 6 ($6\frac{2}{5}$?); D. iii, 7, I; A. usually iii, 9, I, sometimes iii, 8, I or iii, 10, I, rarely iii, 7, I or iii, 11, I; scales often 33, sometimes 35 or 37, seldom 36 or 38, rarely 30, 31, 34 or 40 + usually 2, often 3; usually 6 scales above l. l., seldom 7, rarely 5; 4 scales below l. l.; usually 17 predorsal scales, often 15, 16 or 18, seldom 19, rarely 13 or 14; snout 3 to $3\frac{4}{5}$ in head; eye $2\frac{1}{2}$ to $3\frac{1}{2}$; maxillary $2\frac{1}{4}$ to $3\frac{1}{5}$; interorbital $2\frac{1}{3}$ to $3\frac{3}{4}$; teeth 2, 4–4, 2; length $1\frac{15}{16}$ to 4 inches. Cotypes of *P. leucops* (type No. 2,581, A. N. S. P.) and *S. photogenis* 2, and type of *P. l. engraulinus*, the latter in poor preservation.

Notropis photogenis amœnus (Abbott). Pl. XXI, fig. 53.

One from Stony Run, Cecil County, Md.

Notropis micropteryx (Cope). Pl. XXI, fig. 54.

Alburnellus micropteryx Cope, Journ. Acad. Nat. Sci. Phila., (2) VI, 1869, p. 233. Holston River, Va.

Head 4 to $4\frac{1}{4}$; depth 5 to $5\frac{1}{2}$; D. iii, 7, I; A. iii, 7, I usually, iii, 8, I rarely; usually 35 scales, sometimes 34, 36 or 37 + usually 3, often 2; 5 scales above l. l.; 3 scales below l. l.; usually 17 predorsal scales, sometimes 15, 18 or 19; snout $3\frac{2}{7}$ to $3\frac{1}{2}$ in head; eye $2\frac{3}{4}$ to $3\frac{1}{3}$; maxillary $2\frac{1}{2}$ to $2\frac{7}{8}$; interorbital $2\frac{7}{8}$ to $3\frac{1}{3}$; teeth 2, 4–4, 2; length $2\frac{1}{8}$ to $2\frac{9}{16}$ inches. Cotypes of *A. micropteryx* 2 (type No. 2,842, A. N. S. P.). Also 5 examples, from Eureka Springs, Ark. and Coal Creek, Tenn.

Notropis lirus (Jordan). Pl. XXI, fig. 55.

Nototropis lirus Jordan, Ann. Lyc. N. Hist. N. Y., 1876, p. 342. Etowah River, Rome, Ga.

Cotype of *N. lirus*.

Notropis umbratilis (Girard).

Luxilus lucidus Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 203. Coal Creek, trib. S, Fork Canadian River, Ark.

Head $3\frac{3}{4}$ to 4; depth $3\frac{2}{5}$ to $4\frac{1}{2}$; D. iii, 7, I; A. usually iii, 9, I, seldom iii, 10, I; scales often 39, sometimes 35, seldom 33, 36 or 41 + usually 3, seldom 2; usually 9 scales above l. l., often 10, rarely 11; usually 4 scales below l. l., seldom 5; often 23 to 25 predorsal scales, seldom 20, 22, 26 or 27; snout $3\frac{1}{5}$ to $3\frac{4}{5}$ in head; eye 3 to $3\frac{1}{2}$; maxillary $2\frac{1}{5}$ to 3; interorbital $2\frac{3}{4}$ to 3; teeth 2, 4–4, 2;

length $1\frac{15}{16}$ to $2\frac{5}{8}$ inches. Cotype of *L. lucidus* 2. Also 10 examples, from Marshfield and Sedalia, Mo.

Notropis umbratilis lythrurus (Jordan).

Head $3\frac{7}{8}$ to $4\frac{1}{5}$; depth $3\frac{1}{4}$ to $4\frac{1}{4}$; D. iii, 7, I; A. iii, 10, I; scales often 37, sometimes 35, 39 or 41 + usually 2, rarely 3; usually 10 scales above l. l., sometimes 9; 5 scales below l. l.; often 26 or 22 predorsal scales, seldom 23; snout $3\frac{1}{10}$ to $3\frac{1}{4}$; eye $3\frac{1}{10}$ to $3\frac{3}{4}$; maxillary $2\frac{1}{3}$ to 3; interorbital $2\frac{3}{5}$ to 3; teeth 2, 4–4, 2; length $2\frac{5}{16}$ to $2\frac{3}{4}$ inches. Seven examples from Indiana, and Lansing, Mich., the latter recorded as *Hypsilepis diplæmia* Cope.[9]

Notropis umbratilis ardens (Cope). Pl. XXI, fig. 56.

Hypsilepis ardens Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 163. Head of Roanoke River, Va.

Head 4 to $4\frac{1}{4}$; depth $4\frac{1}{3}$ to $5\frac{3}{4}$; D. iii, 7, I; A. usually iii, 9, I, often iii, 10, I, occasionally iii, 8, I, seldom iii, 7, I or iii, 11, I, rarely iii, 12, I; scales often 40 to 42, seldom 35 or 39 + usually 2 or 3, rarely 4; usually 8 scales above l. l., seldom 7, rarely 9; usually 4 scales below l. l., rarely 5; often 24, 26 or 27 predorsal scales, sometimes 22, 23 or 25; snout $3\frac{1}{10}$ to $3\frac{1}{2}$ in head; eye 3 to $3\frac{3}{4}$; maxillary $2\frac{3}{7}$ to $2\frac{7}{8}$; interorbital 3 to $3\frac{1}{2}$; teeth 2, 4–4, 2; length $2\frac{1}{2}$ to $3\frac{1}{8}$ inches. Cotypes of *H. ardens* 48 (type No. 3,268, A. N. S. P.). Also 176 examples from S. Fork of Cumberland River, Tenn.

Explanation of Plates XV–XXI.

Plate XV—Fig. 1—Notropis bifrenatus (Cope). Example from Holmesburg, Phila., Pa.
Fig. 2—N. cayuga Meek. Example from Silver Lake, Ia.
Fig. 3—N. fretensis (Cope). Type of *Hybopsis fretensis* Cope.
Fig. 4—N. deliciosus (Girard). Cotype of *Moniana deliciosa* Girard.
Fig. 5—N. deliciosus (Girard). Type of *Hybognathus stramineus* Cope.
Fig. 6—N. deliciosus (Girard). Type of *Hybopsis missuriensis* Cope.
Fig. 7—N. volucellus (Cope). Example from Hicksville, O.
Fig. 8—N. procne (Cope). Cotype of *Hybognathus procne* Cope.

Plate XVI—Fig. 9—N. procne longiceps (Cope). Type of *Hybopsis longiceps* Cope.
Fig. 10—N. blennius (Girard). Cotype of *Alburnops blennius* Girard.
Fig. 11—N. illecebrosus (Girard). Cotype of *Alburnops illecebrosus* Girard.
Fig. 12—N. gilberti Jordan and Meek. Cotype.
Fig. 13—N. boops Gilbert. Example from Blue River, Ind.
Fig. 14—N. hudsonius selene (Jordan). Example from Sparrow Lake, Ont.
Fig. 15—N. h. amarus (Girard). Type of *Hybopsis phaënna* Cope.
Fig. 16—N. lutrensis (Baird and Girard). Cotype of *Cyprinella sauris* Girard.

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[9] *Proc. Acad. Nat. Sci. Phila.*, 1864, p. 279, and *l. c.*, 1867, p. 162.

PLATE XVII—Fig. 17—N. lutrensis (Baird and Girard). Cotype of *Moniana lætabilis* Girard.
Fig. 18—N. lutrensis (Baird and Girard). Cotype of *Moniana gracilis* Girard.
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Fig. 20—N. lutrensis (Baird and Girard). Type of *Moniana jugalis* Cope.
Fig. 21—N. lutrensis (Baird and Girard). Type of *Cliola montiregis* Cope.
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Fig. 23—N. ludibundus (Girard). Cotype of *Cyprinella ludibunda* Girard.
Fig. 24—N. stigmaturus (Jordan). Cotype of *Photogenis stigmaturus* Jordan.

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Fig. 32—N. c. cyaneus (Cope). Type of *Hypsilepis cornutus cyaneus* Cope.

PLATE XIX—Fig. 33— N. lacertosus (Cope). Type of *Hybopsis lacertosus* Cope.
Fig. 34—N. rubricroceus (Cope). Type of *Hybopsis rubricroceus* Cope.
Fig. 35—N. chlorocephalus (Cope). Type of *Hybopsis chlorocephalus* Cope.
Fig. 36—N. chiliticus (Cope). Type of *Hybopsis chiliticus* Cope.
Fig. 37—N. altipinnis (Cope). Type of *Alburnellus altipinnis* Cope.
Fig. 38—N. roseus (Jordan). Example from Taylor's Creek, Fla.
Fig. 39—N. chalybæus (Cope). Example from Bristol, Pa.
Fig. 40—N. c. abbotti Fowler. Type.

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Fig. 42—N. xænocephalus (Jordan). Cotype of *Hybopsis xænocephalus* Jordan.
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Fig. 44—N. swaini Jordan. Cotype of *Alburnus megalops* Girard and *N. swaini* Jordan.
Fig. 45—N. luciodus (Cope). Type of *Photogenis luciodus* Cope.
Fig. 46—N. stilbius (Jordan). Cotype of *Notoropis stilbius* Jordan.
Fig. 47—N. atherinoides Rafinesque. Cotype of *Alburnellus jaculus* Cope
Fig. 48—N. dilectus (Girard). Type of *Alburnus oligaspis* Cope.

PLATE XXI—Fig. 49—N. rubrifrons (Cope). Type of *Alburnus rubrifrons* Cope.
Fig. 50—N. rubrifrons (Cope). Type of *Alburnellus percobromus* Cope.
Fig. 51—N. photogenis (Cope). Type of *Squalius photogenis* Cope.
Fig. 52—N. photogenis (Cope). Type of *Photogenis leucops* Cope.
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SPERMATOGENESIS IN LEPIDOPTERA.

MARGARET HARRIS COOK, PH.D

Contents.

Introduction.

Ever since Henking's work on the spermatogenesis of *Pyrrhocoris apterus* (1891) it has been known that in one maturation division one chromosome may go undivided into one of the daughter cells, so giving two classes of spermatids. The significance of this fact was not recognized until ten years later, when McClung (1901) advanced the purely theoretical view that this dimorphism of the spermatozoa bore a direct relation to the determination of sex, and suggested that the spermatozoa containing the extra chromosome, which was called by him the accessory chromosome, were the male determinants. In 1905 Stevens for Coleoptera and Wilson for Hemiptera showed, by comparing the number of chromosomes in the spermatocyte and oöcyte, that the accessory chromosome had its homologue in the egg and hence was the female and not the male determinant. That this marked difference in the behavior of the accessory chromosomes from the other chromosomes in one of the maturation divisions, together with the new interpretation of its function, might throw light on the chromatin substance and its bearing on heredity seemed more probable than ever before, especially if it could be shown that this held true for all classes of animals. In summarizing the work on this subject, McClung (1902) says the accessory chromosome has been found in all insects so far studied, is present in different members of Orthoptera, and, in examining material from Hemiptera, Neuroptera, Coleoptera, and Lepidoptera, this body was found. Miss Wallace has found it in Arachnida and the probability of its general occurrence in Arthropods is thus largely increased. Some hurried examination of vertebrate spermatocytes lead McClung to believe that the accessory chromosome is likewise present among vertebrates and that it will probably be found to be universal.

Except this reference of McClung's to the accessory in Lepidoptera, no other mention of it was found; and, since no recent detailed examination of the spermatogenesis of Lepidoptera had been undertaken, it seemed advisable to examine members of this group. Accordingly, in September, 1905, at Dr. Conklin's suggestion, I began to collect material with the purpose of studying the accessory chromosome in Lepidoptera. Testes were fixed and cut from a number of genera and species, but in most cases were found unsatisfactory. *Philosamia cynthia* was particularly clear and was chosen as a basis for comparative work. Owing to the publication of Dederer (1907) on this species, I shall refer to my own work only when my results differ from hers.

This paper contains, aside from references to *Philosamia cynthia*, a study of the spermatogenesis of *Callosamia promethea*, *Telea polyphemus*, *Automeris io*, *Samia cecropia*, and *Acronycta* (sp.?) as well as a few comparisons with *Danais archippus* and *Papilio cresphontes*. I am indebted to Prof. Calvert, of the University of Pennsylvania, and to Dr. Skinner, of the Academy of Natural Sciences, for aid in the identification of the species here described. The work was done in the Biological Laboratory of the University of Pennsylvania under the direction of Prof. Edwin G. Conklin. I am glad of this opportunity to express my feeling of gratitude to Prof. Conklin for his help and encouragement throughout the years of my work as well as for his suggestions and for criticisms of this paper.

I. Previous Work.

The published works upon Spermatogenesis in Lepidoptera may be divided into two classes: the earlier works, including those of Carnoy (1884), Platner (1889), Cholodkovsky (1894), Verson (1894), Erlanger (1896), La Valette St. George (1897), Henneguy (1891), Meves (1890), and Toyama (1903); the later, those of Munson (1907), Stevens (1906), and Dederer (1907). The earlier workers concerned themselves principally with the origin of the sex cells and the formation of the spermatozoa, with especial reference to achromatic structures. Thus Cholodkovsky finds in the closed flask-shaped end of the testis tube of *Laphria* a large cell from which the cells of the testis arise; and the same subject has been studied by Verson, La Valette St. George and Toyama for *Bombyx mori*. Of all the earlier workers it is perhaps to La Valette St. George, more than to any student of this group, that we are most indebted, for to him we owe our present nomenclature. In 1884 Carnoy, studying the larval testes of two moths, *Chelonia caja* and *Arctia fuliginosa*, made the observation, confirmed for the species here studied, that all the cells in the same cyst are in the same stage of development and he figures and describes a few steps in the development of the first spermatocytic division. In *C. caja* the twenty-four rodlike chromosomes divide longitudinally and move to opposite poles, while in *A. fuliginosa* the chromosomes in a side view are seen upon a spindle as dumb-bells with a transverse constriction. An equatorial plate shows twenty-eight chromosomes so arranged that the twenty peripheral chromosomes surround the eight interior ones. Carnoy's observations on this group are very limited, owing to the fact that he found his material unsatisfactory for studying the reconstructive stages of the nucleus. Platner was the first to describe the whole course of development of spermatogenesis for Lepidoptera. He described the thirty chromosomes in the first spermatocytic division of *Pygæra* and *Sphinx* as short rods with transverse constrictions, and since the rods in the mitotic figure are arranged parallel to the spindle axis, this constriction marks the first plane of division. He confused the acrosome and centrosome, yet confirmed Bütschli's observations by showing that the "large mitosome," Bütschli's "Nebenkern", functions in the formation of the tail of the spermatid. His work, like that of Erlanger (1896) and LaValette St. George (1897), deals largely with the achromatic structures of the nucleus. Of special interest in the light of recent work is Platner's account of the nucleolus, which he describes as one or two rather large and deeply staining bodies which are spherical in shape and eccentrically placed. It seems very probable that these are comparable to the equal pair of idiochromosomes figured for the forms described in the present study.

Toyama (1902; his second paper, 1903, I have been unable to find) describes the whole spermatogenic cycle for *Bombyx*. He begins with a discussion of the formation of the early spermatogonia in the peripheral end of the testis around a large cell which he considers a follicle cell, in opposition to Verson's (1894) idea that it is a large spermatogonium, which by mitotic division gives rise to all the spermatogonia. La Valette St. George (1897), also working on *Bombyx,* failed to confirm Verson. Toyama finds twenty-six to twenty-eight chromosomes in the spermatogonia. These split longitudinally before the formation of the spindle, so that they appear in the prophase of the first spermatocyte as ring-shaped bodies which are each made up of four chromosomes. According to Toyama the first division of these chromosomes is transverse; the second is not a true division but a separation of whole chromosomes, fourteen passing into each cell. During the spindle stage a persistent nucleolus is found which shows no change in the resting stage of the first spermatocytes and is seen to consist of small chromatin granules imbedded in a less dense matrix. This nucleolus is later pushed into the cytoplasm. Meves (1897) working on six species of Lepidoptera, confined himself largely to cytoplasmic structures. He assigns a different origin to the Nebenkern from that of Bütschli and Platner and makes the interesting observation, for the first time, that an axial filament grows out of the centrosome of the resting spermatocyte. Henneguy (1897) confirms this observation of Meves for *Bombyx mori* and *Hyponomenta cognatella.*

Of the more recent contributions, Munson's (1906) on *Papilio rutulus* is chiefly devoted to cytoplasmic structures and is hard to bring into relation with the observations of modern workers, since it shows no contraction stage of the chromatin and no synapsis, "unless a temporary conjugation may be considered to take place when the twenty-eight chromosomes are arranged in a line of seven, four deep." These "tetrads" break up into fourteen dyads. The first maturation division is equational, the second, like that described by Toyama, is not a true division, but a sorting of chromosomes, fourteen going to one pole, fourteen to the other. In the work of Stevens and Dederer special attention is given to the chromatic elements. Stevens (1906) figures and briefly describes the spermatogenesis of *Cacœcia* and *Euvanessa.* In both species there are thirty chromosomes in the first and second spermatocytes and in both there is one large chromosome, which corresponds to the two-lobed body in the growth stage; this body stains differentially in gentian-violet and can be traced through synizesis, synapsis, growth stages, and both first and second maturation divisions, and is interpreted as an equal pair of idiochromosomes comparable to those found by Wilson (1905, *b*) in *Nezara.* Dederer (1907) studied the spermatogenesis of *P. cynthia.* Of the thirteen chromosomes (reduced number) one shows marked individuality throughout; it is always in close connection with the plasmasome, stains deeply when the other chromosomes have lost their staining properties, and in early prophase is seen to take a form similar to the other chromosomes. Dederer, like Stevens, interprets this chromosome, as a pair of equal idiochromosomes of the *Nezara* type.

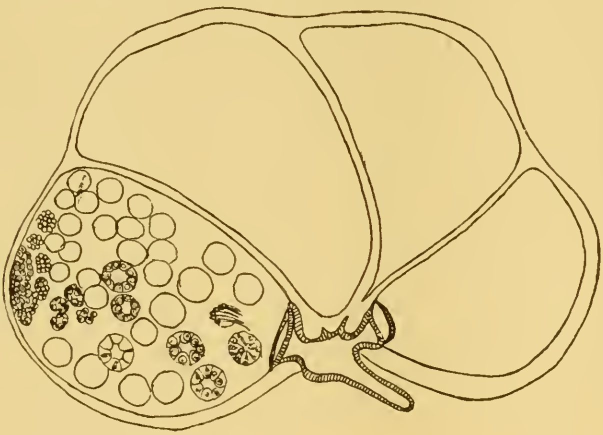
II. Material and Methods.

My material was largely collected in the vicinity of Philadelphia, and was fixed at intervals throughout the pupal stage. The ventral wall of the abdomen was cut along its length and pinned back; after removing the intestines, the fixing fluid was immediately injected into the body so that the testes were fixed during dissection. Of a number of solutions used, Flemming's strong solution, Hermann's platino-aceto osmic, and Gilson's mercuro-nitric gave the best results. Material fixed in Flemming for from six to twelve hours, washed the same length of time in running water, and preserved in various percentages of alcohol, was most satisfactory: here both chromatic and achromatic structures were sharply defined, and the shrinkage which a longer fixation so often produces was avoided. Preparations which had been so fixed and run through the alcohols were then cleared in xylol and embedded in hard paraffin with a melting point of 55° C. Sections were cut from three to nine microns thick. Various stains were used: The best cytological results were obtained with Heidenhain's hæmatoxylin followed by orange-G; this stain gave an almost perfect definition and was used for all general and for most of the detailed work. Thionin, Delafield's hæmatoxylin, safranin and light green, Hermann's safranin-gentian-violet, Auerbach's and Biondi-Erlich's stains were used for micro-chemical tests, but with at best indifferent success. The greatest difficulty encountered in technique has been in finding a stain which will clearly differentiate basichromatin from oxychromatin. In the early spring of 1907 I began to make smear preparations by spreading bits of testes upon a slide with dissecting needles, and after drying, staining them in Bismarck Brown for twenty-four hours as described by Foot-Strobell (1905). These proved very helpful. The cells stretched in drying and were several times larger than those in sections, so that they were especially useful in studying spireme stages and in counting chromosomes in cell plates. Their disadvantage lies chiefly in the lack of the sequence of stages so clear in sections, but when studied in connection with sections and particularly when the number of chromosomes is small, they have been invaluable.

III. Observations.

To the family of Saturnids belong those moths which are silk weavers *par excellence* in the caterpillar state. Among our most common native species are *Callosamia promethea* and *Samia cecropia*, which emerge from the pupa case in May or June. Much has been written of the keenness of the mating instinct in *promethea* and my own observations confirm these accounts. The moths mate and lay eggs which hatch in from eleven to fourteen days and the caterpillar pupates in from five and a half to eight weeks, depending upon its supply of food. The pupæ of *C. promethea* are very like those of *P. cynthia* and the two may be easily confused. This is especially true since the caterpillar of *P. cynthia* will live upon the same food plants as that of *C. promethea*, but in this case it is smaller than usual and weaves a cocoon just like that of *C. promethea*. The number of chromosomes in an equatorial plate differs in the two and it was sometimes necessary to use this means of identifying these two species.

The testes in Lepidoptera originate as paired glands. They are situated under and on each side of the intestine in the region of the sixth segment. In moths of the family Saturnidæ these organs are paired and develop in size until just before the moth emerges, when the ripe spermatozoa are discharged into the greatly enlarged vas deferens and the testes become smaller, shrivelled, and translucent. In *Danais archippus*, *Papilio cresphontes*, and in *Acronycta* (sp.?) the testes, which are paired in the larval stage, during the pupal stage become closely applied to each other along the midline and form a single spheroidal body, colored almost royal purple in *D. archippus* due to the pigment of the surrounding epithelial coat. In *D. archippus* (summer brood) the testes contained developed spermatozoa six days after pupation, the time of pupal development being from eleven to fourteen days. In moths the rate of development varies with the species. Some *S. cecropia* and *A. io* kept in the laboratory became imagoes in January, while *C. promethea* under similar conditions shows much greater retardation. *Promethea* fixed in February showed a few first maturation divisions and then came a long period when from March to May development of the spermatozoa did not proceed farther than the spermatids. The testes of the saturnids are kidney-shaped, tinged the faintest yellow and divided into four lobes; they are surrounded by a layer of connecting tissue, which forms partitions between the lobes and between the cysts. The cells are arranged in the order of their development, from the periphery inward: the extreme anterior end of the testis until late in development is occupied by the primordial germ cells—the spermatogonia, either singly or in groups, but not yet surrounded by a membrane. No early larval material was obtained, so the origin of the spermatogonia, whether from a "Verson cell," a metamorphosed spermatogonium, or arising around a supporting follicle cell, cannot be discussed. The primordial germ cells divide and redivide until a certain number of daughter cells is formed, usually from sixteen to twenty-four. These are then grouped into cysts surrounded by connective tissue and containing cells in about the same stage of development. Between this region of the spermatogonia and the spermatocyte of the growth period are found all stages of synizesis and synapsis.



Throughout the testes, but especially where spermatogonia are changing into spermatocytes, whole cysts of degenerating cells are found; in these the chromatin is gathered into one large or several small, compact, deeply staining granules, while the cytoplasm is granular and stringy. In Auerbach's and other differential stains these granules stain like active chromatin, showing that a chemical change is taking place in them. Though these degenerating cysts are far more common in this region than elsewhere, yet they are found throughout the testes, especially where spermatids are forming. Paulmier (1899) figured and described just such degenerating cells for *Anasa tristis*; though here they are found only after the spermatogonic and before the spermatocytic stages: their appearance in this region of special growth caused Paulmier to interpret them as "food cells." Munson (1906) suggests that a cause for disintegration may be found in the failure of the chromatin to secrete karyolymph. Dederer's (1907) observation of the division in autumn of a few first spermatocytes of *P. cynthia* and her suggestion that these degenerating cysts of cells can be traced to the degeneration of those cells which have undergone precocious maturation seems an excellent explanation of their origin.

Next to these synapsis and synizesis stages and arranged in some sort of sequence from the periphery to the center of the cysts are found spermatocytes in various stages of growth; primary spermatocytes, secondary spermatocytes, spermatids, and developing and developed spermatozoa.

Callosamia promethea.

1. *Spermatogonia.*—The spermatogonia of *promethea* are small oval cells which in their earlier stages are crowded together and closely pressed against the walls of the testes. Secondary spermatogonia are somewhat larger and extend further inward so that they are easily studied. In what Wilson (1902) says has been falsely characterized as "the resting stage", the nuclei are spherical and faintly staining and fill by far the greater part of the cell; within the nucleus is found an irregular meshwork of linin threads upon which chromatin granules are scattered. In the early spermatogonial cells (Pl. XXII, figs. 1, 2 and 3) there are found chromatic masses or "net knots": they are spherical and resemble plasmosomes in which chromatin granules are entangled. These granules are of the same size as those scattered throughout the nucleus, and that they are simply an aggregation of these is suggested by the fact that in later stages, when the granules are more widely scattered through the nucleus, this net knot, after decreasing in size and in the number of contained granules, finally disappears (fig. 4). The basichromatin granules now stain more deeply and become aggregated along the linin to form a spireme. It has been impossible in *C. promethea* to distinguish any structure in this spireme, though in smear preparations of *P. cynthia* it is clearly seen to be composed of twenty-six pairs of chromosomes lying side by side and each joined to the other by linin threads. The significance of this will be discussed later. The chromatin of the spireme condenses, and in equatorial plates of the last spermatogonial division thirty-eight small, densely stained, and compact chromosomes may be made out (fig 6). In smear preparations this plate is easily seen, and among the chromosomes one pair is very plainly smaller than all the others; but even here, where the size of the plate is enlarged many times by the method of fixation, it is still too small to offer much opportunity for studying size relations.

In preparation for the last spermatogonial division the chromosomes become regularly arranged upon the spindles, divide equally and are drawn towards the poles, the cell lengthens and with it the connecting fibres. At the point at which the new cell wall will be laid down a zwischenkörper of four small granules is to be seen (fig. 9). It was just at this stage of telophase that Montgomery (1900) was able to demonstrate that synapsis took place by an end-to-end union of homologous pairs of chromosomes; in *C. promethea* the chromosomes were often distinguishable as somewhat feathery bodies with linin connections, but they were so closely crowded, due to the small size of the cell and large number of chromosomes, that it was impossible to follow the process. After the separation of the chromosomes the centrosomes divide and the nuclear membrane is reconstructed to form the cells of the primary spermatocyte.

2. *Growth Period of the Primary Spermatocyte.*—It is during this period, when the cells grow but do not divide, that the chromatin undergoes marked changes: it first forms a long spireme which is seen to be looped on one side of the nucleus; as the looping proceeds, the chromatin mass stains more deeply until it is impossible in ordinary preparations to make out anything of the spireme arrangement (fig. 12). This is the "synizesis" of McClung or "the contraction stage" of Wilson. Since similar stages have been described by Wilson, Stevens, and a number of workers on insect spermatogenesis, and since similar stages appear in smear preparations, there seems little doubt but that this contraction stage plays a perfectly normal part in the constructive life of the cell and is not an artifact, as argued by McClung (1900). The number of cells showing different stages in synizesis varies with the period of development: in young pupæ they may occupy almost half the testes, while in later stages relatively few cells may be found which show this condition. What takes place during this period of intense staining and contraction of the chromatin it has been impossible to make out; for even when much destained little can be seen. Some help has been found in smear preparations where the long thin thread can be clearly seen to be formed of chromatin granules with linin connections (fig. 13); though this stains much less deeply than in sections, so that somewhat of its structure can be made out, yet it is never definite enough to enable one to follow the steps of contraction nor to determine whether conjugation of the chromosomes takes place during this stage. The chromatin comes out of the contraction stage by an unwinding of the condensed thread; in a few cases this could be traced as a continuous spireme (fig. 19), though usually it is made up of a small number of loops which at first only partly fill the nucleus: this corresponds to "stage e" or "early post synapsis" of Wilson (1905).

In the next stage, or late post-synapsis (figs. 20 and 21), the threads are somewhat contracted but more widely spread throughout the nucleus. In smear preparations (figs. 19, 20 and 21) the spireme of both early and late post-synapsis shows a longitudinal split which corresponds to a similar split in the last spermatogonial spireme (as seen in *cynthia*). The spireme now segments into the reduced number of chromosomes (fig 22): in smear preparations it may still show the longitudinal split of the late synapsis stage; in sections, where there is always a greater concentration of chromatin granules, the spireme is shown segmented into loops which have their middle point marked either by a thinner part or by a slight knob-like projection. This marks the plane of the first division (fig. 22). During the growth stage the spermatocyte greatly increases in size, while its basi-chromatin almost completely loses its staining property and becomes loose and indefinite in structure. This is true only in part, for in smear preparations, in which the chromatin segments stain less deeply but never entirely lose their identity (fig. 26), the chromosomes are seen as faintly staining bodies made up of chromomeres joined by linin threads. It is at this period that, for the first time, a spheroidal, darkly staining body appears and stands out in sharp contrast to the faintly stained nucleus; it is usually eccentrically placed, and is often seen dividing so that it may appear as two separate bodies or as a dumbbell (fig. 23). Its appearance, behavior, and staining reaction suggest its similarity to the accessory chromosome of McClung, the chromatin nucleus of Montgomery (1901), the heterotropic chromosome or idiochromosome of Wilson, and the odd chromosome of Stevens; while its frequent dyad nature during the growth period, indicating its bivalence, and its subsequent behavior, relate it to the third type described by Wilson, in which the idiochromosomes are of equal size. Following the terminology of Wilson, I shall call this body the idiochromosome.

3. *Prophase of First Maturation Division.*—In preparation for the first maturation division the chromatin again assumes its staining property and definite groups of chromatin granules appear upon the spireme, the nineteen aggregations of basi-chromatin which have been distinguishable throughout the growth stage in smear preparations now become more clearly defined, the longitudinal split of the spireme is still seen and each chromosome is joined to the other by a continuous linin thread (fig. 26). A similar condition is seen in sections where each chromosome shows a longitudinal split, while some of the chromosomes are beginning to join to form rings (fig. 27). In a little later stage the segments have opened into ring-like granules (figs. 32 and 28) and

exactly correspond at this time to the ring-shaped chromosomes figured by vom Rath (1892) for *Gryllotalpa*. Blackman (1905) considers the first maturation division of *Scolopendra* a longitudinal one because "the longitudinal division of the chromatin segments is the first which occurs in prophase"; but though in *promethea* the longitudinal division is present from post-synapsis, yet this is clearly the plane of the second maturation division and must be explained as a precocious splitting.

Constrictions such as are seen in figs. 22 and 26 can be easily traced to such stages as are seen in figs. 28, 30 and 31. By concentration small thicker rings are formed, until, by continued thickening, the central space becomes more and more reduced and in most cases the longitudinal split is entirely or almost entirely concealed. It may be retained as a narrow slit between the two ends of a dumbbell or a rounded or diamond-shaped space in the center of an occasional tetrad (figs. 37 and 38).

A

B

The changes in form which the chromosomes undergo during prophase are shown in text figs. A and B.

In early prophase the chromosomes appear first as granular aggregations, as at A and E; these aggregations next open wide to form granular rings B; then by condensation the rings become much thicker and the granular appearance is lost. Rings may be lengthened, C, and show slight constrictions which mark the plane of the first division, or may be clearly rounded, D; F and G shows an approach to tetrads. Complete condensation is rarely seen in smear preparations. a, b, c, are the earliest stages shown in sections. These are made up of more of less condensed granules with no indication of a longitudinal split, but a slight constriction is usually seen as in a and b; and though no split is seen, yet stages like d and e make it necessary to assume such a stage. The granules are single and the ring of about one-half the thickness of the loop, and the ends which overlap in d become joined in

e. Condensation now takes place into dumbbells and tetrads and the longitudinal and transverse planes of division can be clearly made out.

4. *Maturation Divisions.*—The chromosomes formed by the condensation of rings now become arranged upon the fibres so that a side view of the spindle during metaphase shows the chromosomes as symmetrical dyads which are so placed that the first division, which is always equal, may be seen to be transverse, and, if conjugation has taken place as I believe by an end-to-end union of the chromosomes, division is reducing (Pl. XXIII, figs. 42, 43). An equatorial plate during metaphase shows nineteen chromosomes (Pl. XXIII. fig. 40). While the chromosomes are in metaphase the centrosomes divide and each becomes enclosed by a small centrosphere; as division proceeds the astral rays increase in length until they seem to press against the wall of the cell, a constriction is seen in the cytoplasm and the zwischenkörper is formed at this point (fig. 44). During late anaphase the chromosomes become so crowded as to lose their separate outlines (fig. 45), but these become distinguishable in the prophase of the second maturation which is rapidly passed over (fig. 46).

The spindle of the second maturation division is quickly formed and the chromosomes become arranged upon it as dyads (fig. 50). The second maturation spindle in both methods of fixation can be distinguished from the first by its smaller size and by the smaller size of the chromosomes. Division, like that of the first maturation, is equal, and the chromosomes may be seen in anaphase as separate, spherical bodies (fig. 51), while in telophase they are a densely staining mass about which a nuclear membrane is forming (figs. 53 and 54). The second division of the chromosomes is longitudinal and may be traced back to the longitudinal split of the spireme. The centrosomes and their accompanying structures show much the same behavior in the second as in the first division; the cells increase greatly in length and a constriction, which is marked by the zwischenkörper, appears at the equator.

Since there is no unequal division of chromatin material in either the first or second maturation divisions, it is clear that there is no "accessory chromosome" and hence no visible dimorphism of the spermatozoa; there are, however, reasons for believing that the peculiarity of behavior of one of the bivalents during the growth stage classes it with *Nezara* as an equal pair of idiochromosomes.

5. *The Idiochromosome.*—While the other chromosomes have been undergoing these changes of form, the idiochromosome described for the growth stage as a single or double body (figs. 23–29), which reacted

to basi-chromatin stains, has also changed in shape and apparently in structure. What during the growth stage appeared as a homogeneous mass shows as prophase advances a clearer plasmosome and a darker chromatin part. In smear preparations, when all the chromosomes can be seen at one time, it becomes perfectly clear that this idiochromosome forms one of the nineteen chromosomes. Fig. 39 shows this to be true even into late prophase. This is a smear preparation in which the plasmosome of the same size as the chromosomes may be recognized as a clearer body with a central chromatin band. In early prophase in both smears and sections, when the spireme is splitting or opening into rays, this body may assume a ring shape (fig. 27), showing a lighter central space around which is arranged the chromatin. Because of its close connection with the plasmosome the idiochromosome always appears larger in these stages than any of the other elements, but with its condensation into a ring or dumbbell-shaped chromosome this size relation is lost, and after its dissociation from the plasmosome I was unable to distinguish it from the other chromosomes. Although this idiochromosome is first seen in *C. promethea* after the late post-synapsis when the chromatin has lost its staining property, yet its subsequent history makes it seem more than probable that it was present from the earliest stages: whether the net knots of the spermatogonia bear any relation to this or whether the idiochromosome has been separated from the rest of the chromatin during synizesis must remain conjectural. Its condensed condition during the growth stage and frequent early division while the rest of the chromatin is passing through the usual series of changes before entering upon prophase, as well as its close relationship with the plasmosome, point to the fact that, certainly in structure and possibly in function, this idiochromosome shows peculiarities which separate it from the other chromosomes.

6. *Metamorphosis of the Spermatids.*—The two spermatids which arise as a result of the second spermatocytic division are elongated cells with a rather small nucleus whose chromatin is in the form of granules. In the telophase of the second maturation division, before the nuclear membrane is complete, the chromosomes are more or less condensed and surrounded by the remains of the spindle fibres of the last spermatocytic division (fig. 54); this spindle fibre material persists and is later traced to the nebenkern. The nucleus assumes an eccentric position so that it lies very near the wall of the cyst, and as the nuclear membrane is formed, the chromatin becomes more scattered throughout the nucleus and the material of the spindle fibre, which

at first was irregularly arranged, is now collected into a spherical mass at the proximal pole of the nucleus to form the beginning of the nebenkern (fig. 56). The centrosomes in an archoplasmic mass still retain their position at the distal pole of the nucleus, and from the more distal one is seen to grow out a flagellum which corresponds to similar structures to be described for both first and second spermatocytes and interpreted as a precocious axial filament (figs. 55 and 56). As the spermatid develops the centrosomes may be seen to migrate until they assume their ultimate position at the posterior side of the spermhead and the archoplasm or idiozome which surrounds the centrosomes migrates with them (figs 57–59). After the centrosomes have moved around to their final position at the proximal pole of the nucleus, the idiozome is seen as a small body, clearer than the nebenkern and lying beside it (fig. 60), and at this time, in the nucleus of each spermatid, a round darkly staining body is to be seen (figs 56–61). Since there is no evidence of an unequal division in either first or second maturations and since this body is found in most of the spermatids (its absence in some being explained by oblique cutting), there seems no likelihood of its bearing any relation to the accessory chromosome described by so many workers on insect spermatogenesis. I conclude that it is a new formation, and that it is comparable to a similar body described as "chromatin nucleolus" by Stevens (1906) for Coleoptera and by Boring (1907) for Hemiptera. From the distal centrosome, which now lies just beside the nucleus, the axial fibre continues to grow; and as this grows through the center of the nebenkern and cell cytoplasm both elongate, the former to form the inner, and the latter the outer tail envelope.

7. *Centrosomes.*—In the earlier "rest stages" of the spermatogonia the centrosomes, which could be followed through every subsequent step of development, were not visible; but the amount of cytoplasm is so small and the cells so crowded that they might easily be overlooked, and since they are to be seen in all spermatogonic divisions of both the primary and secondary spermatogonia they may be assumed to be present even though not seen except when the cells are actively dividing. Just before the formation of the last spermatogonial spireme (figs. 4 and 5), when the chromatin is scattered through the nucleus as separate granules, two minute centrosomes situated near the nucleus are seen to divide and move toward opposite poles: the nuclear membrane disappears and the mitotic figure is formed as usual (figs. 7 and 8). After the division of the chromosomes the centrosomes divide and may be seen surrounded by a mass of archoplasm (fig. 10).

From this stage the centrosomes which have been followed through every step of development show unfailing persistence and regularity in movement, in form, and in division. This observation, like that of Conklin (1902) for *Crepidula* and Paulmier for *Anasa*, supports the view that the centrosome is entitled to the rank of a permanent cell organ.

In the succeeding growth stage the centrosomes surrounded by faint astral rays are seen to separate; then they divide: one pair moves towards the nulcear membrane, the other pair lies upon the cell wall (fig. 25). In preparations which have been somewhat deeply stained cilia of considerable length are seen to have grown out from each granule and extend into the lumen of the cyst (figs. 24, 25 and 29); these correspond to the ciliated centrosomes figured by Meves for *Pygæra* (1897) and by Henneguy for *Bombyx* (1898), differing only from those shown by Meves in the shapes of the centrosomes, which in *Pygæra* are described as hooked or V-shaped bodies. In *C. promethea* these are plainly small dumbbell-shaped structures and are exactly like the centrosomes described by most workers, differing only in the possession of the flagellum.

While the chromosomes are passing through the prophase of the first maturation division, the paired centrosomes, enclosed by a small centrosphere, move to opposite sides of the nucleus where they appear as dumbbell-shaped bodies surrounded by a clear archoplasmic zone and short radiating fibres (figs. 31 and 32). As the nuclear membrane disintegrates, the astral figure increases in size, its fibres extending outward into the cytoplasm and inward towards the middle of the cell, and as division proceeds the astral rays increase in length until they seem to press against the wall of the cell. I have never observed a flagellum going from the centrosome at this stage, though such has been figured and described by Henneguy. After completion of the metaphase the centrosomes divide and appear in the telophase of the first maturation division as two separate bodies, each surrounded by an archoplasmic mass; the centrosomes migrate to opposite sides of the nucleus in an axis at right angles to the first maturation spindle. Just at this time a flagellum is seen to grow out of one of the centrosomes (fig. 48), this flagellum, though somewhat longer, is similar to those described for the first spermatocytes.

One other structure in the cytoplasm which is of interest is the "chromatin granule" first seen during the growth period (fig. 25). These granules, either single or dividing, stain like chromatin, are surrounded by a clear zone, and are traceable through succeeding stages;

that they may have some functional significance seems probable and this will be discussed under the development of the spermatid.

Telea polyphemus.

Telea polyphemus, which belongs to the sub-family Saturinæ, is found in its larval stage feeding upon oak and other shade trees. After the cocoon is made, in part from the folded leaves of its food plant, it falls to the ground. Material was collected from about Bellefonte, Pa., and from Newark, N. J., through the kindness of Mr. Herman H. Brehme. Development in *T. polyphemus* is somewhat more rapid than in *promethea,* and shows a greater dependence upon temperature conditions.

Spermatogonia which are found in the periphery of the testes show always an eccentrically placed mass formed by a plasmosome in which is embedded a number of darkly staining granules (fig. 62). The last spermatogonial division is preceded by the formation of a thick spireme which segments into a large number of chromosomes, probably sixty, though the number is so great and the chromosomes so massed that it is impossible to be sure that this count is correct (Pl. XXIV, fig. 66). A side view of the spindle shows the dumbbell-shaped chromosomes arranged upon the spindle fibres (fig. 67); these divide symmetrically and are seen in telophase as feathery chromosomes arranged upon linin threads (fig. 69). It is possible that a synapsis takes place at this time, but, owing to the large number of chromosomes, I have been unable to observe it. The chromatin now forms a long slender spireme which in both smears and sections is seen to be made up of granules (fig. 70). This spireme gradually becomes looped (fig. 71) until concentration is complete and all the chromatin lies in a darkly stained mass against one side of the nucleus (fig. 73); the chromatin then passes out of this contraction stage by a loosening of the loops (figs. 74 and 75), which stretch out into the nucleus and in late post-synapsis completely fill it (fig. 76). The spireme is made up of a number of threads which seem to be composed of single granules, though the linin threads are double, and in a few cases (smear preparations) there was some evidence in these granules of a longitudinal split. At this stage (fig. 75) a large deeply staining body appears for the first time and becomes more pronounced as the basi-chromatin loses its staining reactions, and throughout the growth stage of the spermatocyte this body retains its staining reaction and may be seen either as a single or dumbbell-shaped structure. The chromatin now resumes its staining property and the chromosomes appear as broken segments of the spireme usually bent or twisted at their center; then these segments begin to condense and a longitudinal split is seen in them (fig. 81). Though the number of segments at this time could not be counted, yet it was plainly the reduced number, and this reduction must have taken place during the last few stages when, because of the deeper staining and greater massing of the chromatin, it was impossible to follow the steps by which this pseudo-reduction occurred. The ring chromosomes of the prophase are seen to be formed by the coming together of the split ends and the gradual condensation of the chromatin mass: this concentration is complete in sections, and dumbbell-shaped chromosomes and occasionally tetrads are formed, which are connected by linin threads (figs. 83–85). At this stage of prophase, when growth has reached its greatest extent, the cell is several times as large as in the beginning of the growth period, and the nucleus, which has increased in size with the cell, is usually eccentrically placed. At this time chromatin granules similar to those described for *C. promethea* are found in the cell cytoplasm and are traceable throughout all succeeding steps.

A metaphase of the first maturation division shows thirty chromosomes (fig. 87) which are symmetrically placed; their division is equal and reducing. The chromosomes of the first polar plate are too condensed to count and quickly pass through the prophase of the second maturation. The centrosomes move so that the second division is at right angles to the first and the chromosomes quickly arrange themselves for the second division, in which, as in the first, there is an equal division of the chromatin: an equatorial plate of the second spindle shows thirty chromosomes, smaller than in the first and always single (fig. 92). The distinct zwischenkörper and a number of the chromatin granules mentioned above are seen during telophase both in the cytoplasm and upon the mantle fibres (Pl. XXV, fig. 98). The development of the spermatid shows no new features, but corresponds very closely to that described for *C. promethea*.

Centrosomes are seen throughout all stages: in the resting spermatocyte they appear as small paired structures closely pressed to the cell membrane and with the short flagellæ extending into the lumen (fig. 79); as development proceeds these centrosomes move nearer to the nucleus and migrate to opposite sides of the cell in preparation for the first division, and in late prophase and anaphase stages they appear as dumbbells and are so conspicuous by their size and prominence that they might almost be taken for very small chromosomes. Astral rays are well developed and, so far as could be determined, these grow out directly from the centrosomes.

Automeris io.

This species was found abundantly about Lansdowne, Pa., feeding upon maple trees and rose bushes. The larvæ pupated in September and showed comparatively rapid development. The paired testes of *Io* resemble those of other members of the Saturnids in position and color, but differ in shape; instead of the kidney-shaped body, such as has been described for *C. promethea* and *T. polyphemus*, each of the four lobes of which it is composed is rounded and distinct, and the testes become elongate by the two lateral lobes meeting in the centre and the two distal ones being pushed longitudinally. As in the other forms each testis has but a single vas deferens.

Secondary spermatogonia are comparatively large cells with few scattered chromatin granules and a rather large plasmosome which stains like chromatin and shows a loose structure (figs. 98 and 99), and from which, as a center, short chromatin threads are seen to radiate, suggesting the karyosphere described by Blackman (1905 b) for *Scolopendra*. Figs. 100, 101, and 102 show three stages in the last spermatogonial divisions: controsomes are present with aster and spindle fibres well developed, division is equal, and in telophase the massing of the chromosomes is complete. The spermatogonial plates were so condensed that all attempts to determine the number of the chromosomes were unsuccessful.

In going into the contraction stage the chromatin becomes looped on the side of the nucleus, which lies toward the greater amount of cytoplasm (figs. 103 and 104); then the loops begin to loosen, and in early post-synapsis is seen for the first time a round darkly staining body (fig. 106) which at this stage is quite small, but, as the skein gradually loosens and the loops extend more and more into the nucleus, this body, the idiochromosome, becomes more marked, and during the growth period it is seen either as one or two round dark-staining bodies. During this stage the centrosomes lie very near the inner cell wall and from them flagellæ grow out into the lumen of the cyst. Fig. 109 shows a cell in the early rest stage; here the centrosomes are single and the flagellum which grows from each is quite short. Fig. 110 shows a similar stage where the cell has grown to about twice the size of that in fig. 109; in this, the centrosomes have divided and the flagellum which grows from each centrosome is relatively long.

In preparation for prophase it may be seen that the spireme has broken into segments which are of various shapes and, in most cases, so bent at the center as to suggest their formation by the union of two chromosomes (fig. 111). These now split and join end to end to form the bipartite and quadripartite chromosomes of the prophase (figs. 114, 115 and 117), which in *io* show a far greater variety of form than in any of the other species described. In the very beginning of the prophase, when the chromosomes are forming from the split section of the spireme, the idiochromosome so compact and darkly staining throughout the growth period, may be seen to be composed of two parts, a paler-staining plasmosome and beside and upon this a chromatin mass: later the plasmosome fades and this peculiarly formed chromosome is no longer distinguishable from the others. A spermatocyte equatorial plate shows thirty-one chromosomes, and the metaphase and anaphase of the first maturation shows that this division is equal and reducing (figs. 119 and 120). The second division is also equal and separates whole chromosomes along the longitudinal axis.

Throughout almost every step the centrosome can be traced as a dark granule surrounded by an archoplasmic mass. As prophase advances, astral rays are seen about the centrosomes, which at this time have divided and appear as dumbbells, and from them astral fibres radiate in all directions, becoming especially well developed on the side toward the nucleus. Of equally marked development are the spindle fibres, which in the telophase of the second division may be traced directly to the nebenkern of the spermatid, while a clear vesicle, the idiozome, lying on one side of the nucleus of the spermatid, can also be traced to the archoplasmic mass surrounding the centrosome of former stages.

The cells, which after the second division are irregularly placed, are now arranged with their nuclei against the wall of the cyst so that the entire wall is covered with the heads of the spermatozoa, while the tails project into the lumen (Pl. XXVI, figs. 131 and 132). During the development of the spermatozoon marked changes occur in the nucleus: the chromatin becomes granular and scattered and the nucleus decreases in size and frequently bends through an angle of 90° to 180°; later, when the condensation of the nucleus becomes more marked and the tail elongates, the cells again change their position, coming to lie with their heads crowded together and their tails parallel (figs. 133, 134 and 135).

Samia cecropia.

This species was found abundantly on maples and many bushes about Philadelphia. Development is very similar to that of the other forms described. The resting spermatogonia show one or two net knots; these are more compact than those of other species and, unlike them, are surrounded by a clear area. Figs. 140–142 show stages of the last spermatogonial division; here the chromosomes in metaphase are too crowded to count. A thin skein is formed preparatory to synapsis (fig. 143) and by condensation of this the chromatin becomes collected at one side of the nucleus (fig. 144); later it spreads through the nucleus and gradually fills it (figs. 145 and 146). In the growth stage which follows we find the same large, deeply-staining body described for the other species. The centrosomes which have been followed since the last division of the spermatogonia are seen at this time as two small dark bodies near the nuclear membrane (fig. 147); these may be clearly seen to pass through the regular cycle of changes, a cycle which is repeated in each maturation division, and which in many respects may be parallel with the changes which take place during division of the nucleus. In *S. cecropia,* as in all the other species here studied, the centrosomes seem to be continuous from generation to generation as is the nucleus itself. The chromosomes, in smear perparations, retain their outlines during the growth stage (fig. 148); in this the nucleus has been separated from the cytoplasm and much stretched in drying. Corresponding almost exactly with similar stages in *C. promethea,* we have the gradual condensation into rings and dumbbells, while the idiochromosome, which retains its continuity longest, finally assumes the same form as the others and is indistinguishable from them. Division in first and second maturations closely follows that of the other Saturnids, and the remnants of the spindle fibers which surround the chromosomes of the last division and extend far into the cell cytoplasm may be seen to go directly into the spermatid and there form the nebenkern. The spermatozoon has here been traced to its complete development. The earlier stages correspond to those described for other members of the family, but as development proceeds (Pl. XXVII, figs. 167–170), the decrease in size of the nucleus and elongation of the tail seem to be connected with the extension of the head piece, which at this time appears as a cytoplasmic projection containing a darker body and only differing from the rest of the cytoplasm in its greater clearness. While the chromatin has been condensed into a small round mass which completely fills the nucleus, the head piece has increased in length and has become pointed and shield shaped, and the axial filament has grown very long. The final stage of development shows a pointed head piece with its acroblast, a long narrow nucleus, a very slightly developed middle piece, and an exceedingly long tail which, due to a twisting of the inner and outer membranes about the axial filament, has the appearance of a spiral.

Acronycta sp.

A small cocoon found upon a *Cecropia* cocoon was identified by Prof. John B. Smith of Rutger's College as an *Acronycta*, possibly *oblinita*. By comparison with *oblinita* it was found that this was not the species, but because of certain unusual structures in the cytoplasm of both spermatocytes and spermatids it seemed of sufficient interest to be included in the present study. This material was fixed with the same care and by the same methods as were used for other forms so that the structures here described cannot be the result of bad preservation.

The testes which in all the Saturnids remain paired are fused in this form along the midline, suggesting a similar condition mentioned for butterflies. In the rest stage of the first spermatocyte the nucleus shows the usual deeply-staining nucleolus and a fine linin meshwork, while in the cell cytoplasm beside the centrosomes a darkly-stained body appears (figs. 171 and 172); except for its greater size, this body appears and behaves like the "chromatin granules" described for the family of Saturnids, and like them may be seen to divide and migrate to opposite poles of the cell (figs. 178 and 179). In addition to this an irregular mass is often found which in form and staining reaction resembles chromatin and looks as though it had been thrown out of the nucleus; though this suggests the Mitochondria of Benda (1899) and similar bodies described by Meves (1902) and Schreiner (1906) and is traceable in many cells throughout all stages, yet it was not seen to take any part in cell development. In the cytoplasm in all stages of prophase (figs. 173 and 174) both "chromatin granule" and Mitochondria are to be seen: the former as divided and beginning to migrate; the latter as an inert mass. In the first maturation division (fig. 177) a partial division of the Mitochondria is seen, while figs. 176, 178 and 179 show various stages in the equal division of the chromosomes and of the "chromatin granule." One thing which is very noticeable here in contrast to all other forms is the position of the spindles which lie to one side of the cell, while the chromatin granule and Mitochondria occupy the other side; an exception to this is seen in fig. 176, where one of the "chromatin granules" is placed upon the spindle. A metaphase of the second maturation division shows, in addition to a chromatin granule and a Mitochondria twenty-nine chromosomes. By an apparently equal division of the chromatin granules each spermatid receives not only a nucleus and a nebenkern from the mother cell, but also a "chromatin granule" surrounded by a clear zone; this granule at first lies beside the nucleus of the spermatid, but soon moves toward the head, where it takes its final position and appears to be transformed into the acrosome.

Spermatids and Spermatozoa.

The metamorphosis of the spermatid of each species here studied has in most of its parts been considered in the preceding text; thus, as has been pointed out, the sperm head is made up of the modified nucleus of the second spermatocyte plus the head shield, while what in many animals would correspond to the middle piece is in Lepidoptera only the region occupied by the two centrosomes. The nebenkern which seems to be common to all insects refers, when used in its original sense (Bütschli, 1871), to that body in the spermatid which is formed at least in part by the spindle fibres of the second maturation division and which later gives rise to the inner tail membrane. Many workers on insects, among whom may be mentioned La Valette St. George, Platner, Erlanger, Henking, Wilcox (1896), and Paulmier, trace its origin at least in part to the remnants of the spindle, though Paulmier attributed only a small part to the spindle fibres, believing that the nebenkern in *Anasa* is formed largely from the yolk mass. Meves (1901), on the other hand, claims that this body is built up independently of the spindle fibres out of granules which were present in earlier generations, and which are identical with the yolk granules of Paulmier, the Cytomitosomen of La Valette St. George, and the Mitochondria of Benda. No trace of yolk granules were found in the Saturnids and the dark-staining accessory masses figured for *Acronycta* were found to take no part in the formation of the nebenkern; but, in both smear preparations and sections, the nebenkern material for all the species studied was clearly traceable to the spindle fibres of the second spermatocytic division.

The problematical parts which remain to be discussed are the subsequent history of the chromatin granule and the origin of the head piece and axial filament. Many writers describe the head piece or acrosome as arising from the idiozome which migrates to the anterior pole of the cell. The Schreiners (1908) have shown that the head piece of Myxine is made up of two separate Anlagen, the primary and secondary head vesicles, which are only joined in the beginning of sperm ripening: the primary head vesicle formed from the sphere takes its place after the second division, while the secondary head vesicle remains in the opposite part of the cell near the centrosome and only reaches its final position during the beginning of sperm ripening. A third view is that of Lenhossék (1899), who derives the acrosome from the cytoplasm. The acrosome in Lepidoptera is formed from two parts—a clearer vesicle and a dark granule, but the idiozome which migrates from the acrosomal region in early development has not been seen to return, nor has it been possible to trace the sphere material to this region; it therefore seems most probable that the acrosome in Lepidoptera has been formed from modified cytoplasm. The chromatin granule noted throughout preceding pages and described as a small granule staining in iron hæmatoxylin and surrounded by a clear zone, is seen in very young spermatids to lie quite near the nucleus and in a position corresponding to the idiozome; in *Acronycta* this granule moves nearer the head of the nucleus, and a similar granule is later found within the head piece; the same relation is suggested in the Saturnids. The presence of this body recalls the "chromatin body" described by Lenhossék (1898) as an extruded nucleus of unknown origin which degenerates without taking any part in the formation of the spermatozoon, as well as a similar body shown by the Schreiners (1908) to be present in *Myxine*. King (1907) finds such a body in Amphibia, traces it from the primary spermatogonia to the acrosome of the spermatozoon, and because of its function names it "acroblast." The extrusion of the chromatin granules from the nucleus during the growth stage like that described for Myxine has here been observed, but although it persists and is traceable through the spermatid, yet further research is required to determine whether this chromatin granule of Lepidoptera is really functional or whether like similar granules described by other workers it plays no part in the development of the sperm.

The origin of the axial filament from one of the centrosomes of the middle piece was first demonstrated by Moore (1895) for Elasmobranchs. Paulmier described a similar origin for *Anasa* and gave proof for this by the discovery of the occurrence in giant spermatids of two and four axial filaments. That the axial filament actually arises from the centrosomal substance, or is formed like astral rays and spindle fibres by a differentiation of the cytoplasm, are the two views most widely held. Meves (1897) in his work on *Pygæra* accepts the latter view, believing that "die Fäden der Schmetterlingspermatocyten extracellular gewordene Mitomfäden darstellen." The same writer concludes for *Lithobius* "dass die bei Lithobius beobachteten Fäden sind aus dem einen der beiden Centralkörper durch Längenwachstum desselben, hervorgegangen," and Korff (1899) on *Helix* and Suzuki (1898) on Elasmobranchs show that the inner centrosome elongates and so support the first view of Meves that this contractile element may be derived directly from the centrosomal substance. The precocious attempt of the centrosome in the first and second spermatocytes to form a flagellum as has been described by Meves, Henneguy, and in the present work for three species of Saturnids, and *D. archippus* (fig. 191) and *P. cresphontes* (fig. 192) lends weight to the view that at least in Lepidoptera the out-growth of the axial filament from the centrosome is comparable to the formation of spindle fibres and astral rays. This suggests a possible relationship with other ciliate cells of both plants and animals, and in comparing the vibratile cilia of Lepidoptera with those of plants one is struck with the analogies which exist: the dark-staining granule at the base of the cilium is similar both in appearance and position to the centrosome of the spermatocytes, while the axial filaments in both cases are similar in appearance, vibratile nature, and the part they play in fecundation. Such centrosomes have been figured and described by Webber (1897) for *Zamia* and by Ikeno (1894) for *Cycas* and *Ginkgo*, though the two authors differ in their interpretations; Webber believing that these are only "centrosome-like," while Ikeno does not hesitate to consider them as true centrosomes similar to those of animal spermatozoa. Ishikawa's (1899) observations that the flagellum of *Noctiluca* grows out from the centrosomal end of the cell, its substance apparently arising from the central spindle, strengthens this view, while Belajeff's (1897) comparison of the spermatogenesis of Characeæ, Filicineæ, and Equisetaceæ with such animal forms as the Salamander shows a close relationship between the cilia of spermatozoids and the axial filament of spermatozoa.

IV. Theoretical Considerations.

As long ago as 1885 Rabl concluded that each chromosome is a persisting individual and not a structure formed anew in each generation. Van Beneden (1883) advanced the theory of individuality of the chromosomes by pointing out that there is a constant number of chromosomes for each species, always half this number in each maturation division and that the number is restored by fertilization. This does not mean that the chromosomes remain unchanged, but that a chromosome of any generation is the descendant of a particular chromosome of a preceding generation. This view was strongly supported by Sutton (1903) who, basing his theory on his own cytological work as well as upon Boveri's (1902) experimental work on the sea urchin egg, concluded that the chromosomes must be the seat of particular qualities, and showed, as Montgomery (1901) had done, that synapsis is brought about by the conjugation of maternal and paternal chromosomes of the same size. This led to the view that homologous chromosomes represent homologous characters and only by the definite association of chromosomes of certain characters can Sutton's theory of the purity of the germ cells be maintained.

Individuality is further extended by establishing a definite number of chromosomes for each species. The number of chromosomes found in the equatorial plates of the family Saturnids ranges from thirteen in *P. cynthia* to thirty-one in *A. io*, and there is no evidence, that *P. cynthia* is more highly developed than other members of the family. This is in accord with the view of Montgomery (1906), who after tabulating the number of chromosomes in several hundred species of plants and animals, was forced to give up his theory of a correlation between the number of chromosomes and the evolutionary stage of the species. McClung (1905) claims that the family Acrididæ is characterized by a fixed number of chromosomes which is constant for all the genera and species: the genera are characterized by a definite arrangement and association, while the species show the same grouping as the genus but are distinguished by the size difference of the chromosomes and spindles. He considers that a definite series of chromosomes accompanies a group of somatic characters used by systematists for classification. That the chromosomes may be of classificatory significance has already been mentioned for *cynthia* and *promethea*, where the external difference of the pupa was often so slight that only by reference to the number of chromosomes could the species be definitely determined; this was, however, by the marked difference in number, not in arrangement.

If this individuality is to be maintained, maturation mitoses must show one transverse and one longitudinal division, and while the end result is the same, whether the first division is transverse or longitudinal, yet it seems probable, as Montgomery (1903) points out, that the first division will be found in all cases of heterotypic division to be reducing. By a comparison of the forms here described with *P. cynthia*, where twenty-six pairs of granules can be counted in the spermatogonia and thirteen in the first spermatocyte, I conclude that pseudo-reduction takes place in the family Saturnidæ either during the telophase of the last spermatogonic division or during synizesis by an end-to-end union of homologous chromosomes, and that the angle in the middle of the rods (fig. 22) and the constriction in the rings (fig. 26) and dumbbells marks this point of union of univalent chromosomes, as well as the point of separation of the first division.

The longitudinal split of the post-synaptic stages which corresponds to a similar split in the spermatogonia and remains open and traceable until the chromosomes are upon the spindle might be assumed to be a side-by-side union considered by A. and K. Schreiner (1904) to be "the" method of conjugation, and as such I at first interpreted it; but by a careful study of the steps in the formation of the chromosomes from the segmentation of the spireme to the prophase, viz., the opening of the chromatin segments into rings and their linin connection, it becomes clear that the Weismannian method of reduction could only be brought about if conjugation had taken place by an end-to-end union, as first interpreted by Montgomery (1900), for only in this way would there be one transverse and one longitudinal division, so separating univalent chromosomes. A conjugation by parasynapsis would result in two reduction divisions and the individuality of the chromosomes would be destroyed. I am led to conclude that this longitudinal split is a precocious division early laid down to mark the plane of the second maturation division.

The accessory chromosome first described by Henking (1891) for *Pyrrochoris apterus* and later by McClung (1899), Sutton (1902), and Baumgartner (1904) for Orthoptera, Blackman for Myriopoda, Wallace (1900) for Arachnida, Paulmier (1899), Montgomery (1898, 1901, 1906), Wilson, Stevens, etc., for Hemiptera, Stevens and Nowlin (1906) for Coleoptera, and Lefevere and McGill (1908) for Odonata, has by its peculiar behavior gone far toward establishing the theory of individuality of the chromosomes. McClung was the first to suggest that the accessory chromosome might be a sex determinant, believing that this chromosome was peculiar to the sperm; but Stevens and Wilson, while corroborating this suggestion of sex determination, showed by a comparison of the equatorial plate of somatic cells and germ cells of both sexes that it is the female and not the male that possesses this additional chromosome.

In his arrangement of the Heteroptera into three groups according to the three types of spermatozoa, Wilson has brought all cases into harmony with the dimorphism theory and has given direct evidence of the conjugation of maternal and paternal chromosomes. The first class is one in which there is a single heterotropic chromosome resulting in two classes of spermatozoa of which one-half possesses, one-half lacks this element; in the second class the male has the same number of chromosomes as the female but possesses one large and one small idiochromosome while the female possesses two large chromosomes; and in the third class the idiochromosomes are equal in size in both sexes, though because of certain peculiarities of behavior the equal pair of idiochromosomes may be considered as representing different characters, so that the dimorphism, though masked, may nevertheless be considered present in this class also.

The question arises, can the species of Lepidoptera here studied be brought into relation with the theory of dimorphism and individuality of the chromosomes?

A careful examination of the chromatin element in the species here described shows, as has already been pointed out, that one chromatin element acts differently from the others during a certain period in the development of the germ cells. It is distinguished from all other cell structures by its staining reaction, its precocious division, and its close association with a plasmosome; while later it shows likeness to the other chromosomes in form, valence and division; such behavior makes it necessary to interpret this, as other workers have done, as an equal pair of idiochromosomes representing different characters from those of the other chromosomes and expressing by their peculiar behavior a masked dimorphism.

The present study of Lepidoptera offers no such support to the theory of the individuality of the chromosomes as Sutton found in *Brachystola* and other workers have found in Hemiptera, yet the following facts are evidence in favor of this theory; (*a*) that the number of chromosomes remain the same from generation to generation, (*b*) that they are seen in maturation divisions to be formed of pairs of equal size, (*c*) that in smear preparations the boundaries can be traced and the chromosomes never entirely lose their continuity during the growth stage, and (*d*) that at least one of the chromatin elements shows marked peculiarity in its behavior, and can therefore be traced throughout the growth period. These facts show that Lepidoptera like the other insect orders may be brought into harmony with recent cytological work.

V. Summary.

1. The spermatogonia contain an equal number of chromosomes of about the same size and shape, and in the family of Saturnids a net knot of chromatin granules is always found during the resting stage.

2. During the growth period of the spermatocyte a dense body is found which is either single or dumbbell shape, is eccentrically placed, and stains like basi-chromatin; in *T. polyphemus* and *A. io* it first appears in the early post-synapsis stage, though in other species it is

not distinguishable until the chromatin loses its staining properties. Later this body shows a clearer plasmosome part with the chromatin in a band or in scattered granules, and from this chromatin a chromosome is formed which has the same valence as the other chromosomes and is indistinguishable from them. Because of its behavior this structure is comparable to similar bodies described by Wilson and may be considered as an equal pair of idiochromosomes.

3. The spireme segments into the reduced number of chromosomes and by condensation the rings become the dyads and tetrads of the first maturation division. By the Foot-Strobell (1907) method of smear preparations, the longitudinal split could be seen in both post-synapsis spiremes and early prophase and its relation traced to tetrad formation and succeeding maturations. The first maturation division is reducing separating univalent chromosomes, while the second is longitudinal and equational.

4. The same number of chromosomes is found in the equatorial plate of both first and second spermatocytes and by equal divisions the spermatids each receive similar chromosome groups, so that there is no visible dimorphism of the spermatozoa.

5. Centrosomes were traced from the secondary spermatogonia throughout the whole development of the germ cells. Aster rays and spindle fibres are well developed and the difference between these is especially well shown in mitotic figures in *A. io.*

6. A chromatin granule enclosed by a clearer area is first found in the cytoplasm of the growth stage. This has been described for all forms and in addition an accessory chromatin-like mass has been figured for *Acronycta;* whether the chromatin granule really functions as the acroblast of King cannot be determined without further research. The accessory mass is present in only part of the cells and is seen to degenerate.

7. A precocious attempt of the centrosomes to form a flagellum is seen in three of the species of moths studied and in two butterflies. In *Promethea* this flagellum has been traced from the early growth stage of the first spermatocyte through prophase, second spermatocyte, and early spermatid into developed spermatozoa, while it has also been described and figured for the growth stage of *A. io*, *T. polyphemus*, *P. cresphontes*, and *D. archippus*. This adds additional weight to the view that the axial filament grows out from the centrosome and suggests that its origin is similar to that of astral rays and spindle fibres.

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Description of Plates XXII–XXVII.

All the figures, with the exception of the text figure, page 10, were drawn at the level of the table with the aid of a camera lucida. A Zeiss microscope was used with a No. 8 ocular and a 16 mm. oil immersion objective, giving a magnification of 2,250 diameters. The plates have been reduced to about one-third their original size.

Plate XXII—*Callosamia promethea*—Figs. 1–4—Spermatogonial rest stages, showing stages in the disappearance of the net knot.
Fig. 5—Spermatogonial spireme.
Fig. 6—Spermatogonial equatorial plate showing 38 chromosomes.
Fig. 7—Spermatogonial metaphase.
Fig. 8—Spermatogonial anaphase.
Figs. 9 and 10—Spermatogonial telophase showing formation of nuclear membrane.
Fig. 11—Formation of spireme preparatory to synizesis. Spermatocyte.
Fig. 12—First spermatocyte, synizesis.
Fig. 13—First spermatocyte, synizesis (smear preparation).
Fig. 14—First spermatocyte, chromatin in loops.
Figs. 15–18—Degenerating cells.
Fig. 19—First spermatocyte, early post, synapsis (smear preparation).
Figs. 20–21—First spermatocyte, late post-synapsis (smear preparation).
Fig. 22—First spermatocyte, spireme divided into reduced number of chromosomes.
Figs. 23–26—First spermatocyte, growth stage.
Fig. 26—First spermatocyte, smear preparation showing continuity of the chromosomes.
Figs. 24, 25 and 29—First spermatocyte, ciliated centrosomes.
Fig. 27—First spermatocyte, split segments.
Figs. 32, 33—First spermatocyte, ring formation.
Fig. 28—First spermatocyte, condensation of rings.
Fig. 34—First spermatocyte, formation of plasmosome.
Figs. 35–38—First spermatocyte, stages in prophase of first maturation division.
Fig. 39—First spermatocyte, smear preparation, late prophase showing plasmosome with chromatin band.

Plate XXIII—*Callosamia promethea*—Fig. 40—First spermatocyte, equatorial plate, 19 chromosomes.
Fig. 41—First spermatocyte, polar plate, 19 chromsomes.
Fig. 42—First spermatocyte, metaphase, lateral view.
Fig. 43—First spermatocyte, anaphase.
Fig. 44—First spermatocyte, telophase.
Fig. 45—Second spermatocyte, polar view.
Fig. 46—Second spermatocyte, prophase, chromatin scattered, chromatin granule present.
Fig. 47—Second spermatocyte, prophase, rearrangement for second division, zwischenkörper marks cell axis.
Fig. 48—Second spermatocyte, prophase, two chromatin granules present, ciliated centrosomes.

Fig. 49—Second spermatocyte, Equatorial plate, 19 chromosomes.
Fig. 50—Second spermatocyte, metaphase spindle.
Figs. 51 and 52—Second spermatocyte, anaphase spindle.
Fig. 53—Second spermatocyte, telophase.
Fig. 54—Spermatid, first stage, chromatin granule present.
Fig. 55—Spermatid, degenerating.
Fig. 56—Spermatid, first stage showing chromatin granule, ciliated centrosome and chromatin nucleolus.
Figs. 57 and 58—Spermatid, second stage.
Fig. 59—Spermatid, formation of axial filament.
Figs. 60 and 61—Spermatid, later stages.

Plate XXIV—*Telea polyphemus*—Fig. 62—Early spermatogonial stage, showing net knot.
Fig. 63—Late spermatogonial stage.
Figs. 64 and 65—Spermatogonial spireme.
Fig. 66—Spermatogonial, equatorial plate, probably 60 chromosomes.
Figs. 67 and 68—Last spermatogonial, division.
Fig. 69—Spermatogonial telophase (oblique section).
Fig. 70—First spermatocyte, spireme preparatory to synizesis.
Fig. 71—First spermatocyte, beginning of synizesis.
Fig. 72—First spermatocyte, synizesis of smear preparation.
Fig. 73—First spermatocyte, synizesis.
Fig. 74—First spermatocyte, coming out of synizesis.
Fig. 75—First spermatocyte, early post-synapsis, showing plasmosome.
Fig. 76—First spermatocyte, late post-synapsis.
Fig. 77—First spermatocyte, fading of spireme.
Fig. 78—First spermatocyte, growth stages.
Fig. 79—First spermatocyte, ciliated centrosomes.
Fig. 80—First spermatocyte, segmented spireme, showing plasmosomes.
Fig. 81—First spermatocyte, segmented spireme, showing split.
Figs. 82–85—First spermatocyte, showing various stages in prophase.
Fig. 86—First spermatocyte, early metaphase.
Fig. 87—First spermatocyte, equatorial plate, 30 chromosomes.
Fig. 88—First spermatocyte, metaphase spindle, showing "chromosome granule."
Fig. 89—First spermatocyte, anaphase.
Figs. 90 and 91—Second spermatocyte, rearrangement of chromosome for second division.
Fig. 92—Second spermatocyte, equatorial plate, 30 chromosomes, "chromatin granules."
Fig. 93—Second spermatocyte, anaphase.
Fig. 98—Second spermatocyte, telophase, showing zwischenkörper and chromatin granules.
Fig. 94—Spermatid, early stage.
Fig. 95—Spermatid, second stage.
Figs. 96 and 97—Spermatid, later stage, formation of axial filament.
Fig. 191—Ciliated centrosome (*Danais archippus*).
Fig. 192—Ciliated centrosome (*Papilio cresphontes*).

Plate XXV—*Automeris io*—Fig. 98*a*—Early spermatogonial rest stage.
Fig. 99—Later spermatogonial rest stage, showing curious net-knot.
Fig. 100—Spermatogonial metaphase.
Fig. 101—Spermatogonial anaphase.
Fig. 102—Spermatogonial telophase.
Fig. 103—First spermatocyte, going into synizesis.
Fig. 104—First spermatocyte, later stage.
Fig. 105—First spermatocyte, complete condensation.
Figs. 106 and 107—First spermatocyte, early post synapsis.
Fig. 108—First spermatocyte, later post-synapsis showing plasmosome.
Fig. 109—First spermatocyte, growth stage, double plasmosome, ciliated centrosome.

Fig. 110—First spermatocyte, later growth stage, double plasmosome, centrosomes divided and ciliated.

Fig. 111—First spermatocyte, segmented spireme, segments opening into rings.

Figs. 112–115—First spermatocyte, stages in the formation of dyads and tetrads of prophase.

Fig. 113—First spermatocyte, formation of chromatin-plasmosome.

Figs. 116 and 117—First spermatocyte, early metaphase.

Fig. 118—First spermatocyte, equatorial plate, 31 chromosomes.

Fig. 119—First spermatocyte, metaphase spindle.

Fig. 120—First spermatocyte, anaphase spindle.

Fig. 121—First spermatocyte, telophase.

Fig. 122—First spermatocyte, telophase, polar view.

Fig. 123—Second spermatocyte, arrangement for second division.

Fig. 124—Second spermatocyte, equatorial plate, 31 chromosomes.

Fig. 125—Second spermatocyte, metaphase spindle.

Fig. 126—Second spermatocyte, anaphase spindle.

Fig. 127—Second spermatocyte, telophase.

Fig. 128—Spermatid, first stage.

Fig. 129—Spermatid, second stage.

Fig. 130—Spermatid, later stage, formation of axial filament.

Plate XXVI—*Automeris io*—Figs. 131–135—Spermatids, later stages, showing development.

Fig. 136—Spermatids, c. s. through axial filament and membranes.

Samia cecropia—Figs. 137 and 139—Spermatogonial stages, rest stage showing plasmosome.

Fig. 139—Spermatogonial stages, metaphase spindle.

Fig. 140—Spermatogonial stages, anaphase spindle.

Fig. 141—Spermatogonial stages, telophase.

Fig. 142—First spermatocyte, formation of spireme, preparatory to synezesis.

Fig. 143—First spermatocyte, smear showing granular thread of synezesis.

Fig. 144—First spermatocyte, early post-synapsis.

Fig. 145—First spermatocyte, later post-synapsis.

Fig. 146—First spermatocyte, late post-synapsis.

Fig. 147—First spermatocyte, growth stage, showing plasmosome and chromatin granule.

Fig. 148—First spermatocyte, growth stage, smear preparation, showing identity of chromosomes.

Figs. 149–152—First spermatocyte, formation of dyads of prophase, formation of a chromosome from a chromatin-plasmosome.

Fig. 153—First spermatocyte, equatorial plate, 30 chromosomes.

Fig. 154—First spermatocyte, metaphase spindle.

Fig. 155—First spermatocyte, anaphase spindle.

Fig. 156—First spermatocyte, telophase spindle.

Fig. 157—First spermatocyte, telophase, polar view, chromosome scattering.

Fig. 158—First spermatocyte, telophase, polar view.

Figs. 159 and 160—Second spermatocyte, arrangement for second division.

Fig. 161—Second spermatocyte, equatorial plate, 30 chromosomes.

Fig. 162—Second spermatocyte, metaphase.

Fig. 163—Second spermatocyte, anaphase.

Fig. 164—Early spermatid.

Fig. 165—Spermatid, second stage.

Plate XXVII—*Samia cecropia*—Fig. 166—Spermatid, second stage.

Figs. 167–169—Spermatid, later stages.

Fig. 170—Spermatozoon, vibratile filament, ½ its length.

Acronycta sp.,?—Figs. 171 and 172—First spermatocyte, growth stage showing "chromosome granule" and mitochondria.

Figs. 173 and 174—First spermatocyte, stages in prophase.
Fig. 175—First spermatocyte, equatorial plate, 29 chromosomes, mitochondria and chromatin granule in cytoplasm.
Fig. 176—First spermatocyte, metaphase.
Figs. 177 and 178—First spermatocyte, anaphase.
Fig. 179—First spermatocyte, telophase.
Fig. 180—First spermatocyte, telophase, polar view.
Fig. 181—Second spermatocyte, equatorial plate.
Fig. 182—Second spermatocyte, metaphase.
Fig. 183—Second spermatocyte, anaphase.
Fig. 184—Second spermatocyte, telophase.
Fig. 185—Spermatid, second stage.
Figs. 186–190—Spermatid, development.

THE POLYCHÆTOUS ANNELIDS DREDGED BY THE U. S. S. "ALBATROSS" OFF THE COAST OF SOUTHERN CALIFORNIA IN 1904: II. POLYNOIDÆ, APHRODITIDÆ and SEGALEONIDÆ.[1]

BY J. PERCY MOORE.

POLYNOIDÆ.

This family of scaled annelids is well represented in the collection by twenty-six species, about half of which belong to *Harmothoë* and related genera or, as they are here regarded because of their intergrading characters, subgenera. Twelve species are considered to have been previously undescribed; four species, previously known from Japanese waters, are recorded from the American side of the Pacific for the first time; nine are more or less well known on the shores of California or northward and one species is doubtful. It is worthy of remark that of the twelve species described as new no less than eight lack pigmented eyes, so far, at least, as can be determined without recourse to sections. These are distributed through a wide range of genera. With the exception of *Nemedia microlepida* they all came from considerable to great depths (500–2,000 fathoms). One species (*Polynoë renotubulata*) is further remarkable for having the nephridial papillæ prolonged into slender tubes which reach far above or beyond the parapodia.

Halosydna pulchra (Johnson).

Polynoë pulchra Johnson, Proc. Cal. Acad. Sci. (3), I (1897), p. 177.

Several specimens, the largest of which is 35 mm. long and has 60 segments, occur in the collection. Except in two cases nothing is stated on the labels regarding the commensal associations which are frequent with this species. All have the medial or the posterior half of the elytra more or less closely speckled with brown spots. Some have the dorsum of each segment conspicuously marked with two brown cross-bars. The prostomium of this species is intermediate in some respects between the form characterizing the Lepidonotinæ and the Harmothoinæ. In general it resembles the former most closely, free cephalic peaks being absent and the cephalic lobes prolonged

[1] Part I was published in these Proceedings for June, 1909, pp. 321–351, Pls. XV and XVI.

into the bases of the lateral tentacles, but a well-marked articulation cuts off the latter as distinct ceratophoric segments.

One example has the proboscis protruded. It is large and evidently powerful, 5 mm. long, 2.7 mm. wide, cylindroid, little depressed distally, smooth. There are nine dorsal and nine ventral prominent apertural papillæ and behind each series a small rounded median tubercle. Jaws pale brown, with large blunt fangs, the lower biting to the right; lateral cutting plates thin, low, rather extended but weak and directed chiefly laterally.

Stations 4,310, off Point Loma, vicinity of San Diego, 71–75 fathoms, green mud and fine sand; 4,414, northwest of Santa Catalina Island, 156–162 fathoms, fine gray sand and mud; 4,420, northeast of San Nicolas Island, 33 fathoms, fine gray sand; 4,453, off Point Pinos Light, Monterey Bay, 56–62 fathoms, green mud, "on *Luidia*;" 4,457, same locality, 40–46 fathoms, dark green mud, "on *Luidia*."

Halosydna insignis Baird.

Halosydna insignis Baird, Journ. Linn. Soc. London, VIII (Zool.), 1865, p. 188.

Polynoë brevisetosa (Kinberg), Johnson, Proc. Cal. Acad. Sci., Ser 3., Zoology, I (1897), p. 167. Figs. 24, 31, 40 and 46.

This very remarkable species is well represented in the collection by both the commensal and the free-living phases. Were it not that Johnson's familiarity with the species in its native surroundings enabled him to demonstrate their identity workers on preserved material alone would almost certainly have separated them as distinct species, though close inspection shows that they agree in their strictly technical characters.

Though there are no accompanying notes specifying their hosts or associates it is evident that most of the examples were commensals, they having the elongated form and other characteristics of this phase. The specimens measure from 15 to 45 mm. long, the smallest, while intermediate in proportions, approximating the short stout form of the free-living rather than the slender, elongated form of the commensal phase. As is the case with the former the elytra are strongly imbricated and cover the middle of the back nearly or quite completely. Both phases exhibit color variations through various shades of gray and brown or dusky and the elytra, while usually mottled, may be quite plain and uniformly colored. The pigment may be arranged in distinct spots or assume a reticular pattern around paler areas as in *H. californica* Johnson. Most constant is a white spot over the pedicel of attachment and a black or deep brown spot mediad of or behind it. Some specimens with elytra otherwise completely pigmentless have the anterior ones thus marked. Rarely this assumes the character of a distinct ocellus as in *Lepidasthenia gigas* (Johnson).

The tuberculation of the elytra also varies, the larger smooth papillæ, which are scattered among the numerous small corneous prickles, being elevated and conical or low and rounded, sometimes confined to the first pair of elytra, sometimes present on all or nearly all. Marginal cilia may be confined to the anterior elytra of commensal specimens but are longer and present on all elytra of free-living individuals, which also possess a tuft of five or six long ones just behind the middle of the anterior border. The end of the notocirri may be abruptly contracted as in Johnson's figure, or taper gently into the terminal filament and this condition occurs independently of commensal or free existence. Notopodial setal tufts are usually longer than indicated in Johnson's figure and some of the dorsalmost neuropodial setæ bear an obscure accessory tooth or spur, and on commensal individuals the dorsalmost pair of neuropodials may be much enlarged.

Free-living examples of this species have much the general aspect of *Lepidonotus sublevis* Verrill and *L. clava* (Montagu), but of course are readily separated by having eighteen instead of twelve pairs of elytra and by other generic characters. Their neuropodial setæ differ from those of commensals in being more slender and less strongly hooked at the end and in having fewer (about 7) pectinated frills. Besides being larger the elytra are also tougher and more horny and the marginal cilia are longer. The distribution of the examples in this collection suggests that other conditions than commensalism may be effective in differentiating the two forms.

The proboscis appears to differ in no way in the two phases, in examples of both of which it is protruded. On a specimen 15 mm. long it has a length of 2.6 mm. and a terminal width of 1.6 mm.; one 40 mm. long has these measurements 5.5 and 3.2 mm. respectively, the base being terete, the distal end depressed, with apertural papillæ $\frac{9}{9}$. Jaws massive and deep brown, the fangs very stout, compressed, the ventral biting to the right; cutting plates well developed.

Ehlers,[2] taking a comprehensive view of this and related nominal species, unites, under the prior name of *H. patagonica* Kinberg, *H. brevisetosa* Kinberg, *Polynoë chilensis* Quatrefages, *Lepidonotus insignis* Baird, *Lepidonotus grubei* Baird and, with some doubt, *Halosydna parva* Kinberg. His conclusion is partly based upon the

[2] *Festsch. Feier d.* 150-*jähr. Bestehens d. Königl. Gesell. d. Wissensch. z. Göttingen*, 1901, pp. 45–47.

examination of specimens from the Californian coast sent to him by Dr. Johnson. Considered in this wide sense the species ranges along the entire Pacific coast of America from the Straits of Magellan to Stephens Passage, Alaska.

Stations 4,421, southeast of San Nicolas Island, 291–298 fathoms, gray mud and rocks (elongated form); 4,453, off Point Pinos Light, Monterey Bay, 49 fathoms, dark green mud (short form); 4,457, same locality, 40–46 fathoms, dark green mud (short form); 4,464, same locality, 36–51 fathoms, soft dark gray mud (short form); 4,496, off Santa Cruz Light, Monterey Bay, 10 fathoms, fine gray sand and rocks (20 specimens of the elongated form).

Halosydna californica (Johnson).

Polynoë californica Johnson, Proc. Bos. Soc. Nat. Hist., XXIX (1901), p. 387.

Specimens of this handsome species from 12–30 mm. long occur in the collection. The elytra present considerable color variation: Some are pale brown with the characteristic reticular pattern; others have them of a nearly uniform reddish brown, with a white spot, accentuated by a small deep brown spot, over the point of attachment; on one of the latter the first three pairs are translucent mottled grayish. Two of the smallest and the largest one have the elytra pale uniform gray with colorless lateral margins and no mottling and the white attachment spots on those of the last two pairs only. The two stations at which examples were taken yielded *H. insignis* also. No notes on commensalism are furnished but the specimens from Station 4,421 were entangled with terrebelid tentacular filaments.

Stations 4,421, southeast of San Nicolas Island, 291–298 fathoms, gray mud and rocks; 4,496, off Santa Cruz Light, Monterey Bay, 10 fathoms, fine gray sand and rocks.

Halosydna interrupta v. Marenzeller.

Halosydna interrupta v. Marenzeller, Denksch. d. kais. Akad. d. Wissensch. Wien, Math.-Nat. Cl., LXXII (1902), p. 570, Taf. I, fig. 2.

Polynoë semierma Moore, Proc. Acad. Nat. Sci. Phila. (1903), pp. 402, 403, Pl. XXIII, figs. 2 and 3.

The occurrence of a well-preserved and apparently complete example (though in three pieces) of this species in the collection permits of the determination of the above synonymy and the correction of both original descriptions, which were based upon incomplete and poorly preserved specimens. The prostomium of the type of *P. semierma* is badly macerated and the description based upon it quite incorrect and misleading. The following description of the present example is therefore supplied.

Prostomium small, nearly as long as broad, depressed, with a median dorsal furrow dividing it for the entire length into two smooth, convex lobes that taper at the anterior end gently into the bases of the slender tentacular ceratophores. No peaks and no prominent ocular lobes. Eyes two pairs, very small; the posterior strictly dorsal near caudal border; the anterior lateral on widest convexity of prostomium. Median ceratophore arising from cephalic sinus, slender, about one-half of its length extending beyond lateral ceratophore. Median tentacular style about five and one-half times length of prostomium, slender, tapered, smooth, with a moderate subterminal enlargement and a very delicate terminal filament about as long as the prostomium. Lateral tentacles arising from the frontal prolongation or ceratophores; styles slightly more than one-half as long as the median style, very slender, without evident subterminal enlargements and the terminal filaments relatively longer than those of the median tentacle. The single palp remaining is moderately stout at the base, about five times as long as the prostomium, strongly annulated and tapered to a very short terminal filament.

Peristomial parapodia apparently quite achætous. Tentacular cirri like median tentacle and about three-fourths as long, the ventral slightly shorter. Notocirri alternately longer and shorter; the longer styles frequently having a line of fracture or articulation near the middle which gives the appearance of a greatly elongated cirrophore. Posteriorly the longer cirri follow immediately the elytra and are succeeded by shorter ones. The neurocirrus of somite III of one side is duplicated.

The specimen is 55 mm. long and has 107 segments. The elytra are small, leaving the entire middle of the back uncovered, and there are thirty-six pairs the first fifteen arranged as in *Harmothoë* to somite XXXII, the sixteenth on XXXIV and the remaining ones on every third following segment. Von Marenzeller's specimen, which was dredged at a depth of 480 m. off Eno-sima, Japan, consisted of two pieces. The anterior of nineteen segments bore ten pairs of elytra arranged like their homologues in *Harmothoë*, etc. The posterior piece consisted of twenty-seven segments terminated by a pygidium and bearing seven pairs of elytra on the third, sixth, eighth and every third segment following. Marenzeller considers that somites XX to XXIII along with two pairs of elytra on XXI and XXIII have been lost and that the first three pairs of elytra on the posterior piece are borne, therefore, on XXVI, XXIX and XXXI. This placing of the elytra is the only discrepancy existing between his description and the present specimen, which agrees fully in this respect with the type of *P. semierma*. If v. Marenzeller's example, however, lacks the seven segments (XX–XXVI) and the three pairs of elytra borne on XXI, XXIII and XXVI the elytra on the posterior piece would fall on somites XXIX, XXXII, XXXIV, XXXVII, etc. and the agreement would be complete.

This specimen is well colored, each segment being marked on the dorsum with a rather bold, transverse dull purplish-brown bar and the elytra are slightly mottled with brown.

Station 4,339, off Point Loma Light, vicinity of San Diego, 241–369 fathoms, green mud.

Lepidonotus cæloris Moore.

Lepidonotus cæloris Moore, Proc. Acad. Nat. Sci. Phila., 1903, pp. 412–414, Pl. XXIII, fig. 12.

This species, originally discovered off Japan and later found to be widely and plentifully distributed from Vancouver to the Kadiak Islands, is now determined to be equally common in the region covered by these explorations, from which it was previously known through a single small example dredged at Monterey Bay. The bathymetrical range shown by these explorations is from 26 to 1,400 fathoms.

These specimens range in size from 8 to 35 mm. and present all of the color varieties of yellow, orange, reddish, olive brown, dark brown, dusky and nearly black, the brighter colors being sometimes confined to the papillæ, sometimes overspreading the entire elytra. The elytral tubercles show a distinct tendency to become larger than on northern examples and at the same time lower, flatter and smoother, especially on middle scales. At the ends of the body they are frequently conical.

Several specimens have the proboscis extended. On one 25 mm. long it is 5.3 mm. long and 3 mm. wide, cylindroid, somewhat depressed at distal end and bearing the usual nine dorsal and nine ventral blunt papillæ. Jaws deep brown; the fangs rather stout and blunt, cutting edge rather long, knife-like.

Stations 4,310, Point Loma Light, San Diego, 71–75 fathoms, green mud and sand; 4,326, off Point La Jolla, vicinity of San Diego, 243–280 fathoms, soft green mud; 4,411, off Long Point, Santa Catalina Island, 143–245 fathoms, gray sand and shells; 4,417, off Santa Barbara Island, 29 fathoms, fine yellow sand and coralline rock; 4,420, off San Nicolas Island 32–33 fathoms, fine gray sand; 4,421, same locality, 229–291 fathoms, gray mud and rocks; 4,423, same locality, 216–339 fathoms, gray sand, black pebbles and shells; 4,427, off Santa Cruz

Island, 447–510 fathoms, black mud and rocks; 4,430, off Gull Island, Santa Cruz Island, 197–281 fathoms, black sand, pebbles and rocks; 4,431, off Santa Rosa Island, 38–40 fathoms, mud, sand and rock; 4,461, Monterey Bay, off Point Pinos Light, 285–357 fathoms, green mud; 4,515, same, 368–495 fathoms, green mud, sand and shells; 4,531, same, 26–28 fathoms, fine gray sand, pebbles and rock; 4,550, same, 50–57 fathoms, green mud and rock; 4,574, off Cape Colnett, Lower California, 1,400 fathoms. Especially plentiful at stations 4,420, 4,421, 4,430, 4,431 and 4,461, most of the other stations yielding only one or two specimens.

Lepidonotus sp. ?

A nearly perfect Lepidonotus 12 mm. long was at first referred to *L. carinulatus* Grube, a species that has been recorded from the Red Sea and the Philippine Islands by Grube, from Japan by v. Marenzeller and more recently from Ceylon by Willey. There exists a close resemblance, especially in the character of the elytra between this specimen and Grube's description but serious discrepancies arise with Marenzeller's and even more with Willey's descriptions. The neuropodial setæ are of the typical Lepidonotus type with no trace of a true subapical spur, but the last pair of toothed plates is greatly developed and superficially somewhat resembles a spur, the remaining ones being reduced in number and much reduced in size or even obsolete. On the whole they resemble the corresponding setæ of *L. cœloris* but are more slender.

On most of the elytra the horny bosses take the form of subcircular bases rising into more or less compressed keels, many of which are more or less irregular and spinous but which as a rule are smooth and lack the sculpturing so evident on typical *L. cœloris*. Anterior elytra, however, show traces of this sculpturing on the more conical papillæ. The marginal fringe is very long and extensive. The prostomium has the typical *Lepidonotus* form quite unlike Willey's figure of *L. carinulatus*. Their color is pale brown with a light spot over the point of attachment.

On the whole it seems best to consider this specimen provisionally as a variation of *L. cœloris*.

Station 4,496, off Santa Cruz Light, Monterey Bay, 10 fathoms, fine gray sand and rocks.

Eunoë barbata sp. nov. Pl. XXVIII, figs. 1–6.

Form moderately robust, dorso-ventral depth nearly equal to width of body in anterior half but the posterior tapering region much more depressed. Segments 39. Type 29 mm. long; maximum width at XII: body alone, 4.5 mm.; between tips of parapodia, 8 mm.; between tips of setæ, 10 mm.

Prostomium very small, its width less than one-fifth width of body, broader than long; dorsal furrow shallow and short, the cephalic lobes not well differentiated from each other or from the median ceratophore. Peaks very short and blunt, inconspicuous, but diverging from the median tentacle, well above and largely free from the lateral tentacles. Eyes two pairs, black, conspicuous, the diameter of each about one-eighth width of prostomium; the posterior pair dorsal and near the postero-lateral border; the anterior pair ventro-lateral, anterior to middle of prostomium. Median tentacle with short, stout ceratophore half as thick and one-third as long as prostomial width; styles lost from both type and cotype. Lateral tentacles with ceratophores one-half length and one-fourth diameter of median; styles nearly twice length of prostomium, the basal half nearly uniform in diameter, followed by a slight enlargement bearing the abruptly filamentous terminal third, sensory cilia few and scattered, short, with slightly bulbous tips. Palps slender, terete or slightly five-angled with prominent longitudinal lines of densely placed cylindrical cilia, regularly tapered, about five to five and one-half times as long as the prostomium. Facial ridge low but, owing to its dark brown color on a white background, very conspicuous.

Peristomium represented dorsally by a small nuchal fold, ventrally produced forward and united with prostomium. Its parapodia bear from one to three small curved setæ. Cirrophores of tentacular cirri prominent, reaching beyond anterior border of prostomium; styles rather stout, subequal, the dorsal reaching to end of third quarter of palps, the ventral slightly shorter, gently tapered to a fusiform subterminal enlargement which passes abruptly into a terminal filament less than one-fifth the total length; sensory cilia scattered, short with thickened ends. Mouth with the usual swollen, rugose lips, the lateral pair embracing the facial ridge anteriorly. Metastomial segments strongly arched anteriorly, posteriorly depressed and tapering to the minute pygidium which (on the type) bears a single cirrus resembling the tentacular cirri but little more than half as long and entirely pale. Neural groove broad and well defined. Nephridial papillæ begin on VI at postero-lateral border of segments, short and directed slightly upward into the furrows.

Typical parapodia rather short, less than one-half width of segments, stout, little compressed, interramal cleft little developed, the notopodium overlapping neuropodium from behind. Notopodium much smaller than neuropodium but reaching nearly as far distad, ovate, compressed, oblique, divided by the setigerous cleft and bearing near the ventral border a prominent, conical acicular tubercle. Neuropodium compressed, the base somewhat narrowed and distal part expanded and tapering to a right-angular apex near the dorsal border, from which the tapered truncate acicular process projects and bears on the dorsal side of its distal end a blunt, finger-like cirrus equal to its own length. On posterior segments the two rami become more nearly equal, the notopodium more slender and projecting and the interramal sinus wider.

Notocirrophores prominent, cylindroid with tumid base, suberect and curved, arising postero-dorsad to notopodia; styles similar to tentacular cirri, mostly curved postero-medially over dorsum, on middle segments reaching the length of their terminal filaments beyond median line and nearly unchanged in length posteriorly. On all parts except the terminal filament they bear numerous cilia of varied lengths, many of those on the basal half having a length of twice the diameter of the style. Neurocirri arise much proximad of the middle of ventral face of neuropodium, are smooth, subulate, slender and reach nearly to the base of the acicular process of neuropodium. Neurocirrus of II about two and one-half times length of others and terminated abruptly in a filament.

Aciculum single in each ramus, stout, tapered, yellow, the blunt end projecting for a considerable distance beyond the acicular process. Setæ all pale yellow. Notopodials arranged in a short compact tuft projecting much dorsad but spreading only slightly. They (Pl. XXVIII, figs. 2 and 3) are about as stout as the neuropodials, the distal half bearing numerous, rather distinct and extensive combs; their ends blunt and free of the transverse pectinated processes for only a short distance, some nearly or quite smooth but many bearing a greater or less number (figs. 2 and 3) of appressed scale-like teeth and a few with brush-like ends like those of *E. truncata.* The few peristomial setæ are like the shorter, curved notopodials. Neuropodial setæ (fig. 1) in about three supra-acicular and six subacicular series, gently curved, with enlarged ends bearing from eleven, on the short setæ of the ventral row, to twenty, on those of the dorsal row, transverse pectinæ on each side which become conspicuous in size and distinctly alternate in position only toward the distal end; smooth tips long, two to three times greatest diameter of the setæ, stout, strongly hooked and without trace of an accessory process. Caudally the setæ become much more slender but are otherwise unmodified.

Elytraphores 15 pairs, on II, IV, V, VII, to XXIII, XXVI, XXIX, XXXII. They are rather small and only moderately prominent with oval or slightly auricular scars from which the elytra are very easily detached. Alternating with them but more mesad in position are small and simple rounded dorsal tubercles. Elytra (Pl. XXVIII, fig. 4) of moderate size and rather thick, soft, texture. Except for a few posterior segments they nearly or quite cover the dorsum. Those of the first pair are small and irregularly circular, the second and third pairs narrow and strongly reniform or bean-shaped; remaining ones so far as known rather broadly ovate-elliptical with the broader end lateral and the anterior border slightly concave or nearly straight. The small scar lies well anterior and slightly lateral to the middle. Except for a small translucent portion of the antero-medial border the surface is thickly covered with hard tubercles, very small and numerous at the antero-medial margin (figs. 4 and 5) but becoming larger and fewer toward the postero-lateral margin (figs. 4 and 6). With the exception of the very smallest these tubercles are knoblike and bear on the summit two, three or more stout, sharp points; some of them are very thickly studded with spines which vary in length on different elytra. A variable number of tubercles near the posterior border and in the neighborhood of the scar are much more massive than the others; these likewise are studded with spines, long or short according to the habit of the particular elytron; many of them are surrounded by a raised ring. Marginal fringe extensive, passing round nearly the entire exposed margin, the cilia slightly knobbed distally and varying much in length, those on the posterior border short and inconspicuous, those of the lateral border exceeding the length of the largest papillæ. Scattered over the exposed surface among the spines are numerous short cilia and slightly behind the middle of the posterior border is a loose irregular tuft of cilia, some of which are even longer than the longest lateral cilia. On the first pair large rough tubercles are scattered round the entire margin and the cilia have an even more extensive distribution but are much shorter.

Color of middle portion of dorsum brown or olive; parapodia and under parts chiefly colorless. Prostomium purple; eyes black; tentacular elytrophores brown, the lateral very dark; styles of cephalic tentacles, tentacular cirri and notocirri of setigerous segments beautifully mottled brown and white with the white tip preceded by a brown and this again by a white annulus at the beginning of the subterminal enlargement. Facial ridge brown, palps and notocirri colorless. Elytra, except for the translucent colorless portion, beautifully mottled with brown, gray and white, the papillæ brown or yellow.

A single specimen of this species (cotype) occurs in the collection from Station 4,496.

The type is No. 2,028 of the collection of this Academy and is referred to on p. 335 of the PROCEEDINGS for 1908 under the name of *Harmothoë hirsuta* Johnson as coming from Station 4,205 in Puget Sound. My belief at that time was that *H. hirsuta* lost the areolation of the elytra and the accessory tooth of the tips of the neuropodial setæ with age but additional material has convinced me that this is not the case. This species, though related to *H. hirsuta*, differs in the form of both notopodial and neuropodial setæ and in the absence of elytral areas.

Station 4,496, Monterey Bay, off Santa Cruz Light, 10 fathoms, fine gray mud and sand.

Eunoë cæca sp. nov. Pl. XXVIII, figs. 7–12.

A species having the general aspect of *Polynoë pulchra* Johnson, of similar commensalistic habits, but somewhat stouter. The body is rather thick dorso-ventrally and the parapodia slope upward, forming a shallow, open trough above, a peculiarity that at once distinguishes this species from the last. The type is 40 mm. long, the maximum width at about X being, body—6 mm., between tips of parapodia—11 mm., between tips of setæ—14 mm. Number of segments 43. Two of the cotypes are of equal size, the third about one-fourth smaller.

Prostomium (Pl. XXVIII, fig. 7) squarish, the posterior border alone strongly rounded, slightly wider than long, posterior half of lateral border somewhat bulging and convex, sides anterior to this gently convergent to the prominent antero-lateral angles or peaks; anterior borders nearly straight with a very shallow median emargination; no dorsal furrow and no eyes. Ceratophore of median tentacle at level of dorsal surface of prostomium and separated from it by a very slight transverse groove, barrel-shaped, about one-half length of prostomium and, owing to slight development of anterior fissure, standing freely and prominently forward. Style (fig. 7) about three and one-half times length of prostomium, slender, regularly tapered, with filamentous tip and no subterminal enlargement; sensory papillæ almost entirely wanting, only a very few small ones being present. Lateral tentacles arising at a low level on antero-ventral face of prostomium from cylindrical ceratophores which are nearly as long as, but much more slender than, the median ceratophore and which lie well mediad of the cephalic peaks; styles about one and one-third to one and one-half times length of prostomium, very slender, subulate, with long filamentous tips. Palpi also very long, slender and perfectly smooth, four to four and one-half times length of prostomium; sensory papillæ not obvious. Facial tubercle unusually large, elevated on facial ridge.

Mouth large with prominent, pouting, trifid, furrowed lips, the facial ridge passing between the anterior pair. Peristomium obvious only through its parapodia which project well forward beyond the cephalic peaks and bear on the medial side a prominent tubercle from which projects the end of a stout brown aciculum and below this a pair of stout notopodial setæ; beyond this the cirrophores separate. Styles of tentacular cirri similar to median tentacle which the dorsal slightly exceeds, the ventral slightly shorter.

Metastomial segments indistinctly separated by faint furrows, the whole ventral surface forming a somewhat prominent sole-like structure, with the neural furrow and lateral ridges only moderately well-marked. Nephridial papillæ begin of VI; small, flattened, inconspicuous and projecting upward between the bases of the parapodia. Owing to the peculiar elevation of the parapodia the dorsum of the body appears to be depressed and gives the effect of a furrow. Elytrophores occur on II, IV, V, VII, IX, XI, XIII, XV, XVII, XIX, XXI, XXIII, XXVI, XXIX and XXXII = 15 pairs; they lie well out on the bases of the parapodia, are low and wide and often constricted below the nearly circular free surface. Dorsal tubercles are subconical prominences occurring at the same level as the elytrophores but projecting beyond them slightly lateral. The greatest width is at about somite X, anterior to which the sides curve broadly into the oral region and behind which they taper regularly to the pygidium, which is a minute, short, tubular segment with dorsal anus, below which is a common cirrophore bearing the two very slender anal cirri exceeding in length the greatest width of the body without parapodia.

Parapodia rather short, on anterior and middle segments scarcely more than one-half width of segments bearing them. As indicated above they slope dorsad from the ventral surface rather strongly. They are compressed and at the base rather deep, the rami only slightly separated (Pl. XXVIII, fig. 8). Notopodium very short and thick, the moderately elongated, conical acicular process obliquely truncated at the end, projecting from its ventral margin and reaching to or slightly beyond the end of the neuropodial acicular process. Neuropodium compressed, tapered to a blunt point and extended beyond the notopodium by a foliaceous margin or presetal lobe including in its dorsal part the rather obscure acicular process, which is broad and flat, nearly as long as the notopodial acicular process and bears at its end a short, blunt flat cirrus. Parapodium II scarcely differs from the others.

Notocirrophores arising almost directly behind notopodia, prominent, suberect, reaching level of neuropodial acicular process, cylindroid with somewhat tumid base. Styles (fig. 8) long and slender, reaching to middle of dorsum and far beyond setæ tips, like medium tentacle in all respects. Those at the caudal end much elongated and slender.

Acicula single, deep brown, very stout, tapered to acute, pale tips which project slightly beyond the acicular processes in both rami. Neuropodial setæ (Pl. XXVIII, figs. 9 and 10) reduced in number, usually two supra-acicular and six subacicular series of two to four each on middle segments. All stout, deep yellow, prominent, with the thickened terminal portion strong and long (generally about two-fifths of exposed length); transverse pectinations numerous and close but exceedingly fine and on many setæ quite obsolete, apparently as the result of wear; smooth tip rather long (2–3 times diameter of seta) stout, curved and lacking an accessory tooth (fig. 10). Notopodial setæ also comparatively few, forming an irregular loose bundle, deep yellow, about as stout as the neuropodials but much shorter, nearly straight, tapered to blunt, smooth tips and with the transverse rows of spines nearly or quite obsolete (figs. 11 and 12). Both kinds of setæ resemble those figured by McIntosh for *Polynoë euplectellæ* but are stouter.

Elytra attached with moderate firmness, of delicate gelatinoid consistency and in their evidently much contracted state shrunken away from the middle line and having a deep central depression and more or less folded and frilled raised margins. Probably they are in life flat and overlap widely. So far as can be determined the first is circular, the others more or less broadly reniform. They are colorless, translucent and totally without marginal cilia or obvious tubercles on the smooth dorsal surface. Under the microscope an area of rather closely placed minute horny tubercles appears behind the hilum and similar tubercles are scattered widely over the entire surface.

Except for a slight purplish brown color of the head the entire worm is colorless.

Station 4,537, Monterey Bay, off Point Pinos Light, 861–1,062 fathoms, hard sand and mud. Commensal on *Holothuria* sp. (four specimens).

Harmothoë (Lagisca) multisetosa Moore.

Lagisca multisetosa Moore, Proc. Acad. Nat. Sci. Phila., 1902, pp. 267–269, Pl. XIV, figs. 29–36.

The specimens in the collection referred to under this and the following two names form a puzzling group the status of which was decided upon only after much hesitation. This arose chiefly from the imperfect preservation of the specimens and the absence of attached elytra, but also because of the similarity and variability of the species. All three species have the caudal end of the body slender and tapered and prolonged considerably beyond the last elytra.

The cephalic peaks vary greatly, being sometimes much more prominent and acute than is usual in the genus, sometimes short and round, but it is probable that these variations arose as the result of conditions of preservation. No attached elytra were found but two or three loose ones differ from those typical of this species in no way except in the slight development of soft papillæ. A bottle from station 4,405 containing some examples of this and the next species yielded three kinds of loose elytra: those typical of the two species and another form lacking large soft papillæ and covered thickly with long slender acute spines, resembling very closely, therefore, the elytra of *Lagisca crosctensis* McIntosh. A study of all the material at my disposal brings to light an unbroken series between this form and those with large soft papillæ and small spines. The setæ figured by McIntosh differ considerably from those of *L. multisetosa* which have the pectinated plates of the neuropodials continued almost to the tip. It seems not improbable, however, that a fuller knowledge of the *Lagiscæ* of the Pacific will demonstrate a multiplicity of variable and intergrading forms.

Stations 4,405, off San Clemente Island, 654–704 fathoms, green mud; 4,427, off Santa Cruz Island, 447–510 fathoms, black mud and rocks; 4,453, Monterey Bay, off Point Pinos Light, 49–51 fathoms, green mud; 4,517, same, 750–766 fathoms, green mud and sand; 4,574, off Cape Colnett, Lower California, 1,400 fathoms.

Harmothoë (Lagisca) lamellifera v. Marenzeller.

Polynoë (*Lænilla*) *lamellifera* v. Marenzeller, Denkschr. königl. Akad Wiss. Wien, XLI, Math.-Nat. Cl., 2d. Abth. (1879), pp. 115–117, Taf. I, fig. 5.

Lagisca multisetosa papillata Moore, Proc. Acad. Nat. Sci. Phila., 1908 p. 335.

Most of the specimens here referred to this species agree closely with v. Marenzeller's description and figures but others have setæ and elytra that vary somewhat in the direction of both the preceding and following species, from typical examples of both of which these are distinguished by the much reduced cephalic peaks, the sparseness of the marginal fringe of cilia on the elytra, the very short blunt tips of the notopodial setæ and the very slender and elongated neuropodial setæ with their remarkably rich pectination consisting of forty or more pairs of combs reaching nearly to the tip.

Marenzeller's figure of the prostomium is undoubtedly drawn from a specimen in which the peaks were retracted and bent dorsad so that they fail to be represented in the figure. All of my specimens possess minute but quite evident peaks. If my interpretation be correct the ventral lamella referred to by v. Marenzeller is an integumental fold close to the nephridial papillæ and under certain conditions of preservation appears in many species. It is therefore not diagnostic and occurs in some of these specimens and is absent from others.

Typical elytra quite like v. Marenzeller's figure were found in bottles containing specimens of this species from stations 4,339, 4,405, 4,425 and 4,428. The margin bears but a few short cilia and the outer surface is thickly studded with small, truncate horny spines among which are scattered, posterior to the attachment and more or less arranged in oblique rows, the larger soft papillæ. These are generally brown in color and of low, rounded, somewhat recumbent form and appear to be hollow. Usually they are small and quite numerous. Others have the papillæ near the posterior border much more enlarged and several from stations 4,339 and 4,405 have few small soft papillæ but much larger mammilliform or sugar-loaf-shaped submarginal papillæ exactly like those of the types of *L. multisetosa papillata*. In one case these papillæ number only four or five, clavate and connate with the surface of the scale except at the tips, and in the case of two elytra from station 4,405, which appear to be the first pair, the papillæ are large, decumbent cones.

The setæ agree closely with v. Marenzeller's figures but the accessory tooth of the tip of the neuropodials is present more commonly than he indicates and the pectinated plates reach nearer to the tip. The rows of spines of the notopodials always reach nearly to the blunt tip which is frequently roughened but the extent of the tip thus exposed varies somewhat.

While most of the specimens are small and much broken some of those from station 4,405, although completely denuded of appendages, have all segments present. One of the largest of these has forty-three segments, the fifteenth pair of elytrophores occurring on XXXII, and measures 55 mm. by 15 mm. between setæ tips. Marenzeller gives only thirty-six segments.

The color above is a pale or medium brown with two narrow, white lines across each segment, the venter gray; elytra more or less suffused with brown on the medial half. Several of the specimens are filled with eggs.

Stations 4,305, off Point Loma Light, near San Diego, 67–116 fathoms, gray sand and shells; 4,310, same, 71–75 fathoms, green mud and fine sand; 4,339, same, 241–369 fathoms, green mud; 4,389, off Point Loma Lighthouse, 639–671 fathoms, green mud, gray sand; 4,405, off San Clemente Island, 654–704 fathoms, green mud; 4,425, off San Nicolas Island, 1,100 fathoms, green Globergerina mud and fine sand; 4,428, off Santa Cruz Island, 764–891 fathoms, green mud.

Harmothoë (Lagisca) yokohamiensis McIntosh.

Lagisca yokohamiensis McIntosh, Challenger Reports, Zoology, Vol. XII, pp. 89, 90, Pl. XIA, figs. 12 and 13.

This species lacks the large soft papillæ that adorn the elytra of the two preceding. The horny papillæ are small, conical or truncate and are uniformly distributed over the entire exposed portion of the elytra. Marginal cilia are moderately long and have slightly bulbous tips and a few longer cilia are borne on the surface near the posterior margin.

Notopodial setæ are rather stout, the largest about three times the diameter of the neuropodials and their smooth tips (Pl. XXXI, fig. B) are much longer than in the preceding species, the rows of spines very numerous and the longest nearly encircling the seta. The extent to which they bend over the dorsum and protect the elytra is noteworthy and calls to mind the condition in *Gattyana*. Neuropodials (Pl. XXXI, fig. A) also have much longer tips and only twenty to thirty pairs of pectinated plates and the rather prominent accessory tooth is present on all but the ventralmost rows. Notocirri are long and very slender with the subterminal enlargement scarcely visible and the terminal filament unusually long and bear a moderate number of clavate cilia much longer than those on the tentacles.

Several have the proboscis protruded. In one 28 mm. long it is 4.6 mm. long and 2.5 mm. at the orifice. It is clavate, the distal end nearly circular, the mouth rather small and lozenge-shaped; orifical papillæ nine above and nine below. Jaws pale brown, the fangs compressed, prominently outstanding like a parrot's beak and the knife-like cutting plates directed more antero-posteriorly than transversely. Complete examples have from forty-four to forty-six segments.

Color above dark or usually pale brown with or without narrow transverse white lines, below nearly colorless. Elytra colorless or the posterior part marked with brown usually in three large blotches. Ova occur in only one specimen from an unknown station.

This may be the Hawaiian species referred to *H. haliaeta* McIntosh by Treadwell. These specimens agree very closely with McIntosh's description and figures. The marginal cilia of the elytra might be more correctly described, however, as moderate in size and number rather than long and numerous. McIntosh pointed out that his species is closely related to *Polynoë* (*Lænilla*) *lamellifera* Marenzeller, the only conspicuous difference being the absence of soft elytral papillæ. *Polynoë subfumida* Grube is another allied species.

Stations 4,414, off Santa Catalina Island, 152–162 fathoms, fine gray sand and mud; 4,427, off Santa Cruz Island, 447–510 fathoms, black mud, rocks; 4,430, off south coast of Santa Cruz Island, 197–281 fathoms, black sand, pebbles, rocks; 4,515, Monterey Bay, Point Pinos Light, 368–495 fathoms, green mud, sand, shells; 4,537, same, 1,041–1,062 fathoms, hard sand and mud.

Harmothoë scriptoria sp. nov. Pl. XXVIII, figs. 13–17.

A pretty, dainty species with delicate, easily detached scales. Moderately slender, slightly depressed, little tapered toward the two ends which are nearly equally rounded. Measurements of type: length 15 mm., width at X, body, 1.6 mm., between tips of parapodia 4 mm., between tips of setæ 5.5 mm. Number of segments 39. Type ♀ filled with ova.

Prostomium (Pl. XXVIII, fig. 13) slightly longer than wide with a distinct longitudinal dorsal median furrow for its entire length, slightly and regularly convex laterally, broadly rounded or subtruncate anteriorly, without distinct peaks and little or not at all overhanging the bases of the lateral tentacles. Eyes, two pairs, black, small; the posterior not more than one-fourteenth width of prostomium, dorso-lateral, separated by two or three times its diameter from posterior border of prostomium; the anterior slightly larger, lateral and slightly ventral, about one-third of length of prostomium from its anterior end. Median ceratophore short and thick, projecting but little from the cephalic sinus; style of median tentacle unknown but its character may be judged by the tantacular cirri. Lateral tentacles small, total length less than prostomium, arising from anterior face of prostomium slightly below median ceratophore, their ceratophores very short; styles regularly subulate. Palps two and one-half or three times as long as prostomium, rather stout and projecting laterally beyond prostomium at base, tapering gradually to near tip and then rapidly to a sharp point; no distinct raised lines or ridges. Facial ridge large, broad and rounded.

Peristomial parapodia large and projecting well-foward beyond prostomium, achætous, the tentacular cirrophores well separated; styles moderately slender, regularly tapered, without subterminal enlargement, terminal filament short or indistinct; the dorsal about four-fifths, the ventral three-fourths length of palpi. Mouth surrounded by a furrowed trilobate lip. Remaining segments well marked. Greatest width near anterior end (VII or VIII), thence body regularly but very gently tapered caudad. Neural furrow distinct and deep. Nephridial papillæ not clearly seen, evidently very small. Dorsum with intersegmental furrows well developed except in pharyngeal region. Dorsal tubercles small and inconspicuous. Pygidium larger than usual in the family; anus dorsal. Anal cirri lost but a pair of small cirri, evidently the last notopodials, at sides of anus.

Parapodia (fig. 14) rather prominent, nearly equalling width of body on middle segments. In the type the base somewhat swollen with eggs, thence tapered distad to the pointed apex. Neuropodium large, compressed, tapered to a prominent, acutely triangular, flattened, acicular lobe, beyond which the aciculum appears not to project (fig. 14[a]). Notopodium of typical parapodia reduced to a small antero-dorsal setigerous lobe with a finger-shaped acicular process at its ventral border from the end of which the tip of the small aciculum projects.

Notocirrophores small, but rather elevated, situated a little dorsad and caudad of notopodia; styles short, reaching tips of neuropodial setæ only, subulate with thickened base tapered to slender, acute point, bearing a very few minute clavate sensory cilia or none. Neurocirri arising far out beyond middle of ventral face of parapodia, not reaching end of neuropodia, slender, regularly subulate, acute. Neurocirrus of II about twice as long as its parapodium, nearly equal to ventral tentacular cirrus.

Elytra 15 pairs, having the customary arrangement, small, and little elevated. Elytra (Pl. XXVIII, fig. 15) easily detached, only slightly imbricated and barely covering dorsum. First pair subcircular and completely hiding prostomium, its small scar slightly caudad of middle; the next two strongly reniform with a deep hilum close to which is the scar of attachment; succeeding ones larger, broader and less deeply emarginate, with the scar slightly antero-lateral of the center; the last pair, finally, subquadrate-elliptical with the attachment anterior to the center. All are thin, delicate and membranous, perfectly smooth, and entirely lack cilia and tubercles, except for a small area of minute, rounded corneous granules just behind the hilum. They are pale and daintily colored, with a bluish-gray ground and white subcentral spot, a pale brown postero-medial submarginal crescent and a small more deeply colored pigment spot over the point of attachment. The first has a complete circle of brown round a white center. Under the microscope the surface shows close and curious fine pencil-like white markings (fig. 15[a]) usually wavy or crenulated and often bent or branched, having somewhat the appearance of written characters. The branching of the nerves from the scar is also very obvious.

Acicular single in each ramus, the notopodial very small and its acute tip projecting freely from the end of the acicular process; neuropodial very much stouter, its tip just appearing at the surface ventrad and proximad to the tip of the acicular process.

Notopodial setæ (Pl. XXVIII, fig. 17) forming a whorl, few, short, not reaching to level of tip of neuropodium, about as stout as neuropodials, colorless or pale yellow, scarcely curved, tapered, blunt-pointed, the distal half marked with numerous, fine, close combs, which become longer distally and reach nearly to the tip. As usual the dorsalmost are stouter, shorter and more curved. Neuropodial setæ (Pl. XXVIII, fig. 16) in three supra- and eight subacicular series, colorless, slender and rather long, with the distal enlargement short and strong except on the ventral rows; marked with twelve (dorsalmost) to twenty-two (ventralmost) pairs of pectinated plates which are closely appressed, the longer proximal ones being finely divided, the distal becoming shorter and nearly entire, the last very close to the accessory tooth; smooth tip very short, ending in a short, strongly hooked, claw-like tooth and an almost equally prominent and strong accessory tooth. On II the neuropodials are much smaller and more slender and nearly like the notopodials.

Dorsum olive green, venter gray; prostomium purplish, a dorsolateral area overlooking the anterior eyes pale; tentacular ceratophores brown, the base of the lateral styles also brown; palps and tentacular cirri unpigmented; lips and facial ridge slightly brown or colorless; parapodia uncolored; notocirrostyles with basal half brown, sometimes marked by a white ring, and distal half also white; neurocirrostyles brown with white tip and often a white ring or spot above base.

Stations 4,452 (type), Monterey Bay, Point Pinos Light, 49–50 fathoms, green mud and fine sand; 4,460, same, 55–167 fathoms, green mud, gravel.

Harmothoë triannulata sp. nov. Pl. XXIX, figs. 18–22.

A species of neat and trim appearance, more slender than *H. imbricata*, about as depressed as that species and on the whole resembling it. The four known specimens are all small, the largest being 17 mm. long; the tpye is 12 mm. long; maximum width of body 1.4 mm.;

between tips of parapodia 3 mm. and between tips of setæ 4.8 mm. Number of segments 39.

Prostomium (Pl. XXIX, fig. 18) small, depressed, the frontal slope slight and nearly plain, divided for nearly the entire length by a median dorsal furrow; width slightly exceeding length, greatest in posterior half, anterior to that contracted and narrowed into cephalic peaks, which are prominent, acute and widely divergent and well separated from the median ceratophore; anterior sinus broad and moderately deep (about one-third prostomial length), continued by dorsal furrow nearly to caudal border. Eyes black, conspicuous but not large; the posterior dorsal and touching or nearly touching posterior border of prostomium, their diameter one-eighth or one-ninth of prostomial width; anterior pair on sides of prostomium behind middle, little visible from above, looking laterad and slightly forward, in type but little larger than posterior eyes but on other specimens one-fourth or more larger in diameter.

Median ceratophore (Pl. XXIX, fig. 18) arising in frontal sinus, short and stout, its length not exceeding one-third prostomium and width nearly equal, cask-shaped, scarcely reaching beyond peaks. Style rather stout, not more than twice length of prostomium, basal two-thirds subcylindrical with a very slight subterminal enlargement, nearly the distal third coarsely filamentous; sensory cilia numerous, nearly as long as diameter of style, with slightly bulbous tips. Ceratophores of lateral tentacles short and thick, situated far back so that they are invisible from above, nearly meeting below median tentacle; styles (fig. 18) less than one-half length of median style, subulate, the base somewhat thickened but the distal half very slender and delicate; sensory cilia scattered, much shorter than on median tentacle. Palps (fig. 18) also arising far back, about three to three and one-half times length of prostomium, rather slender, the base less than one-half width of prostomium, gently tapered to near end, then abruptly contracted into a short terminal filament, thickly covered with minute globoid sensory cilia giving to it a brownish coloration. Facial ridge short and narrow.

Peristomial parapodia (Pl. XXIX, fig. 18) achætous, the tentacular cirrophores not quite reaching level of cephalic peaks; styles exactly like that of median tentacle except that they are slightly more slender; the dorsal equal to median tentacle, the ventral slightly shorter but with the filament relatively longer. Mouth with the usual full, pouting lips.

Body rather deep, the segments well differentiated and of remarkably uniform width to near the caudal end where they taper rapidly into the minute pygidium. Neural furrow and lateral ridges little marked but the ventral field as a whole prominent and very smooth; the dorsal surface very little cross-furrowed. Nephridial papillæ begin at VI but are very minute and inconspicuous throughout, often pigmented. Anal cirri similar to notocirri but longer, equal to greatest width of body and parapodia without setæ. Elytrophores small and prominently elevated, with constricted pedicle and circular bearing surface; because of their whiteness in a brown background they are very conspicuous; fifteen pairs with the usual arrangement.

Parapodia (Pl. XXIX, fig. 19) rather short and small, little compressed, their basal depth much less than the depth of the body and their length nowhere exceeding by more than a trifle one-half the width of the segments; posterior parapodia not relatively longer than others. Notopodia little prominent, flattened lobes prolonged into a short, blunt, postsetal, acicular process. Neuropodium much larger but short and abruptly truncated, the nearly square or very broadly rounded postsetal lip merging with the presetal lip at the dorsal margin; the presetal lip prolonged from the dorsal margin into the short, broad, blunt acicular lobe, which bears a minute finger-like cirrus above the projecting end of the aciculum.

Notocirrophore (Pl. XXIX, fig. 19) slightly dorso-caudad of notopodium, short, reaching not quite to base of notopodial acicular process; base swollen, the rest cylindrical and rather strongly curved. Style exactly like median tentacle, scarcely reaching tips of longest setæ and but little beyond median line, longer near caudal end, rather richly provided with sensory cilia with bulbous ends and nearly as long as diameter of style. Neurocirri (fig. 19) with small cirrophore posterior to ventral border proximad of middle of neuropodium; style very regularly subulate, slender, short, not reaching end of postsetal lip at level of aciculum; no sensory cilia. Neurocirrus of II two-thirds as long as ventral tentacular cirrus.

Acicula as usual single, straight, tapering, yellow styles, both projecting freely from the ends of their respective acicular processes. Neuropodial setæ in four supra-acicular and seven or eight subacicular series, nearly colorless, rather stout, nearly equaling notopodials in this respect; the shafts straight and distal enlargements (Pl. XXIX, fig. 21) of moderate length, gently curved and tapered, with from sixteen (ventral) to twenty-two (dorsal) pectinated plates on each side which are deeply and finely divided, becoming prominent and somewhat imbricated toward the distal end, which is smooth for a distance of about one and one-half to twice the diameter of the seta and terminates in a slightly curved point and slender appressed accessory process, which is absent from the ventral row or two. Notopodial setæ moderate in number, short, forming an inconspicuous depressed whorl, short, very pale yellow, little stouter than neuropodials, gently curved, with numerous, and close ($3\frac{1}{4}$ to $3\frac{1}{2}$ in space of diameter of seta), rather conspicuous (especially on dorsal setæ) transverse pectinæ leaving a rather long, blunt, smooth tip not less than the diameter of the seta (Pl. XXIX, fig. 22). Setæ not elongated caudally.

Elytra (Pl. XXIX, fig. 20) completely covering dorsum of all but five or six posterior segments, the first nearly circular, the others broadly elliptical with a slight antero-marginal concavity. Scar antero-lateral of center. Except for a very small naked area at the antero-medial margin the entire surface is studded with small horny cones or blunt, rough tubercles which become somewhat larger latero-caudad where the margin bears a sparse fringe of rather short cilia with slightly bulbous ends, a few short ones of the same kind being scattered over the surface back of the border. Along the margin there is also usually one or a few small soft papillæ like those of *H. imbricata* but usually ovate (though in one specimen they are rod-shaped) and scattered over the entire surface posterior to the scar.

Colors pale and delicate on these specimens, the dorsum generally colorless or white, the median field quite unspotted anteriorly in the proboscidial region but generally with a more or less evident transversely elongated brown spot near the posterior margin of middle and posterior segments. On each side of each segment is a somewhat V-shaped brown spot, the apex of which covers the dorsal tubercles and the anterior face of the elytrophores. On the most pigmented segments two small brown spots may occur at the base of, but not on, the cirrophores. On the exposed caudal segments these several spots tend to merge. Parapodia, elytrophores, notocirrophores, neurocirri, anal cirri and venter uncolored. Prostomium slightly purplish or pink, probably brightly colored in life but not pigmented; eyes black. Styles of median tentacle, tentacular cirri and notocirri white with three pale brown but obvious bands at the base, the proximal and the distal ends of the subterminal enlargement. Lateral tentacles, facial ridge, nephridial papillæ and lips pale brown; palps uncolored or dusky. Elytra delicately blotched with somewhat irregular, confluent pale brown spots on a colorless ground, the median and covered portions and lateral border being free from pigment and the deepest coloration occurring over the point of attachment behind which is a conspicuous small white spot from which the markings somewhat radiate.

Proboscis of one specimen (cotype) protruded nearly 3 mm., width 1.7 mm., cylindroid, depressed slightly, orifice with nine dorsal and nine ventral prominent papillæ. Jaws pale brown, the fangs large and prominent, the ventral biting to right; cutting plates low and curved caudo-laterad.

There are four specimens, two from each station and three of them are filled with nearly mature ova and sperm.

This species is closely related to *H. imbricata* but differs obviously in the much more posterior position of the anterior eyes, which are placed more nearly as in *H. crassicirrata*.

Stations 4,420 (cotype), off San Nicolas Island, 238 fathoms, hard black mud; 4,431 (type and cotype), off Santa Rosa Island, 38–41 fathoms, green mud, coarse sand and rocks.

Harmothoë sp. ?

A small specimen denuded of all cephalic appendages, cirri and elytra. The setæ rather closely resemble those of *Lagisca elizabethi* as figured by McIntosh. It is possible that this may be the species recorded by Treadwell in his paper on Polychæta of Hawaiian waters under the name of *Harmothoë halæita*. According to Treadwell's account his specimens differ consideralby from McIntosh's description.

Station 4,463, Monterey Bay, off Point Pinos Light, 48–111 fathoms, rocky.

Harmothoë hirsuta Johnson.

Harmothoë hirsuta Johnson, Proc. Cal. Acad. Sci., 3d Series, Zoology, Vol. I, pp. 182, 183, figs. 27–29, 38 and 53.

This species, originally described by Johnson from San Pedro, has since been recorded by Ehlers from the coast of Chile, by Treadwell from the vicinity of San Diego and by the writer from Alaska and Puget Sound. Unfortunately the latter record is partly erroneous owing to an apparently mistaken belief that marked changes take place in the character of the scales and setæ during growth. This error is corrected under the heading of *Eunoë barbata* of which species one of the Puget Sound specimens referred to in 1908 under the name of *H. hirsuta* is the type.

The elytra and setæ are quite characteristic and agree closely with Johnson's figures. Some of the marginal polygonal areas bearing the large papillæ may be ill-defined, the spines are often rough, bifid or trifid and the cilia on the posterior are as long as those on the lateral.

margin. Frequently the smooth tips of both notopodial and neuropodial setæ are even longer than indicated by Johnson's figures. The accessory tooth of the latter is best developed on the dorsal rows and frequently absent on the ventralmost two rows. The palpi are slightly angulated by six raised longitudinal lines bearing cilia. One of the most striking superficial characters of this species is the prominence of the notopodial setæ.

Stations 4,420, off San Nicolas Island, 32–33 fathoms, fine gray sand; 4,496, Monterey Bay, off Santa Cruz Light, 10 fathoms, fine gray sand, rocks.

Harmothoë tenebricosa sp. nov. Pl. XXIX, figs. 23–28.

A rather broad and strongly depressed species with long, laterally directed parapodia. The type, like one of the two largest specimens, has 41 segments, is 35 mm. long and at somite X has a width of body of 4 mm., between tips of parapodia of 9.5 mm. and between tips of setæ of 14 mm.

Prostomium (Pl. XXIX, fig. 23) about one-fifth wider than long, strongly arched above, sloping forward from the prominent posterior region; greatest width near posterior end, the sides strongly convex; anterior border depressed in middle, with a wide fissure from which a furrow extends for a short distance caudad; at a distance from the fissure equal to its width the blunt peaks rise rather abruptly and project prominently forward freely above the bases of the palps and lateral tentacles. (One specimen has the peaks retracted and little prominent and another (sta. 4,528) has the prostomium less contracted anteriorly and more quadrate in form.) Eyes totally wanting. Frontal ridge and tubercle very conspicuous, mouth trilobate, surrounded by very prominent protuberant furrowed lips.

Ceratophore of median tentacle (fig. 23) arising from frontal fissure, cylindroid, short, projecting only a little way beyond the peaks; style less than three times length of prostomium, moderately slender with a faintly indicated subterminal enlargement and a rather long, slender subterminal filament. Ceratophores of lateral tentacles at level of palps and partly covered by median tentacle, reaching nearly to end of median ceratophore; styles scarcely longer than prostomium the basal half or more tapered, the rest filamentous. Sensory papillæ absent or nearly so from all cephalic appendages. Palps slender, regularly tapered, from three to five times length of prostomium according to state of contraction or extension in different specimens; filamentous tip very short, no longitudinal ridges or lines of sensory cilia.

Peristomium not distinct, its parapodia (Pl. XXIX, fig. 23) elongated and reaching beyond cephalic peaks, bearing on its medial face two small setæ beyond which the cirrophores diverge slightly; styles of tentacular cirri similar to median tentacle, the dorsal about as long as the latter, the ventral slightly shorter. Metastomial segments depressed, with strongly marked neural furrow and muscular ridges below; segments anterior to XX of nearly uniform width, posterior to that tapering regularly to pygidium which has the usual form but has lost its cirri. Nephridial papillæ begin on VI, when fully developed prominent, subconical, with enlarged base and tubular end directed dorsad between bases of the feet.

Parapodia (Pl. XXIX, fig. 24) very prominent, fully as long as width of segments bearing them on middle of body and exceeding this caudally, in basal part dorsal and ventral borders nearly parallel; rami well differentiated. Neuropodium compressed and expanded into a large, obliquely-ovate, foliaceous, presetal lobe prolonged slightly into a tongue-shaped process and including in its dorsal border the acicular process and aciculum. Notopodium rather prominent, with a constricted base and compressed free setigerous lobe, its ventral part prolonged into a very long, slender, tapered, blunt-ended acicular process which reaches nearly as far as the neuropodial acicular process and bears no terminal cirrus. The foliaceous lobes are largely developed on middle somites but are reduced toward the ends of the body. Posterior parapodia become more slender and elongated.

Notocirrophores (Pl. XXIX, fig. 24) arise almost in contact with the notopodia but slightly caudad and dorsad of them; they are cylindroid with enlarged bases and reach far beyond the notopodial setigerous lobe. Styles slender, elongated, reaching far beyond tips of setæ or well beyond dorsal median line, tapered nearly regularly, with very slight subterminal enlargement, to a long filamentous tip; a very few small clavate sensory cilia scattered throughout their length. Neurocirri with short, well-differentiated cirrophores and rather long, regularly tapered styles reaching to the middle of the foliaceous presetal lobes.

Acicula single in each ramus, stout and brown at base, tapering to slender, colorless tips which project freely, the notopodial from the end of the acicular process, the neuropodial from behind the tip of the presetal lobe. Notopodial setæ (Pl. XXIX, figs. 27, 28) in an irregular, slightly spreading tuft, moderately numerous, pale yellow, rather stout, straight or slightly curved, tapered to blunt points and practically smooth, the pectinations being nearly obsolete. Two setæ of this kind occur on the peristomial parapodium; and on posterior parapodia the number is much reduced. Neuropodial setæ longer and more slender than in *H. cæca* and pale yellow or straw-color instead of deep yellow. They are few in number, only from one to three in each series and on middle somites usually only one or two supra-acicular and six (or five) subacicular setæ or series of two or three setæ. The shafts are nearly or quite as stout as the notopodial setæ and the long distal enlargements (fig. 25) arise gradually and are never strongly developed but are longer than in *E. cæca*. They are only slightly curved and taper gently to rather strongly hooked, acute tips (fig. 26) provided with a prominent, slender and acute accessory tooth which becomes progressively smaller on setæ of the more ventral rows and is often absent on the ventralmost. Transverse pectinations are equally close and numerous and only slightly more marked than in *E. cæca*.

Elytrophores have the same arrangement as in *E. cæca* but are rather smaller and more elevated. They are situated far out on the parapodia. The dorsal tubercles (fig. 24) which alternate with the elytrophores project very prominently and their free ends come nearly into contact with the notocirrohores. Elytra have small areas of attachment and are readily displaced, nearly all of them being loose in the known specimens. They are nearly indistinguishable from those of *E. cæca* but are somewhat more membraneous and delicate. They lack marginal cilia and surface tubercles except for a single triangular area of crowded small ones with its base at the hilum and apex at the scar. The branching nerves radiating excentrically from the scar of attachment are particularly large.

Entire body pale yellow entirely lacking pigment; all cephalic appendages, cirri and elytra quite colorless.

Stations 4,400, north of San Diego, lat. 32°, 50' N., 118°, 03' W., 500–507 fathoms, green mud (type and cotype); 4,528, Monterey Bay, Point Pinos Light, 545–800 fathoms, soft gray mud (cotype).

This species resembles *E. cæca* in general appearance but differs in many respects and especially in the longer and more slender neuropodial setæ with accessory subterminal tooth. It departs in many ways from the more typical species of *Harmothoë*, especially in the structure of the parapodium.

Harmothoë (Evarne) fragilis sp. nov. Pl. XXIX, figs. 29, 30; XXX, figs. 31–33.

In general resembling *Evarne impar* Malmgren, moderately depressed, greatest width far forward tapering regularly but only slightly caudad. Length of type 19 mm.; maximum width (VII or VIII), 3 mm.;

between tips of parapodia about 5 mm., and between tips of setæ, 7.2 mm. Number of segments 37.

Prostomium (Pl. XXIX, fig. 29) as wide or slightly wider than long, depressed, frontal slope moderate, divided by a median dorsal furrow for most of length, the halves smoothly rounded; postocular region somewhat contracted but concealed by a membraneous nuchal fold; greatest width slightly anterior to middle and occupied by prominent ocular swellings anterior to which is a rather abrupt constriction sloping immediately into the peaks. Cephalic peaks usually rather large and prominent, with steep medial slopes and blunt apices separated from the median ceratophore by an interval not exceeding three-fifths diameter of median sinus which reaches nearly to the center of the prostomium and is continued into the dorsal furrow. Eyes two pairs, both large and prominent, black; the posterior one-sixth to one-eighth width of prostomium, facing nearly dorsad at posterior lateral angle, separated from concealed caudal border of prostomium by nearly their diameter and from each other by three to five times their diameter; anterior eyes one-fourth to one-sixth width of prostomium, on sides of ocular swellings anterior to middle and seen from above only through the tissues of the head, separated from posterior eyes by one to one and one-quarter times the diameter of the latter. Some specimens have the eyes even larger and they are always conspicuous although the anterior are little visible from above.

Median ceratophore (Pl. XXIX, fig. 29) about one-half length of prostomium but deeply inserted into sinus and scarcely reaching beyond peaks; style unknown, missing from all specimens. Ceratophores of lateral tentacles cylindroid, fully half as long as median ceratophore but owing to position well back on ventral face of prostomium they are usually completely concealed in dorsal view by the cephalic peaks; styles nearly three-fourths length of prostomium, subulate, the distal one-third slender; sensory cilia elongated and enlarged. Palps about three to three and one-half times prostomial length, rather stout at base, where their diameter nearly equals one-half width of prostomium, smooth or often annulated, tapered to a short terminal filament and bearing a few lines of very small globoid sensory cilia. Facial ridge moderately prominent, reaching into mouth, which is surrounded by the usual prominent trifid lips.

Peristomium obsolete above, its rather small parapodia bearing a small tuft of notopodial setæ and its cirrophores not quite reaching level of prostomial peaks, largely concealed by notopodial setæ of II which spread over them; styles (Pl. XXIX, fig. 29) unusually slender, elongated subulate with filamentous ends, without subterminal enlargement and bearing filamentous sensory cilia with rounded ends and as long as one-half diameter of style; the dorsal twice, the ventral one and three-fifth times length of prostomium. Metastomial segments separated by only obscure furrows; the dorsum little convex and with scarcely noticeable transverse ridges; elytrophores and dorsal tubercles both low and inconspicuous. Venter very smooth; neural furrow and lateral muscular ridges little developed except toward caudal end. Nephridial papillæ begin at VI, arising from well-marked, rounded swellings at posterior base of parapodia, all small and directed dorsad into interpodal clefts. Pygidium minute with dorsal anus directed dorso-caudad and surrounded by a finely crenulated border. Anal cirri missing from all specimens but judging from the size of their scars of large size.

Parapodia (Pl. XXX, fig. 31) short, less than one-half width of segments at anterior end and middle of type, longer toward caudal end and throughout the length of some specimens but never prominent, compressed, fully as deep as long, dorsal slope very steep, rami well differentiated, not greatly unequal in size. Neuropodium rather slender, divided distally into a short, broad, truncate postsetal lobe and a much longer, slender, compressed presetal lobe tapering to a blunt end and including the acicular process which terminates in a slender cirrus about two-thirds as long as the process. Notopodium relatively large, nearly as broad as setigerous portion of neuropodium which it overlaps broadly from behind, bearing a long, slender, tapered blunt, acicular process lacking a cirrus and reaching nearly to the end of the neuropodial acicular process without its cirrus. Some specimens have the parapodia studded with small spherical bodies filled with a mass resembling spores which project from the surface and which are probably parasitic in nature.

Notocirrophores (Pl. XXX, fig. 31) situated close to the notopodia and partly concealed behind their setæ, subconical with swollen base reaching tip of notopodial acicular process; styles long and slender like tentacular cirri, regularly tapered without subterminal enlargement, bearing sparsely distributed slender cilia with globoid ends, many of them as long as diameter of style, reaching about two-fifths of length beyond tips of longest neuropodial setæ and to elytrophores of opposite side. Neurocirri (fig. 31) arising behind middle of ventral face of parapodia by a small cirrophore; styles subulate, slender, reaching to base of acicular process or beyond, entirely lacking sensory cilia or with a very few minute ovate ones. Neurocirrus of II more than twice length of others.

Acicula of the usual form, pale yellow, the acute ends projecting freely. All setæ pale yellow, all rather short and little spreading, becoming very little longer caudad. Notosetæ in a single ranked whorl, this arrangement obscured by their being depressed. The shortest and most curved are antero-medial and they increase in size and become straighter laterad, caudad, mediad and back nearly to starting point. They are much stouter than the neurosetæ, many being two and one-half to three times the diameter of the latter, more or less curved and tapering to blunt tips (Pl. XXX, fig. 33); pectinations extending over more than one-half of exposed portion, rather prominent, very regular, two to two and one-half rows in distance of greatest diameter, continuing nearly to tip leaving only a very short and blunt point which is smooth or more or less scupltured or even tufted. Neurosetæ in vertical fan-shaped tufts directed nearly laterad. They are numerous and crowded and appear to be in four or five supra-acicular and eight or nine subacicular series. Nearly colorless with long, slender, very slightly curved shafts; the distal enlargements (Pl. XXIX, fig. 30) rather prominent and long, gracefully curved and tapered; the pectinated appendages rather long and in face-views conspicuous, finely and deeply divided, rather widely spaced, and not numerous, from sixteen in ventral to twenty-three in dorsal series, the proximal ones small; smooth ends long, often three to four times diameter of seta, with rather strongly hooked tips below which on all except the ventralmost is a very slender, acute accessory process reaching nearly to the main tooth.

Elytra fifteen pairs having the usual arrangement. Very little is known of them, few remaining with the specimens. So far as known they are rather small and probably leave a portion of the dorsum uncovered. The first is circular, the next two very deeply reniform or broadly lunate (Pl. XXX, fig. 32), the others ovate reniform with a small and very excentric area of attachment. All known are soft and semi-gelatinous or gelatino-membraneous in texture and the dorsal surface is thickly studded with small conical or truncate roughened spines or horny tubercles among which a few longer cilia are scattered. Rather long cilia form a somewhat dense fringe along the lateral margin. In addition each elytron bears along the posterior margin, beyond which they project freely, several (4–7) large, recumbent, inflated, ovate, deep brown, soft papillæ which are usually very conspicuous and give to the elytron a very irregular outline.

Entire middle field of dorsum between elytrophores deep chocolate brown, rarely paler brown, each segment marked by two delicate transverse white lines which converge and meet on each side at the dorsal tubercle or elytrophore. Parapodia, elytrophores, notocirri, neurocirri, prostomium, palps, tentacular cirri, median ceratophore and under parts unpigmented or (as preserved) white. Facial ridge, paired lips and lateral ceratophores pale brown. Elytra translucent, pale brown, the large papillæ chocolate. The deep solid pigmentation of the dorsum is very characteristic of this species among California Polynoidæ and very few examples fail to exhibit it.

One small example has the proboscis protruded, 2.8 mm. long, about 1 mm. in diameter, subcylindrical, depressed at the orifice which is surrounded by nine dorsal and nine ventral papillæ. Jaws deep brown, of the usual form, the fangs small, the cutting plates broad and directed laterad.

This species differs from *Evarne sexdentata* Marenzeller especially in the character of the elytral papillation, the horny papillæ in the latter being pointed and often bifid, the soft papillæ much smaller. The setæ differ but slightly.

Although represented in the collection by a considerable number of specimens this species is so fragile that not a single perfect example is known. The type is one of two that have all segments and both of these lack elytra and most of the cirri, etc. Not a single one possesses the median tentacle or anal cirri and only eight elytra in all are known. Most of the specimens are anterior ends of fifteen to twenty segments without elytra or cirriform appendages. Another source of imperfection is the frequency with which the parapodia are cast off, some specimens being completely denuded for a considerable distance. There is some variation in the length and sculpturing of the tips of the notopodial setæ and in the length of the cephalic peaks due to varying states of contraction. The only specimen containing nearly mature ova was taken at station 4,418. Two specimens were taken at stations 4,413 and 4,423; only one at each of the others.

Stations 4,351, Point Loma Light, vicinity of San Diego, 423–488, soft green mud; 4,400, lat. 32° 50' N., long. 118° 03' W., 500–507 fathoms, green mud; 4,402, off San Clemente Island, 542–599 fathoms, green mud (cotype); 4,407, off Santa Catalina Island, 334–600 fathoms, gray sand and rocks; 4,413, off Santa Catalina Island, 152–162 fathoms, fine sand (type and cotype); 4,418, off Santa Barbara Island, 238–310 fathoms, dark mud and sand (cotype); 4,421, off San Nicolas Island, 291–298 fathoms, gray mud and rock; 4,423, same, 216–339 fathoms, gray sand, black pebbles and shells; 4,430, off Santa Barbara Island, 197–281 fathoms, black sand, pebbles and rocks; 4,436, off San Miguel Island, 264–271 fathoms, green mud.

Harmothoë (Evarne) forcipata v. Marenzeller.

Evarne focipata, v. Marenzeller, Denksch. kaiserl. Akad. Wiss. Wien, Math.-Nat. Cl., Bd. LXXII, p. 573, Taf. II, fig. 7.

The type of this species, taken off Eno-sima, Japan, at a depth of 200–480 meters, is only 12 mm. long. A similar specimen taken by the Albatross at station 3,707 in Suruga Bay, Japan, in 1900 is in the collection of this Academy.

Much larger specimens, three 15 mm. long, one 27 mm. long and one 36 mm. long, occur in the present collection. The neuropodial setæ are of very characteristic form and agree exactly with v. Marenzeller's figures; those of the ventralmost series, however, are much smaller, very delicate, smooth and have simple acute tips. There are two or three rather large setæ on the peristonial parapodia. The cephalic peaks are very prominent and the anterior eyes nearly twice as large as the posterior. On the first pair of scales the entire surface is thickly studded with small conical points, on the others they are confined to a broad curved marginal band projecting beyond the center of the scale. Notocirri have rather fewer cilia than figured by Marenzeller. Nephridial papillæ begin on VI and are directed upward between the parapodia.

Stations 4,401, south of San Clemente Island, lat. 32° 52' N., long. 118° 13' W., 448–468 fathoms, green mud, sand and rocks; 4,427, off Santa Cruz Island, 447–510 fathoms, black mud, rocks; 4,429, same, 506–580 fathoms, green mud.

Antinoë macrolepida Moore.

Antinoë macrolepida Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 538–541, Pl. XXV, figs. 21–23.

The anterior end of a single specimen with the pectination of the notopodial setæ even finer than usual but quite typical in every other respect. When intact in the parapodia the distal halves of the neuropodial fascicles of setæ have a distinct orange color.

Station 4,523, Monterey Bay, Point Pinos Light, 75–108 fathoms, soft dark mud.

Antinoë anoculata sp. nov. Pl. XXX, figs. 34–40.

A fragile species which reaches a larger size than the average in this family. All of the three specimens lack the caudal end, the type being most complete. Form much depressed, with long parapodia and the body strongly tapered from near the cephalic end. The type measures 36 mm. long; width at X, of body only 4 mm., between tips of parapodia 11 mm., between tips of setæ 14.3 mm.

Prostomium (Pl. XXX, fig. 34) slightly longer than wide, the widest region little more than one-third from the posterior end where the sides swell out abruptly and prominently; from this point the sides are nearly straight and converge rapidly to the anterior lobes which are small and separated by a wide fissure occupied by the base of the median tentacular ceratophore; cephalic peaks minute, well separated from the median ceratophore and well above and free from the lateral tentacles. Dorsum of prostomium very smooth, prominently elevated posteriorly and sloping regularly to the peaks; median furrow very slightly developed and no trace whatever of pigmented eyes.

Median tentacle (Pl. XXX, fig. 34) with large ceratophore nearly or quite one-half the length of the prostomium and rapidly tapered from the broad base which is inserted for only a short distance into the prostomium and united to its anterior lobes. Style slender, delicate, flagelliform and regularly tapered to the end; scarcely twice length of prostomium. Lateral tentacles arising from small, slightly tumid ceratophores beneath peaks and at a level lower than the median ceratophore; the styles small, about as long as median ceratophore, subulate, tapering to slender tips. Palps slender and elongated, nearly twice median tentacle, regularly tapered, smooth, terete, longitudinally striated and terminated by a minute filament. Facial ridge prominent, reaching to trifid mouth which is bounded by rugous lips. All cephalic appendages thickly clothed with minute sensory cilia which on the palpi are scarcely elevated above the surface.

Peristomium obsolete except laterally where it is crowded far forward in the form of parapodia bearing the tentacular cirrophores, which reach the level of the prostomial peaks, and a small achætous acicular lobe. Styles of tentacular cirri resembling median tentacle, smooth, slender, tapered, and lacking subterminal enlargements, the dorsal about equalling, the ventral three-fourths as long as the median tentacle. Body rather narrow and depressed, regularly tapered from near the anterior end; below with prominent lateral muscular ridges bounding a furrow in which is a prominent neural ridge. On the dorsum each segment is marked with deep transverse depressions. Nephridial papillæ begin on VI, arising from the sides of small elevations in the usual position; they soon become long tubes curved upward and backward into the interpodal furrows. Pygidium unknown.

Parapodia (Pl. XXX, fig. 35) very prominent, on anterior segments quite equal to width of body, posteriorly still longer, projecting strictly laterad, the base broad and compressed, the rami well-differentiated. Notopodia rather prominent projections from the strongly sloping face of the parapodia, convex dorsally, its ventral border prolonged into a slender, tapered, acicular process from the extreme end of which the tip of the single stout aciculum projects. Neuropodia very large, sloping from both dorsal and ventral borders to a blunt tip from which projects a blunt, stout acicular process bearing a finger-like terminal cirrus beneath which the tip of the aciculum appears.

Notocirrophores arise immediately above and behind notopodia; they are unusually long and slender and nearly equal the length of the notopodium with its acicular process (fig. 35); styles also long and slender, reaching beyond mid-dorsal line and fully one-third of their length beyond tips of longest neuropodial setæ, regularly tapered to slender tips without subterminal enlargements and bearing a few very short clavate sensory papillæ. Neurocirri very small, arising near middle of ventral face of parapodium and scarcely reaching to ventralmost row of neuropodial setæ, slender, tapered, subulate and quite smooth. On somite II the rami are nearly equal and the neurocirrus reaches nearly to the setæ tips.

Elytrophores low and inconspicuous, borne on somites II, IV, V, VII and alternate segments to XXIII, XXVI, XXIX = 14, a fifteenth on XXXII being probably normal. Dorsal tubercles, which alternate with elytrophores, small but rising prominently above the level of the dorsum, especially on anterior segments. Elytra very readily detached, large and completely covering dorsum, except the first, which is circular with central attachment, the others broadly ovate-reniform with oval scar antero-mediad of center (Pl. XXX, fig. 36). Texture soft and membranous; to the naked eye surface appears smooth and lacking cilia; under the microscope they exhibit an area of minute tubercles between the scar and the anterior border, a slightly granular surface elsewhere and a few minute cilia along the margin. The nerves, branching and radiating from the scar, are conspicuous through the translucent tissues. Many of the elytra are covered with a greenish-yellow incrustation with oblique parallel streaking.

Acicula single, deep yellow, of the usual stout, tapered form with simple tips. Setæ all pale straw-colored, long, forming prominent tufts. Notopodials much stouter than neuropodials, the fascicles forming whorled tufts directed more laterad than dorsad; the setæ (Pl. XXX, figs. 39, 40) very slightly curved, tapered to blunt-pointed, smooth tips below which are very numerous close rows of teeth so fine that they can be differentiated only under high magnification. Somite I (peristomium) possesses two short setæ of this type projecting from below the tip of the aciculum. Neuropodial setæ (Pl. XXX, figs. 37 and 38) more numerous, arranged in three supra-acicular and six or seven subacicular series. All much longer than the notopodials but averaging only about one-third their diameter; the shafts long and distal enlargements inconspicuous, slightly curved and tapered to long, prominent but not especially slender smooth tips, below which are narrow pectinations which become longer and more prominent distad. Setæ of the two dorsal rows (fig. 37^a) are especially slender, with the little enlarged pectinated regions taking up about half of the exposed portion and bearing thirty-five or more pairs of pectinæ. Those of middle rows (fig. 37^b) are stouter and bear about thirty pairs of pectinæ of which the basal ones are mere striations, the smooth tips being especially elongated. Setæ of the ventralmost row (fig. 37^c) have much shorter distal regions with fewer pectinæ and very acute tips. Posteriorly all setæ become longer and more slender.

Except for a slight duskiness in places pigment appears to be wanting but the cuticle exhibits a purplish iridescence.

In the character of its setæ this species departs somewhat from the typical condition and approaches *Eunoë*.

Stations 4,381, off North Coronado Island, vicinity of San Diego, 618–667 fathoms, green mud; 4,517, Monterey Bay, off Point Pinos Light, 750–766 fathoms, green mud and sand (type and cotype).

Gattyana senta Moore.

Gattyana senta Moore, Proc. Acad. Nat. Sci. Phila., 1902, pp. 259–263, Pl. XIII, figs. 1–13.

One specimen occurs in the collection from each of four stations and two from a fifth. Most of the very characteristic and remarkably protected elytra are in place; often they are blotched with brown; the marginal spines of posterior elytra have extremely long acute prongs. As Treadwell states the nephridial papillæ begin on VI but the anterior ones are very small.

A medium-sized example has the proboscis protruded. It measures 4.5 mm. long, 3.6 mm. deep at the middle and 2.4 mm. wide at the end, being truncate subfusiform in shape, compressed at the base, depressed at the aperture; Apertural papillæ nine above and nine below, rather long, blunt at the end. Jaws pale brown, of the usual form, with fang and cutting plate, the ventral somewhat larger and biting to right of upper.

Stations 4,361, Point Loma Light, vicinity of San Diego, 91–97 fathoms, gray sand, mud and rock; 4,377, same, 127–299 fathoms, green mud and sand; 4,420, off San Nicolas Island, 32–33 fathoms, fine gray sand; 4,463, Monterey Bay, off Point Pinos Light, 48–111 fathoms, rocky; 4,532, same, 30 fathoms, gray sand and rocks.

Nemidia microlepida sp. nov. Pl. XXX, figs. 42–44; Pl. XXXI, figs. 45, 46.

The single specimen known fortunately retains the full number of segments and is a long, slender, depressed worm of very even width. Number of segments 85; length 58 mm.; width at X, body only 2.5 mm., spread of parapodia 7.2 mm.; at L, body 2 mm., spread of parapodia 6.8 mm.; greatest depth about 2 mm.

Prostomium (Pl. XXX, fig. 42) small, slightly wider than long, greatest width a little behind the middle where the sides project prominently; anterior to this point the sides are straight and converge strongly to the minute peaks which lie very close to but free from the median ceratophore; anterior fissure rather deep but completely filled by the median ceratophore which is soldered to the prostomial lobes, not more than its distal third being free. Eyes wanting. Median tentacle stout and swollen in the middle, completely filling cephalic sinus and coalesced with the prostomium, on the dorsum of which it rises as a ridge, the distal third free. Style short, about one and one-third times length of prostomium, rather slender, the distal one-third tapering to a short filament. Lateral tentacles (fig. 42) arising from short, thick ceratophores which are united in the median line below the median ceratophore, at the sides of which they are largely exposed; styles short, rather stout and subulate, tapering to very short terminal filaments, their length one-half or less of median style. Palps (fig. 42) imperfect from sloughing of their ends, rather short, little exceeding twice head, thick, little tapered till near end, terete and perfectly smooth, without sensory cilia.

Peristomial parapodia (Pl. XXX, fig. 42) short and thick, diverging above base of palps, supported by a single stout aciculum, the tip of which appears in a dorso-median position; apparently achætous; cirrophores united nearly to their ends; styles like median tentacle and the dorsal of equal length, the ventral slightly shorter, both rather stout, tapered to a short terminal filament and lacking sensory cilia.

Body narrow, at widest part only one-third of width between ends of parapodia and posteriorly, where the parapodia are longer, much less than that; tapering very gently and regularly caudad. Segments well defined, each bearing on the dorsum two prominent, blunt, median papillæ in tandem, all together forming a series which becomes higher and more crowded posteriorly, finally constituting an almost continuous serrated crest. On the ventral side the usual neural furrow is bounded by low, smooth, lateral muscular ridges. Nephridial papillæ begin on VI in the usual position and soon become prominent, strongly clavate, appendages having a length about one-half the diameter of the foot and projecting freely ventro-latero-caudad. Pygidium a short tube bearing a pair of cirri about as long as the median tentacle but much more slender.

Parapodia (Pl. XXX, fig. 43) long, directed strictly laterad and enhancing the appearance of depression; posteriorly they are relatively long so that the extreme width remains nearly uniform. Typical parapodia are scarcely compressed, subconical in form, with the end obliquely truncate. Rami very unequal, the notopodium a scarcely differentiated process about halfway between the notocirrus and tip of the neuropodium consisting chiefly of a rather short subconical acicular process. Neuropodium large, little tapered, its obliquely beveled end slightly compressed and divided into a low presetal lip, slightly prolonged into a short acicular process surmounted by a short, somewhat flattened supra-acicular cirrus, and an equally low post-setal lip. On the first two parapodia the neuropodium is shorter and the notopodium larger; at the caudal end this condition is reversed, the neuropodium becoming very long and slender.

Notocirrus (Pl. XXX, fig. 43) arising from behind base of parapodium far mediad of notopodium, its cirrophore short and stout, directed nearly laterad, style moderately slender with the distal half tapering to a terminal filament which reaches barely beyond the end of the neuropodium and not nearly to the middle line; it bears a few scattered, short, clavate sensory cilia. Neurocirrus arising from a very low cirrophore on ventral side of foot halfway between nephridial papilla and ventral border of neuropodial setæ bundle but is so short that its tip fails to reach either; basal half thickened, tapered to a filamentous distal third, bearing a few cilia like those on the notocirrus.

Acicula of the usual character, the neuropodial especially stout and the blunt tips of both projecting slightly. Setæ very imperfectly known, all except those on a few segments at the ends of the body being broken off flush with the surface. Most of those remaining, like the exposed tips of the acicula are encrusted with a reddish deposit. The description necessarily refers to setæ at the ends of the body, those of the middle segments being probably shorter and stouter. Notopodials a small tuft, colorless, very slender and capillary with close fine serrations for nearly entire length. Neuropodials (Pl. XXXI, figs. 45 and 46) in moderate number, forming an obliquely vertical fascicle not arranged in the usual horizontal series, colorless, all delicate; when complete the distal thickening tapers into a long tenuous tip armed with conspicuous pectinations. Very few setæ possess this tip, being broken off just beyond the thickening as shown in figure 46 but it is probable that the filament is normally present in all.

Elytrophores on II, IV, V, VII, IX, XI, XIII, XV, XVII, XIX, XXI, XXIII, XXVI, XXIX and XXXII = 15. All other metastomial somites bear notocirri and dorsal tubercles. Elytrophores are situated close to the posterior border of the base of the parapodia and slightly mediad of the alternating notocirrophores. They are very small and little elevated with depressed circular centers. Dorsal tubercles are scarcely noticeable on anterior segments but rather better developed behind the elytrophores region.

Elytra (Pl. XXX, fig. 44) rather firmly attached but so small that they were at first overlooked altogether. They about equal the antero-posterior diameter of the parapodia and because of their posterior position slightly overlap the following foot and leave the anterior portion of the one to which they are attached uncovered. The lateral border reaches the lateral side of the notocirrus and the mediad border falls far short of the base of the parapodium, the body being of course, entirely uncovered. They are not in the slightest degree imbricated but are separated by a space equal to at least one-half their own diameter. All are rather thick, firm and leathery, circular or nearly so with the circular or elliptical scar close to the anterior border; the cuticle thick and smooth, without trace of surface or marginal cilia or papillæ; the interior finely granular and opake.

Extended proboscis 4.5 mm. long, 3.5 mm. wide at end; stout, terete at base, somewhat depressed at end; seven blunt bifid papillæ above and seven below, the lateral pairs of most polynoids wanting. Jaws rather thin, the median sutures obliterated, forming above and below an entire transverse plate of a gray color thickened near middle line by a pair of brown ridges that rise into very small points corresponding to the fangs of other polynoids.

No color or pigmentation.

Station 4,522, Monterey Bay, off Point Pinos Light, 149–130 fathoms, gray sand and shells (type only).

Next follow the descriptions of four very imperfectly known blind species described from very imperfect material. They are not very closely related but owing to my doubts regarding their generic designation and my hesitation to establish any new genera that more complete knowledge may show to be superfluous all are here provisionally placed in the genus *Polynoë*.

Polynoë(?) remigata sp. nov. Pl. XXXI, figs. 47–51.

Described from a single incomplete and mutilated specimen having 18 setigerous segments and measuring 17 mm. long, with a maximum body width of about 3 mm. and a width between setæ tips of about 10 mm.

Prostomium (Pl. XXXI, fig. 47) about one-third wider than long, consisting of two broadly pyriform smooth lobes with broad spheroidal ends caudad, the anterior ends narrower but rounded, without distinct peaks. Anterior fissure deep, reaching to middle of prostomium and continued to its posterior border by a narrow furrow. Pigmented eyes totally absent. Median cerataphore arises near middle of head and occupies anterior fissure, moderately stout and cylindroid; style missing. A pair of small swellings below the anterior ends of the cephalic lobes probably represent the bases of the lateral tentacles, the rest of which is missing. Palps both present but the left only perfect, rather small, their basal diameter not exceeding one-third of the width and their length two and one-half times the length of the prostomium, smooth, tapered, with no sensory cilia and no distinct terminal filament.

Peristomium a short but quite distinct ring united to the median furrow of the prostomium by a slight median fold. Its parapodia (Pl. XXXI, fig. 47) fail to reach anterior border of the prostomium, its ceratophores distinct distally. All styles except the left peristomial notocirrus, which has grown fast to the base of the palpus, lost. It (fig. 47) is slightly longer than the palpus, has a slight subterminal enlargement and a short but pronounced terminal filament and lacks sensory cilia.

Few parapodia are perfect. In the middle region (Pl. XXXI, fig. 48) they are little longer than the width of their segments, compressed at the base, the rami well differentiated. Neuropodium elongated, with nearly parallel borders terminated by a short, slightly convex postsetal lip and a pointed presetal lip which is prolonged into a slender, spine-like acicular process nearly the length of the free neuropodium and bearing a short terminal cirrus. Notopodium rather large, more than half as long and half as deep as the neuropodium, truncated conical; the ventral border prolonged into a straight, stiff, slender, blunt-ended acicular process more than one-half the length of that of the neuropodium. All notocirri and neurocirri lost; notocirrophores (fig. 48) very large (probably swollen in preservation), well separated from notopodium. All elytra missing; elytrophores borne on base of feet of somites II, IV, V, VII, IX, XI, XIII, XV and

XVII, high and prominent. Dorsal tubercles rather long and slender. Nephridial papillæ thick and very short.

Acicula rather slender, of usual form. Notopodial setæ very few, usually three to six very closely appressed to acicular process, pale yellow, slightly stouter than neuropodials, straight, blunt and with the transverse lines of teeth extremely close, fine and numerous, appearing under 500 diameters as scarcely discernible transverse lines (Pl. XXXI, fig. 49). Neuropodials (figs. 50 and 51) numerous, forming dense rather long brushes, colorless and delicate, the ends flattened but not much expanded, the marginal serrations very fine and the point rather acute. Colorless.

Station 4,407, off Santa Catalina Island, 334–600 fathoms, gray sand and rocks (type only).

Polynoë(?) flamentosa sp. nov. Pl. XXXI, figs. 52–56.

Known from a single imperfect and incomplete specimen consisting of 24 setigerous segments, 17 mm. long, the body 2.5 mm. wide and the width between seta tips 8.5 mm. Found with *P. remigata* and somewhat resembling that species but with the body more slender and the setæ quite different.

Prostomium unknown, being much macerated and torn and all cephalic appendages lost. No elytra are in place; elytrophores rather small and elevated, farther out on parapodia than on *P. remigata;* borne on the usual somites on the anterior region of the body. Dorsal tubercles very long and slender, especially on posterior segments on which they reach nearly to the ends of the notocirrophores. Nephridial tubercles very short and rather thick and truncated.

Parapodia (Pl. XXXI, fig. 52) closely similar to those of *P. remigata*, the notopodium not so well separated, more conical and tapered and the acicular process stouter at the base and also more tapered. Notocirrophores arise above base of notopodium and are much smaller than in *P. remigata*. A single style remaining on somite XVIII is remarkable for its great length and tenuity, which may be enhanced by abnormal stretching. It is more than one-half the entire length of the worm or twice the total width of body and parapodia, flagelliform without subterminal enlargement or sensory cilia. Neurocirri (fig. 52) arise halfway between nephridial papillæ and end of ventral border of neuropodium to which they reach; they are slender and uniformly tapered.

Notopodial setæ moderately numerous, forming somewhat prominent radiating bundles. They are colorless, rather coarse (Pl. XXXI, fig. 54) nearly straight, tapering to acute points (fig. 53) and bear rather conspicuous half-round ensheathing plates with entire or nearly entire margins along one side. Neuropodial setæ (fig. 55) are very numerous and form dense brush-like bundles as in *P. remigata* but the setæ are considerably stouter than the notopodials, with broad, paddle-like distal expansions (fig. 56) having simple marginal serrations which become rather coarse toward the subacute tip.

The only pigment is a little of reddish brown color on the elytrophores. Station 4,407, off Santa Catalina Island, 334–600 fathoms, gray sand and rocks (type only).

Polynoë(?) aciculata sp. nov. Pl. XXXI, figs. 57 and 58.

A single very imperfect specimen, with 18 setigerous segments and measuring 9 mm. long and 7 mm. between the setæ tips, represents this species.

Prostomium distorted, much contracted and bent dorsad by the protruded proboscis. It is about twice as wide as long and deeply divided by a median fissure into a pair of anteriorly divergent, rounded lobes from between which a small cylindrical median ceratophore, from which the style has been lost, arises. The lateral tentacles and palps also are missing and there is no trace of pigmented eyes. A single ventral tentacular cirrus remains and is a slender, tapered style without subterminal thickening and about twice as long as the width of the prostomium.

The body is slightly depressed and somewhat fusiform, the segments well defined and rather longer than usual, most of them being nearly half as long as wide. Elytrophores on II, IV, V, and alternate segments to XVII, small, low, at base of parapodia and widely separated from notopodial ramus. Dorsal tubercles very small slightly hooked laterally, situated in line with elytrophores. Nephridial papillæ not obvious.

Parapodia largely lost or injured and those remaining evidently considerably retracted (Pl. XXXI, fig. 57). Their length does not exceed the width of the segments and they are strongly compressed and about as deep as long, the rami very unequal. Neuropodium with steep dorsal border and truncate end, the presetal lip of which is produced into a long, stiff, acute, spine-like acicular process which appears to lack a terminal cirrus. Notopodium a contracted achætous subconical tubercle prolonged into an acicular process similar to that on the neuropodium and nearly as long, usually slightly curved.

Notocirrophores (fig. 57) arising in contact with the notopodial tubercle far out or parapodium, prominent and rather long; notocirrostyles flagelliform, smooth, reaching beyond the tips of the longest setæ, only a few in place. No neurocirri remaining.

Both acicula are rather stout, the distal ends being less attenuated than usual and apparently not perforating the integument of their processes; they are longitudinally striated throughout. No trace of notopodial setæ can be detected. Neuropodial setæ are numerous and form a dense silvery white, flat brush not divided into horizontal series and nearly twice as long as the foot. They are straight, delicate and colorless with slender shafts and thin expanded distal ends tapered to blunt points. The margins are serrated with short, appressed teeth which are rather course on dorsal setæ (Pl. XXXI, fig. 58), very fine on those in the ventral part of the bundle.

Proboscis clavate, strongly depressed distally, 4 mm. long, 2.2 mm. broad and 1.3 mm. deep at distal end. Orifical papillæ rather small, nine above and nine below in close series. Jaws deep brown, hard; the fangs prominent; the cutting plates rather small and directed transversely, the ventral biting inside dorsal.

The specimen is of a nearly uniform pea-green color quite probably the result of staining.

Station 4,352, off Point Loma Light, vicinity of San Diego, 549–585 fathoms, green mud (type only).

Polynoë(?) renotubulata sp. nov. Pl. XXXI, figs. 59–64.

Known from the type only—a much mutilated specimen consisting of 35 somites which measure 26 mm. long, with a width of body just behind middle of piece of 3.6 mm., between ends of parapodia of 13 mm. and between tips of setæ of 22 mm.

Prostomium (Pl. XXXI, fig. 59) shaped much like that of *Polynoë longipedata* McIntosh but shorter, the length being about two-thirds width, without the lateral ceratophores subrectangular; posterior region constricted to form a sort of pedicle, anterior to which the prostomium abruptly expands into a pair of opake hemispherical prominences forming its widest part and corresponding to the ocular lobes, within which the opake white bodies are probably modified eyes lacking every trace of pigment. Anterior to these lobes the prostomium is more translucent and tapers slightly into the lateral ceratophores and anterior margin. There is no anterior sinus, dorsal furrow or cephalic peaks. Median ceratophore arising on dorsal surface posterior to middle, short, thick, its diameter more than one-third width of prostomium; its free ends with a deep rim deficient anteriorly and projecting at the sides as rounded lobes possibly corresponding to the tentacular scales referred to by McIntosh in his description of *P. longipedata*. Ceratophores of lateral tentacles cylindrical, continuous with the sides of the cephalic face of the prostomium and separated by about their own diameter or more, their length about one-fourth of prostomium, projecting straight forward; styles three times length of prostomium without ceratophores. Palps very large, stout at base where they very nearly equal width of prostomium, length about six times prostomium, tapered to rather blunt tips lacking a terminal filament; surface smooth and without raised lines or sensory cilia.

Peristomium little developed, concealed largely by prostomium, its parapodia with large ceratophores and apparently achætous. Styles of tentacular cirri long, slender, and regularly tapered, the dorsal as long as the palps, the ventral slightly shorter (Pl. XXXI, fig. 59). Body generally subfusiform. Anterior segments narrow, those following widening to middle of piece and decidedly depressed (partly the result of injury), then tapering again to caudal end which terminates in a small pygidium with dorsal anus from which the cirri have been lost. Segments fairly well differentiated, smooth dorsally, the venter with neural furrow and prominent neural ridge. Nephridial papillæ (Pl. XXXI, fig. 60) very remarkable. They begin on VI, arising in the usual position at the posterior base of the foot and directed dorsad into the interpodal cleft. At first they are delicate and not longer than the diameter of the foot but they rapidly increase in length until at XIV they reach the end of the neuropodium and on following segments extend considerably beyond it as far as the tip of its long acicular process. They are very slender, tapering at the base and filiform for most of their length. Posteriorly they become again shorter. Just how these long papillæ are disposed in the living worm is uncertain but several occupy the position shown by the dotted lines in the figure, passing between the parapodia and in a groove along the posterior face of the one to which they belong to end at the base of the fascicle of neuropodial setæ. Probably this is the normal position but a larger number and especially some longer than the one figured rise, as shown by the solid lines, like dorsal cirri above the parapodia and back. Elytrophores and dorsal tubercles of moderate size but most of them abnormally inflated, precluding an accurate description; the former situated on II, IV, V and alternate segments to XXIII, then on XXVI and XXVIII = 14. Owing to the mutilation of the specimen this distribution cannot be affirmed with entire certainty and it is probable that a fifteenth pair of small ones may exist on the reduced segments at the caudal end.

Parapodia (Pl. XXXI, fig. 60) remarkably elongated; many have been torn away or injured but a sufficient number remains to make evident their noteworthy features. They are much longer than the width of the segments to which they are attached, are compressed at the base and tapered into the neuropodium which is slender with nearly parallel dorsal and ventral borders, slightly compressed and subtruncate distally, the presetal lip longer and somewhat pointed and prolonged into a delicate, acicular process fully half as long as the ventral border of the parapodium and tipped with a short, blunt cirrus overhanging the projecting point of the aciculum. Notopodium scarcely separated from neuropodium, its basal part a small, slightly inflated cone bearing a small tuft of delicate capillary setæ and prolonged into a delicate, slightly curved, almost fiber-like acicular process as long as that of the neuropodium. Above and proximad of the neuropodium is a small notocirrophore and slightly further proximad the slightly developed connate dorsal tubercle alternating with the larger elytrophores.

All notocirrostyles are lost but the appearance of the cirrophores indicates that they are quite small and perhaps rudimentary and it may be that the nephridial papillæ assume some of their functions. Neurocirri (Pl. XXXI, fig. 60) arise from slight cirrophores proximad of the middle of ventral border of parapodia, somewhat inflated (perhaps abnormally) at the base and tapered to delicate tips which reach the base of the nephridial papilla but fall considerably short of the ends of the neuropodia. Anteriorly they are relatively larger and the large cirrophore of II indicates that the lost style is of large size.

Acicula single in each ramus, yellow tinted, much prolonged into delicate, fragile ends which reach to the ends of the acicular processes enveloped in a thin integument beyond which the tip of the neuropodial alone projects. Notopodial setæ a small tuft of very delicate, smooth and long fibers. Neuropodials (Pl. XXXI, figs. 62–64) form a long and dense, flattened, brush-like fascicle projecting conspicuously laterad and slightly dorsad. They are nearly colorless, vitreous and have a fine satiny luster. The shafts are long and delicate, the distal expansions relatively short but very broad and oar-like, gradually widening to near the end and then rather abruptly tapered to a bifid tip (fig. 63); marginal serrations are slightly developed along the convex border, longest at the point of greatest width and becoming obsolete toward the tip.

A single elytron (Pl. XXXI, fig. 61) only—the first one of the left side

—is known. It is attached to II and covers most of the prostomium and immediately adjacent region. It is irregularly orbicular with a very small subcircular scar of attachment, remarkably thick, soft and of cushiony texture, the outer surface and borders everywhere thickly covered with peculiar large, soft hemispherical or dome-shaped soft papillæ, each bearing at its summit a single coarse filament or cilium. Postero-laterally these become larger and frequently confluent in twos and threes to form bilobed of trilobed papillæ.

The specimen is entirely unpigmented; the cuticle is thin and the tissues delicate and translucent with large nerves visible through it. In many places the tissues are more or less inflated. These appearances call to mind the conditions of the similarly abyssal *Laetmonice.*

This species is closely related to the imperfectly known *Polynoë* (*Adametella*) longipedata McIntosh from the North Atlantic, but the latter has stout notopodial setæ peculiarly bifid at the tips.

Station 4,397, off Santa Catalina Islands, lat. 33° 43′ N., long. 117° 42′ W., 2,196–2,228 fathoms, gray mud (type only).

APHRODITIDÆ.

The type genus abounds in this region, being represented in the collection by five species, two of which are evidently abundant. They vary in size from the little aberrant *A. parva,* sometimes less than ten millemeters in length to huge bulky specimens of *A. japonica* seven inches in length and nearly three inches wide. Three of the species have not been described previously. Less common is *Laetmonice,* represented by two species, one of which (*L. producta wyvillei*) occurs at the greatest depth (2,228 fathoms) at which Polychæta were taken by this expedition.

Aphrodita armifera sp. nov. Pl. XXXI, figs. 65, 66; Pl. XXXII, figs. 67–75.

This very noteworthy species is represented by a single specimen. From broad ovate, the anterior end broadly rounded, the greatest width at XV, which is the middle of the length, the width rapidly reduced after XXI, and segments after XXVII forming a slender attenuated caudal region. Moderately depressed, the dorsum less arched than in many species and covered with a thin, clean layer of felt fibers at the sides of which the great lustrous brown spines are quite uncovered and rise over the back much as in a *Hermione,* the largest ones meeting or nearly meeting in the middle line.

Prostomium (Pl. XXXII, fig. 67) deep sunken between the parapodia of I and II and completely concealed by the elytra and felt, regularly ellipsoidal, the width about one and one-third times the length;

posterior margin subtruncate and united to the peristomium by a median nuchal fold, which is about one-fourth as wide as the prostomium and slightly arched. Ocular peduncles small, hemispherical, close together on anterior margin, the right bearing two small black eye-specks, the left lacking them. Tentacle arising from frontal face immediately below ocular prominences, bent downward, very short, not more than one-fourth length of prostomium, consisting of a very short ceratophore and a scarcely longer obpyriform style. Palpi moderately long and slender, about six times length of prostomium with a scarcely distinguishable basal segment, the cuticle smooth and polished to the naked eye but bearing numerous very fine sensory cilia just visible under a magnification of fifty diameters. Facial caruncle a thin compressed plate with somewhat serrated free border, covered with small round papillæ, the ventral process very short.

Peristomium represented dorsally by a short transverse fold, ventrally by small anterior lips; its parapodia (fig. 67) reaching about half their length in front of the prostomium. Tentacular cirri with well-separated stout cirrophores, the styles long and slender, with distinctly bulbous tips preceded by a constriction and slight subterminal enlargement; the dorsal about one-half length of palps and directed upward, the ventral slightly shorter than dorsal and directed downward. Mouth bounded by the peristomium, somite II and posteriorly by a broad, nearly smooth lip which divides III into a pair of lateral swellings and reaches to IV.

Metastomial segments indicated on the venter by transverse integumental ridges on a nearly flat surface bounded laterally by a shallow trench along the bases of the parapodia and divided into a median translucent neural third and lateral muscular thirds; cuticle thickly studded with small globular papillæ. Dorsally the segments are ill-defined, without distinct bounding furrows and with thin integuments and powerful lateral muscle ridges; cuticle thin and thickly studded with minute papillæ (Pl. XXXI, fig. 66). Pygidium slightly cleft for the terminal anus which does not cut through several segments.

Elytra fifteen pairs on II, IV, V and every alternate segment to XXIII, then apparently on XXV, XXVIII and XXXI though the last three are somewhat doubtful. They are of large size and are broadly inbricated, completely covering the dorsum beneath the felt, colorless, translucent without markings or incrustations of any kind, soft and thin but tough and leathery. First three pairs elliptical with major axis transverse; several following nearly circular with attachment anterior to center; proceeding caudally they become successively longer and the line of attachment, which extends from the middle to the lateral margin, shifts to a more posterior position. Those of the last pair are nearly three times as long as wide, tapered posteriorly and are attached about one-fifth of their length from the anterior end. They fold round the slender caudal region and reach beyond the anus, the edges meeting to form a nearly complete tube.

Owing to the rigidity of the dorsal spines and my desire to injure them as little as possible the dorsal fimbriated organs were incompletely studied. Apparently they begin on VI and occupy all cirriferous somites as far as XXVIII, occurring in the usual position near the posterior border of the segments at the level of the lateral border of the elytrophore. They are small and thin, compressed and deeply fimbriated, the middle ones bearing seven to nine rather long, simple or bifid cirriform papillæ (Pl. XXXI, fig. 65).

Parapodia of the usual form, biramous. Neuropodium stout, supported by a single very stout aciculum, truncate, rough and at the end stepped for the three series of setæ, the surface, except dorsally densely covered with spherical papillæ of various sizes but averaging larger than those on the ventral surface of the segments. Notopodium a low, thick ridge prolonged to the dorsum. Neurocirrus arising from a low cirrophore located somewhat distad of the middle of the neuropodium and covered with crowded spherical papillæ of the largest size; style smooth, rather slender, tapered to a slightly bulbous tip which reaches to about base of middle series of setæ. Notocirrus with large cylindroid cirrophore arising just behind the ventral fascicle of notopodial setæ; style reaching to about tip of second largest spine of this group, slender, smooth, tapered to a distinct subterminal enlargement beyond which is a constriction and terminal ball. Peristomial parapodia (Pl. XXXII, fig. 67) small, slender and directed forward, supported by a single aciculum which terminates in the somewhat enlarged end bearing three dense tufts of fine capillary setæ. At the caudal end both rami become free and prolonged laterally and the notopodium lamelliform with a prominent acicular process, while the notocirri are relatively longer with very conspicuous terminal bulbs.

Neuropodial setæ in the usual three horizontal series. On middle segments the ventral series consists of five or six equal, brownish yellow, rather slender and slightly curved setæ, the end (Pl. XXXII, figs. 72 and 73) enlarged, tapered to a slightly hooked, acute tip and usually bearing a pair of small spurs and a few scattered tubercles. Middle series of three, brown, becoming stouter caudad, all smooth, gently curved, tapered without evident enlargement (fig. 71). Dorsal series usually of two stouter, deep glistening brown, nearly straight spines (fig. 70). All middle neuropodial setæ are quite free from hairs and nearly or quite smooth. Toward the caudal end they become gradually elongated with increasing asperities and finally pale-yellow subcapillary setæ roughened with numerous short spines more or less regularly alternating on the two sides (fig. 75). The usual dense fascicle of pinnate setæ replaces the ventral neuropodials on II. In this species, so far as can be determined from a single specimen the spiral pennon is less developed than on the other species (fig. 74).

Notopodial setæ consist of stout, fragile spines and flexible fibers. The former (Pl. XXXII, fig. 68) are deep lustrous brown and form a conspicuous bristling armature penetrating the felt at the sides and protecting the sides and dorsum of the body for its entire length. They are more or less flattened, slightly curved near the base, then straight, very rigid and tapered to subacute points. The core is striated longitudinally and here and there fractured transversely and the hard outer shell is roughened by numerous small tubercles which increase in size toward the distal end until they are just visible under a magnification of four or five diameters (fig. 67). These spines are arranged in a dorsal and a ventral group on each segment. Ventral on middle segments of nine to eleven arranged in a vertical series and rapidly increasing in size from below dorsad, the most dorsal many times larger than the most ventral and more recumbent on the felt. Posteriorly they become longer and more recumbent and anteriorly shorter and more erect. Dorsal fascicles usually consist of two small oblique rows of five or six but on elytrophorous segments may be limited to a single somewhat longer row. These increase in size postero-caudad, the last of each series being much flattened and very long so that they cross those of the opposite side in an abattis-like arrangement. Anteriorly they are short, more erect and do not cross. At the extreme caudal end they become quite slender.

Fibers arise as usual in three tufts, the dorsal felt being formed by the intermediate tufts on all parapodia and by the larger dorsal tufts on elytrophorous segments only. They are exceedingly long and fine with peculiarly hooked tips and interlace to form the even but rather thin layer of felt which in this specimen is free from silt. The ventral or lateral tuft consists of much shorter, coarser, roughened fibers with straight fine points which do not felt but hang in loose fringes behind the parapodia. They correspond to the iridescent fibers of other species but nearly lack this quality and are dull gray and more or less covered with silt.

No color. Much affected with attached parasites which are often arranged with remarkable symmetry on the dorsal side.

Station 4,557, Monterey Bay, off Point Pinos Light-house, 28–40 fathoms, rocky.

In general appearance this species resembles *Aphrodita* (*Lœtmonice*) *aphroditiodes* (McIntosh) but the setæ differ and the palpi are much stouter. The most striking characteristics are the formidable rows of long, stout, lustrous, brown spines which posteriorly meet over the back, and the entire absence of brilliantly iridescent lateral fringes.

Aphrodita japonica v. Marenzeller.

Aphrodita japanica v. Marenzeller, Denks. K. Akad. Wissensch., Wien, XLI (1879), pp. 111 and 112.

This species has been reported already[3] from the dredgings of the "Albatross" as occurring on our coasts from the Gulf of Georgia to Alaska. The Academy of Natural Sciences possesses two very large and bulky specimens nearly seven inches long collected by Professor Harold Heath in 12 fathoms at Pacific Grove, Monterey Bay, in 1897. Professor Treadwell's remarks on the notopodial setæ render it probable that the species reported from Hawaiian waters[4] as *A. echidna* is really this species.

Aphrodita japonica occurs plentifully at numerous stations scattered over the whole range of these investigations, the largest number (twelve) being taken at station 4,436. The specimens vary from 28 mm. (sta. 4,322) to 155 mm. long and 70 mm. in extreme width between tips of neuropodial spines (sta. 4,457). The setæ and other characters agree exactly with the northern examples. The neuropodials increase in number with age and the densely hairy tips of the young become worn quite smooth on old specimens. A characteristic of the species —distinguishing it from related species with elongated hooked notopodial setæ—is the slender, rather long, tapered median tentacular style. This character, however, must be used with caution as the style is sometimes lost or broken and in this condition may resemble the short, clavate tentacles of other species. Marenzeller gives a good figure. The lateral fringes are dull reddish but detached tufts of the dorsal felt often exhibit a dull green color.

Stations 4,322, off Point La Jolla, vicinity of San Diego, 110–199 fathoms, green mud and shells; 4,325, same locality, 191–292 fathoms, green mud and fine sand; 4,334, off Point Loma Light, vicinity of

[3] *Proc. Acad. Nat. Sci.*, 1908, p. 338.
[4] *Bull. U. S. Bureau of Fisheries*, 1903, p. 1,157.

San Diego, 525–541 fathoms, green mud and fine sand; 4,335, same locality and bottom, 500–530 fathoms; 4,353, same region, 628–640 fathoms, green mud; 4,354, same locality and bottom, 646–650 fathoms; 4,358, same region, 167–191 fathoms, green mud; 4,432 and 4,433, off Santa Rosa Island, 243–272 fathoms, green mud; 4,435 and 4,436, off San Minguel Island, 264–287 fathoms, green mud; 4,452, off Point Pinos Light, Monterey Bay, 49–50 fathoms, green mud and fine sand; 4,457, same locality, 40–46 fathoms, dark green mud; 4,464, same region, 51–36 fathoms, soft, dark gray mud; 4,482, off Santa Cruz Light, Monterey Bay, 43–44 fathoms, soft green mud; 4,522, off Point Pinos Light, Monterey Bay, 130–149 fathoms, gray sand and shells.

With the exception of the last, at which a single specimen was taken, the bottom at all of these stations was muddy. Most of the specimens are thickly covered with foreign matter and stained deep brown or black.

Aphrodita refulgida sp. nov. Pl. XXXII, figs. 76–84.

A species of the *japonica-hamata* group, so far as known of moderate size and of smooth, neat appearance. Easily distinguished from *A. castanea* by the brilliant green lateral fibers, the attenuated ends of the neurosetæ and the much less conspicuous notosetæ. Form more broadly ovate than *A. castanea*, only moderately depressed and with regularly arched dorsum, caudal end attenuate. Length of type 36 mm.; maximum width (XV) of body 10.5 mm., between tips of parapodia 18 mm., between tips of neuropodial setæ 24 mm.; total width including lateral fibers when floating in water 29 mm.; maximum depth 11.5 mm. Number of segments 42, the last twelve very small and forming a narrow caudal region concealed by the setæ. Cotypes 23 and 35 mm. long with 40 and 43 segments respectively.

Prostomium (Pl. XXXII, fig. 78) subelliptical, nearly twice as wide as long, smooth and strongly convex dorsally, the sides and front regularly rounded, the posterior border truncate and nearly straight and united to the short peristomium by a broad, convex median nuchal isthmus about one-fourth the width of the prostomium, on each side of which is a deep transverse furrow. Ocular peduncles hemispherical prominences nearly in contact and projecting over the anterior face, each bears two minute black eyes, one dorsal and one ventral. Median tentacle arises from anterior face beneath ocular peduncles, about as long as prostomium, consisting of a short cylindrical ceratophore and a slender tapered style about three times as long as the ceratophore, its distal half colored yellow and terminal bulb minute. Palpi white, the very short basal segment more than one-half the width of prostomium, the rest regularly tapered, only moderately slender, about seven times as long as the prostomium, with slender pointed tips and bearing minute sensory cilia. Facial caruncle a rather prominent, nearly smooth plate, very thin and strongly compressed between the bases of the palpi but somewhat swollen above, terminating above mouth in a short blunt papilla. In all the specimens this papilla is much shorter than on most species.

Peristomium a short transverse dorsal fold united to the prostomium by the nuchal isthmus and forming the anterior lips ventrally. Peristomial parapodia (Pl. XXXII, fig. 78) much prolonged forward, reaching beyond the prostomium fully twice its length, much compressed to near the end which is expanded but not divided into rami; distal end receiving a dorsal aciculum only and bearing three dense flat tufts of capillary setæ, one above the notocirrus, one above and distal to the neurocirrus and the third ventral and much more proximal. Tentacular cirri borne on distal end of medial face of peristomial parapodia. Both consist of short ceratophores and slender tapered styles about one-fifth as long as the palps and with scarcely developed terminal bulb. Mouth bounded by peristomium and posteriorly by a long quadrate lip that occupies the entire middle region of somites II and III and cuts into IV. Anus a small dorsal slit with furrowed rim cutting through the last 4 segments.

Metastomial segments flat below, the boundary between segments and parapodia clearly defined by a deep continuous trench. Segments indicated by thick and deep transverse integumental folds; neural area not sharply differentiated from muscular area. Cuticle thick and opake on the venter, studded with spherical papillæ, much smaller and less crowded than on *A. castanea*, dorsally thinner and on the body smooth with few and scattered minute conical, capped papillæ (Pl. XXXII, fig. 76) which become much more numerous on the bases of the parapodia.

Elytra fifteen pairs, borne on II, IV, V and alternate segments to XXIII and then somewhat doubtfully on XXV, XXVIII and XXXI, following which are eleven small segments tapering to the minute pygidium. Elytra all large, widely imbricated and completely covering dorsum of body and head; they are thin, flexible and tough, having the same form and mode of attachment as in *A. castanea*. The last pair folded into a tube enclosing the caudal segments. Dorsal fimbriated organs begin on VI and alternate with the elytra to XXX, the last two pairs being rudimentary. The others are erect, compressed and hatchet-shaped with the crest-like border divided into six to eight short, blunt processes sometimes flattened or even bifid (Pl. XXXII, fig. 77).

Parapodia prominent, the neuropodia of typical segments about one-third width of segments, pointing straight laterad, stout, conical, little tapered, truncate distally and stepped for the usual three series of setæ. Integument much wrinkled and studded on the sides and venter with spherical papillæ much more widely separated than those of *A. castanea* and smaller than those of *A. armifera*, but larger and more crowded at the bases of the setæ. The aciculum projects slightly from the dorsal step of the foot. Notopodium a low nub extended to the dorsal surface. Neurocirrus arises postero-ventrally from a low fold or ridge in place of a distinct ceratophore near middle of neuropodium; style acuminate, rather stout in basal half, slender and tapered distally and terminated by a scarcely evident knob, smooth, not quite reaching base of middle series of setæ. Notocirri spring from stout cirrophores behind the lateral tuft of notopodial spines; styles slender throughout and little tapered, a slight subterminal and a scarcely evident terminal enlargement. They perforate the felt and rise above it along with the lateral tufts of notopodial spines. Anteriorly the parapodia are gradually reduced in size and directed more and more forward, the first or peristomial being alluded to above. Neurocirrus of II somewhat longer than the others and arising nearer to the base of the foot which approximates the form of the first. Posteriorly the parapodia become very small but slender and elongated with the notopodium as well as the neuropodium projecting freely. They bend ventrad and toward the middle, converting the venter of this region into a groove closed posteriorly. The neurocirri become relatively longer and the subterminal and terminal enlargements are exaggerated.

Dorsal felt an even, regular and near smooth investature covered with a coating of mucous, silt and foreign particles of various kinds. It is unusually thick and composed of very fine fibers arranged in two layers, the inner thin, membrane-like and clean, the outer much thicker and carrying much foreign matter. Penetrating its lateral parts along the sides of the worm are the stout, brown, notopodial setæ in two series and below these the beautiful flowing plumes—unusually long and abundant—of iridescent setæ which glow with a fine golden-green or in some lights, a blue-green metalic luster. Many of these fibers curve upwards onto the felt, the fibers of which also are slightly iridescent when clean.

Neuropodial setæ mostly concealed above by the felt, arranged in the usual three series, the dorsal being stout and deep brown and two or sometimes three in number, the middle paler, about half as thick and four or five, the ventral yellowish brown and much more slender and more numerous, ten being almost invariably present on middle segments. As compared with most similar species setæ of all three series are long and slender and shaped more nearly like those of *A. hamata* than any other species. All are nearly straight—those of the ventral series (Pl. XXXII, fig. 81*c*) most curved—perfectly smooth with no trace of hairyness or tuberculation and with a slight subterminal enlargement tapering to a slender acuminate tip, the last two characters also much more accentuated on the ventral setæ (figs. 81*a–c*).

Notopodium bearing two series of large setæ (Pl. XXXII, figs. 79 and 80) the ventralmost or lateral arranged in a nearly vertical series of six to eight which pass through the felt and then bend sharply dorsad with their slender ends resting upon it. The dorsalmost group is irregular and usually consists of six to eight setæ more or less distinctly in two short rows which penetrate the felt obliquely and rest upon it more or less concealed in the covering silt. All of these setæ are dull brown, soft of texture, longitudinally striated, quite without surface asperities, stout and flat at the base and tapered to slender ends with hooked tips. The apical sheaths sometimes present are unusually long and are free of hairyness (fig. 80). Seta of the ventral series are shorter and more abruptly tapered, the dorsal more gently tapered and reaching beyond the middle of the body, increasing in length from before backward. The capillary fibers have the usual arrangement into dorsal, intermediate and ventral tufts. The former are confined to elytrophorous segments and are very abundant, forming, with the intermediate tuft, the dorsal felt, the individual fibers being very long and slender with hooked tips. The ventral tuft forms the iridescent plumes and the fibers are short, coarser, somewhat rigid, tapered to very fine straight points and are very smooth so that no foreign matter adheres to them.

Toward the head the arrangement of the notopodial setæ becomes simplified by the merging of the two groups of notopodial setæ and two groups of fibers. Neuropodial setæ become longer and more slender and on III and II, the ventral series is replaced by a dense patch of delicate bipinnate setæ (Pl. XXXII, fig. 82). In this group the dorsalmost setæ are longest and coarsest and bear a short pennant-like tip. Passing toward the ventral side this tip increases in size at the expense of the remainder of the setæ and becomes spirally turned until on the smaller ventral setæ nearly the entire toothed portion consists of a spiral of four to five and one-half turns. On I all setæ are smooth fiber-like capillaries. Toward the caudal end, the neuropodial spines become more and more slender and acquire rather conspicuous spur-like teeth, at first few and irregularly arranged and finally in two regular series, extending for a long distance on the very slender and much elongated setæ (figs. 83 and 84). Notopodial spines become more slender and lateral fibers coarser and in brush-like tufts.

No natural color exists on the body but some parts are stained with a yellowish incrustation. Numerous external parasites are attached to the integuments of both dorsal and ventral surfaces.

Stations 4,457, Monterey Bay, off Point Pinos Light, 40–46 fathoms, dark green mud (2 cotypes); 4,464, same region, 36–51 fathoms, soft gray mud (type).

Aphrodita castanea sp. nov. Pl. XXXII, figs. 85–97; Pl. XXXIII, fig. 98.

A species of the *A. japonica* group; narrowly ovate, tapered toward both ends but the posterior much more slender and attenuated, strongly depressed with a nearly flat dorsum and flat, sole-like venter; especially remarkable for the serried rows of numerous rich chestnut-colored notopodial setæ which cover the sides nearly completely. The type is 48 mm. long; maximum width of body (at XIV) 14.5 mm., between ends of parapodia 22 mm., between tips of setæ 31.5 mm.; depth 10.5 mm. number of segments 43.

Prostomium (Pl. XXXII, fig. 85) subglobate, nearly circular in outline or slightly wider than long, slightly depressed, strongly convex above, the ocular elevations prominent and hemispherical, in the position of the prostomium of most of these specimens very little projecting beyond the anterior margin, or even entirely dorsal so that both pairs of eyes are visible from above. Eyes two pairs, minute, black, one above or behind the other according to the degree of elevation of the prostomium. Nuchal fold a sharply defined isthmus about one-fourth as wide as the prostomium and sloping downward to the transverse peristomial fold. Median tentacle arising from the frontal face below the ocular peduncles, its ceratophore short, obconical and about one-fourth to one-fifth the prostomial length, the style (about 15 examined) scarcely longer than ceratophore, strongly clavate, bent into a V-shaped hook. Palpi with rather swollen bases, somewhat obscurely separated as ceratophores; styles four to six and one-half times the length of the prostomium, moderately slender, regularly tapered to acute tips, the cuticle smooth and polished, bearing numerous delicate pointed cilia. Facial ridge very prominent, nearly as long as the prostomium, the dorsal border somewhat inflated above the palpi, the remainder compressed and terminating in front of mouth in a slender, pendant, finger-like process studded with numerous pediculate globular papillæ.

Peristomium forming a narrow transverse fold above connected with the nuchal fold, below a rugous lip. Its parapodia (Pl. XXXII, fig. 85) strongly compressed and prolonged straight forward, more than half its length beyond the prostomium, the distal end slightly expanded and bearing three rather small tufts of capillary setæ. Tentacular cirri with short, rather stout cirriphores arising from the dorsum and venter of the expanded distal end, the dorsal directed somewhat upward, the ventral chiefly outward; styles moderately slender, tapered, without distinct subterminal or terminal bulbs and without cilia. Mouth a small opening bounded by furrowed lips, the posterior lip a broad plate occupying the entire ventral area of II and III and cutting somewhat into IV.

Metastomial segments forming a flat ventral surface fairly well separated from the parapodia by a lateral furrow and differentiated by shallow transverse furrows. To the twenty-ninth the body is nearly equally curved and tapered anteriorly and posteriorly; posterior to this the caudal region is slender and attenuated. Ventral integument thick and opake, so that the neural area, though constituting about two-fifths of the width, is not clearly defined from the muscular as in some species. Venter so thickly studded with spherical tubercles that in many places they touch over large areas, especially on the parapodia. On the dorsum the integument is thinner and translucent and is rather sparsely studded with small bluntly-conical papillæ (Pl. XXXII, fig. 87). Anus a short dorsal slit extending through the last four segments.

Elytra fifteen pairs, on II, IV, V, VII and alternate segments to XXIII, XXVI, XXIX and XXXII, strongly imbricated, in general nearly circular with a slight lateral notch from which the broad linear attachment extends to the center. Posterior ones elongated with anterior attachment, the last about twice as long as wide and folded with its fellow into a tube reaching somewhat beyond the pygidium. In texture they are somewhat firmer and thicker than on the other species here noticed.

Dorsal fimbriated organs begin on VI and occur on all cirriferous somites to and including XXXI. The first is small and the last two rudimentary. On middle segments they are unusually large. They are of lappet-like form, produced freely on the medial side. Free border bearing six or seven lobes most of which are again divided into two or three finger-like papillæ each with a terminal sense organ (Pl. XXXII, fig. 86).

Parapodia of the usual form, the neuropodia shorter and stouter than in *A. refulgida*, terminating in the usual three step-like folds, and on the ventral face thickly crowded with short pediceled globular papillæ, the largest of which occur at the bases of the setæ. Neurocirri arise at about middle of ventral face of neuropodia and reach bases of middle series of setæ. They are slender, especially in the distal half, and end in slightly bulbous tips. No sensory cilia on style but a close cluster of somewhat enlarged spherical papillæ round the base. Notocirri project through the felt at the ventral border of each lateral tuft of notopodial setæ and curve freely dorsad and caudad to a point about opposite the middle of the next succeeding homologous tuft. They arise from large ceratophores and the styles are slender with scarcely obvious subterminal enlargement or terminal bulb and no sensory cilia. Notopodium a scarcely elevated tuberosity receiving the end of a stout aciculum. Toward the ends both rami become more prolonged, the neuropodium slender and the notopodium compressed and somewhat spade-shaped. Peristomial parapodium much prolonged forward and the rami united to the end, the notopodium only retaining an aciculum and the setæ though differentiated into fascicles being all of one kind. Neurocirrus of II about twice as long as the others. Cirri of the much crowded caudal parapodia, which approach each other ventrad, have exaggerated subterminal and terminal thickenings and the notocirri are relatively longer, neurocirri shorter than on middle segments.

Dorsal felt covering somewhat thinner than on *A. refulgida* and not distinctly differentiated into two layers, but continuous and of uniform thickness; formed of a close web of fine dull gray fibers and coated externally with silt. As noted above the notopodial setæ are very conspicuous and the neuropodial spines are freely exposed and project prominently at the sides. Neuropodial setæ in the usual three series, medium sized specimens like the type having commonly two in the dorsal, three or four in the middle and six to eight in the ventral series. All are dark brown, the dorsal ones being especially deep and exhibiting the most splendid bronzy reflections. Dorsal setæ (Pl. XXXII, fig. 92*a*) are nearly straight and retain but little hairyness. Ventral ones (Pl. XXXII, fig. 92*c*, and Pl. XXXIII, fig. 98) are about one-fourth diameter of the dorsal, more curved, with distinctly enlarged and densely pilose ends on which the hairs form a dense cushiony brush often agglutinated into a kind of spur, in addition to which a hirsute sheath may be present. Setæ of the middle series (fig. 92*b*) are intermediate in character. Anteriorly on II and III the ventral series is replaced by a dense tuft of several rows of small pinnate setæ (Pl. XXXII, fig. 93) the longer dorsalmost of which have the tips simply prolonged while on the ventral ones they become spirally twisted, and increase in length at the expense of the strictly pinnate region until the most ventral consist chiefly of a spiral of two to two and one-half turns. Posteriorly all neuropodial setæ become slender, elongated and more or less spinous, the spines appearing at first irregularly and in a restricted region and becoming more regularly biserial and more widely distributed as the setæ become longer and more slender (figs. 94 and 95).

Notopodial setæ in the usual two fascicles; the ventral a vertical series of fourteen to eighteen, visible above the felt on the medium-sized type and cotypes (37–48 mm. long); dorsal fascicle arising in two short parallel oblique series of six to eight each, or on elytrophorous segments sometimes in one series of about fifteen. In each group they increase in size from below dorsally and one or two minute ones may be concealed beneath the felt. Those of the ventral series are bent rather abruptly caudad on to the felt and give an aspect of a series of waves. At the base they are flattened and very stout and taper rather rapidly into the slender ends. Otherwise they are like those of the dorsal fascicle. Setæ of the dorsal fascicle penetrate the felt more obliquely, those on elytrophorous segments at a more dorsal level than the others, and are consequently more recumbent on the felt. They curve rather gently dorsad and at the same time taper very gradually into the long slender ends which cross those of the opposite side and on posterior segments often reach the opposite side of the body. All of those setæ have a chestnut or pale brown color, are soft, flexible and friable, stout and compressed at the base and taper more or less gently to the tip which is rather abruptly contracted into a hard, pointed, strongly bent hook (Pl. XXXII, fig. 88). They are finely striated longitudinally and the surface of the convex side bears numerous small hard asperities (fig. 89). Posteriorly they become more slender and anteriorly much shorter, the former finally terminating in a more open hook and like the lateral felt fibers becoming covered with sticky hairs (Pl. XXXII, fig. 96). Felt fibers arise in dense tufts immediately above the dorsal notopodial setæ on scale-bearing segments only and spread horizontally in a tangled layer. A smaller tuft arises between the two fascicles of setæ on all segments. The fibers are nearly or quite colorless, smooth, very fine, long and of nearly uniform diameter but taper to abruptly hooked tips (fig. 90). Lateral tufts of fibers arising below the notopodial setæ are rather sparse, not much longer than the neuropodial setæ and hang down between the parapodia. They are much coarser than the felt fibers, especially at the base from which they taper to fine straight tips (fig. 91). They are arranged in regular rows like the large setæ. Usually they are very heavily coated with silt but when this is cleaned off they exhibit none of the brilliance of color of many species and scarcely a trace of iridescence. The somewhat roughened surface is covered with a fine hairiness which many result from a mucous coat or the separation of the more superficial constituent fibers (fig. 97). In any case this feature seems to insure the adhesion of silt.

No color other than the extraneous ferruginous incrustation. One specimen dissected contained strings of large ova. None has the proboscis protruded.

Stations in Monterey Bay, 4,446, off Point Pinos Light-house, 52–59 fathoms, green mud; 4,457, same locality, 40–46 fathoms, dark green mud; 4,464, same locality, 36–51 fathoms, soft dark gray mud; 4,467, off Santa Cruz Light-house, 51–54 fathoms, soft dark green mud (cotypes); 4,468, same locality, 51–309 fathoms, fine sand (cotypes); 4,481, same locality, 45–50 fathoms, hard sand; 4,482, same locality, 43–44 fathoms, soft green mud (type and cotypes); 4,485, same locality, 39–108 fathoms, soft green mud and sand; 4,550, off Point Pinos Light-house, 50–57 fathoms, green mud and rocks.

This plainly colored but handsome and very interesting species is confined, so far as known, to the waters of Monterey Bay where it appears to be quite plentiful, the collection yielding twenty-six specimens. With the exception of one doubtful record of depth (51–309 fathoms at station 4,467) it was taken practically exclusively at depths varying little from fifty fathoms and chiefly on muddy bottoms, though a few occurred on sand.

Though resembling *A. japonica, A. negligens* and *A. refulgida* in many respects and especially in the long, soft, hooked notopodial setæ, this species is easily distinguished from all of them by the large number and rich chestnut color of these setæ, and in addition from *A. japonica* by having a short and clavate, tentacular style instead of an elongated tapered one, and from *A. refulgida* by having densely hairy instead of smooth neuropodial setæ and instead of brilliant lateral fringes only tufts of short brownish hair. *A. negligens*[5] is undoubtedly its nearest ally in the Pacific and the resemblance is especially pronounced in young specimens of *A. castanea* in which the lateral fascicles of notopodial setæ tend to be erected, producing the disordered effect that is so characteristic of the known examples of *A. negligens,* but even specimens 19 mm. long have a greater number of setæ than full-grown ones (40–60 mm. long) of *A. negligens.*

The examples in this collection vary from 16–74 mm. long and all exhibit the characteristic flatness of the body, the color and prominence of the notopodial setæ. Both neuropodial and notopodial setæ increase in number with size of the animal. Specimens 16 mm. long have six or seven ventral neuropodials, five to seven visible above the felt besides smaller ones in ventral notopodial fascicles, and nine to eleven in dorsal fascicles. In the ventral notopodial fascicles, in which the increase is most noteworthy, specimens 19 mm. long have nine to ten visible, 24 mm. long about eleven, 30 mm. long twelve or thirteen, 37 mm. long thirteen or fourteen, 47–50 mm. long fifteen to eighteen and 74 mm. long twenty on middle somites; the largest specimen has nine or ten ventral neuropodials. There is also a marked change in the character of the neuropodial setæ, those of the youngest and smallest specimens being always much more densely hairy as well as smaller. The dorsal neuropodial setæ of specimens 16–19 mm. long resemble those of the ventral series of medium-sized specimens while the largest example not only has the setæ of the dorsal series exceedingly stout and blunt, but those of the ventral series of middle segments have through wear lost the apical brush of hairs and the slight terminal curvature and consequently resemble the dorsal setæ of medium-sized specimens. There is no doubt that these changes progress with advancing age.

As is usually true of *Aphroditæ* numerous parasites are adherent to the cuticle, especially of the larger specimens.

Aphrodita parva Moore.

Aphrodita parva Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 529–532, Pl. XXXIV, figs. 3–7.

In the original account of this species, in comparing it with the closely related *A. intermedia* McIntosh it is stated that the latter is 15 mm. long. This should have been 5 mm., making the type of that species smaller than the known specimens of *A. parva.* Until now the latter is known only from the two types taken in the Gulf of Georgia.

[5] Re-examination of the notopodial setæ of *A. negligens* shows that they are often roughened precisely as are those of *A. castanea.*

Four specimens occur in the present collections and have extreme lengths of 9–17 mm. They agree fully with the types.

Stations 4,381 and 4,382, off south point of North Coronado Island, vicinity of San Diego, 642–667 fathoms, green mud.

Lætmonice producta wyvillei McIntosh.

L. producta wyvillei McIntosh, Challenger Reports, Zool., Vol. XII, pp. 44, 45, Pl. VII, fig. 3, IV A, figs. 9–11.

This species is also recorded from Hawaiian waters by Treadwell. McIntosh's specimens had eighteen pairs of elytra. The two in this collection have only fifteen and sixteen pairs respectively with thirty-nine setigerous segments. One of them is evidently regenerating posteriorly. One specimen is much coated with silt. Villiform papillæ are chiefly limited to the oral region.

The protruded proboscis of the larger example is 9 mm. long and 3 mm. in diameter, cylindroid. At the end, surrounding the orifice, is a dense brush of fine papillæ above and below, separated laterally by a small rounded eminence with a small papillæ below and one above the lateral line. The fine papillæ are really the fimbriated borders of closely packed lamellæ. No jaws.

Station 4,397, off Santa Catalina Islands, Lat. 33° 10′ 15″ N., Long. 121° 42′ 15″ W., 2,196–2,228 fathoms, gray mud.

Lætmonice pellucida Moore.

Lætmatonice pellucida Moore, Proc. Acad. Nat. Sci., 1903, pp. 420–422, Pl. XXIII, figs. 19 and 20.

These specimens agree fully with the types taken in Bering Sea. They all have fifteen pairs of elytra which nearly or just meet medially without overlapping. The ventral villiform papillæ are confined to the posterior lip. The specimens vary in length from 20 to 34 mm. and several contain egg strings. Compared with *L. producta wyvillei* the tubercles of the notopodial spines are much larger and the portion of the neuropodial setæ beyond the spur is shorter while the hairs are nearly twice as long as in that species.

Stations 4,353, 4,354, off Point Loma Light-house, vicinity of San Diego, 628–650 fathoms, green mud; 4,382, south of North Coronado Island, 642–666 fathoms, green mud; 4,389, off Point Loma, 639–671 fathoms, green mud and gray sand.

SIGALEONIDÆ.

Of the five species representing this family four are new to the region and three have not been previously described.

Peisidice aspera Johnson.

Peisidice aspera Johnson, Proc. Cal. Acad. Sci., 3d Series, Zoology, Vol. I, pp. 184, 185, figs. 56–59, 63.

One specimen has as many as twenty pairs of elytra. The setæ of the first setigerous parapodium (II) have very much longer appendages than the others.

Johnson's specimens were taken in Monterey Bay and the writer has recorded the species from Alaska. Now reported only from,—

Station 4,460, off Point Pinos Light, 55–167 fathoms, green mud and gravel.

Leanira alba sp. nov. Pl. XXXIII, figs, 99–104.

The type and only known specimen is an excellently preserved anterior end of 52 fully-developed segments and a caudal regeneration cone of 5 + segments. Length 58 mm.; greatest width (at XXX), of body 3 mm., between tips of parapodia 6 mm., between tips of setæ 7.5 mm.; depth at XXX 3.5 mm.

Prostomium (Pl. XXXIII, fig. 99) about three-fourths as long as wide, foreshortened pentagonal in shape, the posterior or basal side slightly concave, postero-lateral pair of sides nearly straight, antero-lateral slightly convex, meeting in a blunt, notched apex. No distinct eyes but an obscure deep-seated pigment spot on each side of base of median ceratophore. Median tentacle arising in a shallow depression on dorsum immediately behind anterior border; ceratophore short but distinct with trace of aliform lamellæ; style short, thick and stiff, its length about equal to width of prostomium, stout fusiform at base, tapering to a short thick filament like the handle of an Indian club. Lateral tentacles coalesced at the base with the dorso-medial face of the peristomial parapodia but more largely free than in *Stenelais tertiaglabra*, similar to median tentacular style and reaching beyond its end, basal two-thirds fusiform, distal third a thick filament, scarcely covered by buccal or peristomial lamellæ. Palpi flagelliform, excessively slender and elongated, about thirteen or fourteen times as long as the prostomium, very regularly tapered to subacute tips and very smooth. The palpi are crowded away from the peristomium by the inserted peristomial parapodia, with the ventral side of the base of which they are united for a short distance. At the base they pass through a loose sleeve formed by the partial union of two foliaceous curved lamellæ (fig. 99) which are united with the ventral face of the parapodium and end in free truncate lobes bending round the palpus, one on its medial ventral side being twice as long as the parapodium, the other on the lateral side reaching scarcely beyond its end. A low smooth facial ridge runs from the prostomium to the mouth.

Prostomium not obvious from above, forming a pair of prominent lateral lips below; parapodia produced straight forward (fig. 99), coalesced with the lateral tentacles above and the palpi below, stout and not much elongated, projecting little more than one-third of their length beyond the prostomium and not at all beyond the parapodia of II, supported by a single (notopodial) aciculum and bearing a small tuft of long, very slender, finely hispid capillary setæ. Tentacular cirri nearly in contact at their bases, separated by the small tuft of setæ only; the dorsal arising by a rather prominent cirrophore, the style also rather stout, tapered, about two and one-half times as long as the prostomium and obscurely moniliform or articulated distally; ventral immediately beneath dorsal, apparently lacking a distinct cirrophore, and the style only about one-third as long as the dorsal but nearly as stout at the base.

The general aspect of the body is remarkably like a *Nephthys*, being somewhat quadrate or prismatic with the dorsum slightly arched and anteriorly finely cross-wrinkled, the ventral muscles forming a somewhat sole-like tract, the intersegmental furrows nearly obsolete, the diameter nearly uniform but gently tapering caudad and the cuticle very smooth with a delicate pearly luster. Only a small regenerating pygidium is present and bears no cirri.

Parapodia arise at a level slightly above the ventral sole and with the exception of several at the cephalic end project directly laterad. They are somewhat compressed and oblong, truncate distally where alone the rami are differentiated. Taking XXV (Pl. XXXIII, fig. 100*b*) as typical the rami are of equal length or the notopodium slightly longer and each supported by a single stout aciculum. The neuropodium is about twice as deep as the notopodium, broad and nearly truncate at the end but sloping gently and symmetrically dorsally and ventrally from a slight elevation and shallow notch which receives the tip of the straight aciculum. On the distal end are two tufts of finger-shaped or fusiform stylodes, a supra-acicular of nine or ten arranged in two rows, of which the posterior are nearly twice as long as the anterior and nearly equal to the setæ and a subacicular of four or five of various lengths; a low entire presetal membrane passes vertically down the anterior face. The setæ are arranged in three curved series, a dorsal anterior curving from the dorsum down the anterior face and slightly caudad above the aciculum, partly enclosing the dorsal group of stylodes, an antero-ventral beginning below and anterior to the aciculum and curving round the ventral side of the ventral group of stylodes, and a postero-intermediate which forms a postero-ventral quadrant round the aciculum as a center. Frequently a fourth short series is detached from the dorsal end of the antero-ventral series and passes obliquely in part between the latter and the postero-intermediate series. Notopodium about half as deep as the neuropodium and partly overlapping it behind, slightly compressed and with gently curved outlines, the distal end divided into two short blunt lobes, the ventralmost of which receives the tip of the curved aciculum while from the furrow between arises the long rank of setæ along a curved, sickle-shaped line with stout anterior and much longer posterior limb passing down the posterior face of the notopodium. Round the outer face of the setæ is a series of seven or eight stylodes more slender than those on the neuropodium, in addition to two or three more dorsal detached ones and a very much larger one with constricted base and widened middle attached immediately above the tip of the aciculum. Dorsal to the parapodium is a deep and wide bay bounded dorsally by the elevated and projecting elytrophore, from the overhanging tip of which projects a minute blunt notocirrus (branchia). On this and more anterior segments ctenidia are absent and the epidermis of the supraparapodial bay is quite smooth. Neurocirrus arising from a low cirrophore near base of neuropodium; style reaching nearly to base of ventralmost setæ, rather stout at base, tapered regularly to an obscurely articulated end bearing a small rounded tubercle on the dorsal side of the base. Other parapodia in the region differ somewhat in the number and form of the stylodes which appear to be somewhat caducous and contractile.

Toward the cephalic end the entire foot becomes shorter, the notocirrus disappears, the neurocirrus becomes short and stout and the end of the notopodium turns round the tip of its aciculum and faces dorsad, presenting a very characteristic rosette of stylodes from the center of which springs a small whorl of capillary setæ. Beginning at IV the parapodia bend successively more forward, that of II pressing the peristomial parapodia closely and reaching to its end (Pl. XXXIII, fig. 100*a*). Caudally of XXV the parapodia soon become relatively longer and their stylodes more slender or extended; near the end of the piece the neurocirri are again shorter but continue slender. At about XXX (XXIX in this specimen) slender stylodes appear in front of the antero-dorsal setæ of the neuropodium and three or four continue to be present in this position to the end of the piece. At XXVII well-developed ciliated pads or ctenidia appear in the dorsal bay and the notocirri (branchiæ) begin to become much larger, swollen, and ciliated. When fully developed as on somite L (fig. 100*c*) they are very stout and hang downward to nearly or quite touch the notopodium. Ctenidia (fig. 100*c*) form three long nearly continuous ciliated cushions, the ventral occupying about the proximal two-thirds of the dorsum of the foot, the intermediate nearly as long a space at the bottom of the bay, and the dorsal a slightly shorter distance reaching nearly to the base of the branchia.

Elytrophores occur on II, IV, V and alternate somites to XXVII and then on every somite. The first three are small, low and cylindroid and situated on the base of the parapodia; following ones soon become more elevated, separated from the parapodia and provided with ovoid scars and protruding lateral ends. At XXVII and beyond they become still more prominent and tumid. Branchiæ (notocirri) occur on elytrophorous segments only and first appear as a minute non-ciliated process on the overhanging end of the elytrophore at XIII. They undergo little change to XXVII where they rather abruptly become larger and ciliated and continue to increase in size as above indicated.

Elytra are easily detached and most of them lie loose in the bottle. The first two are small and nearly circular with central attachment. Those following (probably as far as XXV) are more or less rhomboid or trapezoid (Pl. XXXIII, fig. 101*a*) with rounded corners and slightly concave or indented sides and the scar somewhat laterad of the center; the others are irregularly narrowly ovate with the broad end laterad and scar nearly central, a well-marked umbilicus and deep lateral emargination, resulting in a somewhat trilobate outline (fig. 101*b*). Apparently the dorsum is incompletely covered in the anterior region but completely covered after XXVII, though the elytra cannot overlap much medially. All elytra are soft, flexible, perfectly colorless, smooth and free from cilia or definite papillæ. Some of them (fig. 101*b*) exhibit one to three large, bleb-like elevations along the lateral margins which may be, however, pathological. Internally they are composed of a mass of vertical fibers among which the nerve fibers and nerve cells and slender end organs may be seen.

Acicula yellow; setæ all colorless. Notopodial setæ in a spreading whorl arising along a long curved line which becomes more restricted to the dorsum anteriorly. All are slender and capillary, some quite smooth, others hispid with small stiff hairs arranged in oblique rings or part rings toward the base of the setæ (Pl. XXXIII, fig. 104*a*) this arrangement being gradually replaced in the middle region by one of larger nearly opposite paired spines (fig. 104*b*) which gradually become reduced and disappear, leaving a long and very delicate smooth tip. Such setæ are found in the dorsal part of the bundle, being most numerous and widely distributed posteriorly and fewer and more restricted anteriorly where the first four or five parapodia appear to bear only smooth notopodial setæ in the small fascicles. Neuropodial setæ are mostly semicompound with an imperfect articulation differentiating the peculiarly canaliculated or camerated appendage which tapers to a delicate attenuated tip (fig. 102). All three groups are made up of similar setæ except that those of the posterior series are smaller, and on anterior segments the joint becomes obsolete on antero-dorsal setæ. On XXV and following parapodia one or two delicate setæ with alternating ensheathing plates and delicate very acute tips (fig. 103) occur in the extreme posterior dorsal part of the anterior dorsal series.

Station 4,354, off Point Loma, vicinity of San Diego, 646–650 fathoms, green mud.

This is the first true *Leanira* that has been reported from the North Pacific. McIntosh described several species under this generic designation but as has been several times pointed out these were incorrectly assigned and Willey has recently proposed the genus *Sthenolepis* for them and related species.

Sthenolepis areolata (McIntosh) Willey.

Leanira areolata McIntosh, Challenger Reports, Zoology, Vol. XII, pp. 151–153, Pl. XXI, fig. 3.

This species has been reported hitherto only from the Western Pacific, having been described from Japanese waters by McIntosh and the writer. It was taken south of Yedo in 345 fathoms and in Sagami Bay in 153–749 fathoms.

Several examples in this collection agree perfectly with McIntosh's description and with the Japanese specimens examined by me. The elytra exhibit a slight tendency toward a trilobate form and have a few small blunt horny papillæ not mentioned by McIntosh scattered over the surface. At about XXX the marginal fringe and lateral areolation of the elytra become well marked. The peculiar elongated notocirrus of III is well exhibited in these specimens and is a noteworthy character of the genus. All of the specimens are broken and incomplete, the longest having a length of 130 mm. and 112 segments.

Stations 4,382, south of North Coronado Island, vicinity of San Diego, 642–666 fathoms, green mud; 4,398, Lat. 32° 43′ 20″ N., Long. 117° 42′ 10″ W., 620 fathoms, green mud, rock; 4,518, off Point Pinos Light-house, 66–140 fathoms, hard sand; 4,538, same region, 795–871 fathoms, hard gray sand.

Sthenelanella uniformis gen. et. sp. nov. Pl. XXXIII, figs. 105–112.

A slender, little depressed species very gently tapered from somite

X. The only known specimen is a male filled with sperm represented by the anterior 36 segments and measuring 11 mm. long and 2 mm. in total width.

Prostomium (Pl. XXXIII, fig. 105) partly sunken into peristomium, its profile nearly straight to ocular region where it bends downward rather abruptly into the vertical anterior face; outline nearly circular, truncate behind and slightly wider than long. Eyes black, two pairs, situated close to median ceratophore, both visible from above, those of each side nearly in contact and of the two sides separated by nearly two-thirds of the prostomial width; the anterior pair at about the level of the tentacular axis and twice the diameter of the posterior pair which are dorsal. Median tentacle arising from a short ceratophore not more than one-third of the length of the prostomium and dorso-anterior in position; style about one and one-half times length of prostomium, the basal two-thirds rather stout, the remainder rather abruptly contracted into a filament with a slightly knobbed tip. Tentacular lamellæ thin, aliform, bilobed by a lateral notch, not longer than ceratophore to which the medial border is broadily united. Lateral tentacles united with dorso-median aspect of peristomial parapodia, only their filamentous tips free, the rest concealed by the buccal lamellæ, to the lateral face of which they are united. Palpi arising from distinct ceratophores appearing external to the peristomial parapodia, the styles nearly flagelliform, slender and regularly tapered to delicate tips, more than three times as long as the median tentacle. All cephalic appendages lack cilia but are provided with a few regularly arranged sensillæ bearing minute sensory hairs projecting through cuticular pores.

Peristomium and its parapodia largely coalesced with venter of prostomium, beyond which the latter project for half their length (Pl. XXXIII, fig. 105), bearing at the distal end a dorsal and a ventral tuft of capillary setæ which spread anteriorly and cross in front of the prostomium. Tentacular cirri with very short indistinct cirrophores, the styles similar in form to the median tentacle, the dorsal nearly equal to the latter, the ventral about two-thirds as long. Buccal or peristomial lamella a thin curved plate attached to the medial side of the peristomium and reaching slightly beyond its end.

Metastomial segments rather well marked, except dorsally in the pharyngeal region which is very smooth, about four or five times as wide as long with well-marked ventral muscular ridges and between them a neural groove.

Parapodia strictly lateral, arising near ventral level, rather stout and more strongly compressed than usual in the family. For the most part they project strictly laterad and their length is two-fifths to two-thirds the width of the somites. Though conspicuously biramous the rami are closely united and the interamal cleft is little developed. Neuropodium (Pl. XXXIII, figs. 106 and 107) deep and compressed, scarcely tapered, ending in a thick, obliquely truncate, notched acicular process, surrounded above, behind and below by a perisetal fold, the posterior part of which is well developed as a broad, deep, oblique membrane with the margins entire, the dorsal and ventral portions being less developed, discontinuous and bearing small marginal sensory papillæ. Notopodium (figs. 106 and 107) very much smaller than neuropodium and slightly overlapping its posterior face, subconical or prolonged mammilliform, receiving the tip of the aciculum in the apex and bearing a spreading fascicle of setæ. On the dorsal side of its base is a large opake hemispherical swelling which bears the ventral ctenidium except on anterior parapodia.

Notocirrus rudimentary throughout length of piece—a minute papilla (Pl. XXXIII fig. 107) on the ventro-lateral part of a rather prominent opake swelling representing the dorsal tubercle, ceratophore and elytrophore combined, on the ventral side of the projecting end of which is a peculiar scale-like ensheathing lamina bearing a ciliated area probably representing the dorsal ctenidium. Between the dorsal process and the parapodium is the usual deep bay. Ctenidia are slightly developed and obvious on only certain parapodia. The dorsal and ventral have already been mentioned; the intermediate one (fig. 107)—no better developed—occurs about midway between the others. Neurocirri arise from near base of parapodium from a small cirrophore and reach base of ventralmost setæ; basal half of style enlarged and with a dorsal concavity, distal half slender and divided into three incompletely differentiated subequal segments. First four parapodia directed progressively more forward. On II and III the neurocirri are longer, that of II reaching slightly beyond the end of its parapodia.

Elytra borne on II, IV, V and alternate segments to at least XXI, beyond which I am unable to distinguish which segments have borne elytra. Only the first four pairs and the eleventh elytra are attached, beside which there are a number of loose elytra in the bottle. Those in place fail to meet medially, leaving a large part of the dorsum uncovered and the eleventh pair is especially small, but all curve down the sides quite to the parapodia. First pair circular, the next few oblong with the medial end boldly rounded and the anterior border slightly concave (Pl. XXXIII, fig. 108), the posterior ones nearly equal-sided rhomboids with rounded corners. In all cases the scar of attachment is slightly laterad of the center, and the lateral margin is peculiarly thickened and upturned. The lateral margin of the first bears a close fringe of short, thick, crowded papillæ arranged in two or three rows; succeeding ones bear no papillæ or only a few near the antero-lateral angle, while those still farther back have an increased number partly of cylindroid, partly of clavate papillæ each with an apical sense organ (fig. 109). All elytra are of soft and delicate texture, especially the more posterior which are colorless or exhibit faint traces of pigment. The first four at least are rather heavily pigmented with a mosaic of polygonal chromatophores of slaty fuscous and orange brown forming a blotched reticular pattern enclosing colorless areas, the brown abounding on the periphery, the fuscous toward the center. On the first pair nearly the entire surface is blotched, on the others only a broad oblique band covering the postero-medial exposed parts, the lateral and covered portions being quite colorless (fig. 108).

Acicula, which occur singly in each ramus, are stout, tapered, straight and yellow. Setæ colorless and translucent. Notopodials—loose tufts curving dorsad—of long, very slender, soft, flexible capillaries, plumose with fine hairs alternating on the two sides and, toward the base, where they become long and conspicuous, possibly arranged spirally; they diminish in size and finally become obsolete distally, leaving a long smooth fiber-like tip (Pl. XXXIII, fig. 112). Neuropodial setæ arranged in a modification of the horse-shoe-shaped fascicle of *Sthenelais tertiaglabra*, the anterior gap becoming very large, the whole fascicle much flattened antero-posteriorly and the ventral supplementary series crowded against its ventral face; the result is practically a single vertical rank of setæ with slight dorsal and ventral spurs. These setæ differ greatly from those typical of *Sthenelais*, all of the appendages being short, simple-pointed and non-articulate. The two or three in the dorsal spur have the slightly enlarged end of the shaft roughened by two or three rows of small stiff hairs on each side (a character that becomes less evident and probably disappears posteriorly), and the appendages two or three times as long as the diameter of the shaft, cigar-shaped with blunt tips and more pointed bases (fig. 110). The remainder of the setæ of the main series are stouter, have the ends of the shafts quite smooth, the appendages pointed, straight and conical and from one and one-half to twice the diameter of the shafts (fig. 111*a*). Setæ of the ventral spur again more slender with short somewhat claw-like appendages and smooth shafts (fig. 111*b*). There is a general tendency for the appendages to become longer and more curved anteriorly, while posteriorly many of those in the middle part of the main series become imperfectly coalesced with the shafts to form simple setæ. Peristomial setæ are all of the notopodial-capillary type but the hairs are reduced to the finest denticulations.

Station unknown. Labeled "with yellow *Doris*" probably indicating a commensal habit.

In general aspect this species somewhat resembles *Sthenelais fusca* Johnson but differs greatly in the character of the setæ. Indeed, the character of the setæ is so unique that I feel compelled to separate this species from typical *Sthenelais*, having a complex group of neuropodial setæ most of which have distinct articulated appendages, as the type of a distinct genus or subgenus *Sthenelanella*.

Sthenelais tertiaglabra sp. nov. Pl. XXXIII, figs. 113–120.

Based on two short anterior ends: a cotype consisting of 36 segments from a slightly larger specimen and the type of 45 segments, measuring 22 mm. long, with a maximum body width of 1.3 mm., 2.5 mm. between tips of parapodia and 3.1 mm. between tips of setæ; depth about 1 mm.

Prostomium (Pl. XXXIII, fig. 113) subcircular, somewhat wider than long, with the sides bulging slightly toward the anterior end, slightly narrowed behind and bearing a low protruberance on each side. Eyes two pairs, black; the dorsal larger, situated behind base of middle tentacle, separated by one-fourth or more width of prostomium; ventral pair on frontal face immediately beneath tentacular lamellæ, smaller and somewhat closer together than dorsal pair. Median tentacle arising between the four eyes by a stout ceratophore about three-fourths as long as prostomium; style moderately slender, regularly tapered to a short faintly articulated filament terminating in a minute knob, the cuticle unequally thickened and peculiarly crenulated or crinkled but lacking sensory cilia. Antennal lamellæ spoon-shaped, ovate, diverging wing-like from each side of base of ceratophore and nearly as long. Lateral tentacles coalesced with dorso-medial face of peristomial parapodia, the short free tip projecting beyond the end of the parapodium to a distance of about one-half the length of the latter with the end knobbed and slightly articulated. Like the median tentacles these lack large sensory cilia but are provided with minute tactile organs visible under high magnification. Palpi slender and delicate, about five and one-half times length of prostomium, regularly tapered and smooth. A very slight facial ridge runs to the mouth.

Prostomium completely concealed beneath prostomium, its parapodia produced straight forward at sides of prostomium and reaching about its length anterior to it (Pl. XXXIII, fig. 113). It is supported by a notopodial aciculum, dorsal and ventral to which on the medial side arise the two tufts of capillary setæ. Parapodial lamella a thin, narrow elongated curved plate embracing the medial face of the parapodium like a scale nearly to its end and covering most of the lateral tentacle. Tentacular cirri arising close together on lateral side of distal end of parapodium; dorsal with a short cirrophore and style resembling the median tentacle but much more slender and only about two-thirds as long; ventral without distinct cirrophore and style only about two-fifths as long as dorsal.

Mouth bounded by a pair of lateral lips formed by II and a broad, furrowed, posterior lip extending through III and IV. Body slender and nearly linear, the dorsum more convex than the muscular venter, transverse diameter little greater than vertical, sides nearly vertical but owing to greater width at dorsum slightly overhanging. Segments scarcely defined, the furrows being obsolete and the cuticle very smooth.

Parapodia (with the exception of the first four pairs) projecting directly laterad from near the ventral level, generally little longer than one-half width of segments, somewhat compressed, dorsal and ventral borders nearly parallel, the rami of equal length and separated by a narrow cleft. Notopodium about one-half diameter of neuropodium, broadly rounded and nearly truncate at the end, which bears a low papilla in which the aciculum ends. Ventral to the acicular papilla is a row of four or five short, finger-shaped processes or stylodes increasing in length from behind forward and forming the chord of a high-arched series of setæ surrounding the aciculum and backed by a low crenulated integumental fold. Neuropodium much deeper and more compressed distally where it terminates in a low triangle, the blunt apex of which lies nearer the dorsal than the ventral side and which receives the tip of the aciculum. Surrounding this acicular prominence is a flattened, incomplete ring or horse-shoe of setæ open anteriorly and backed by a low membrane bearing a regular series of stylodes most of which are very short, but increase in length both dorsally and ventrally where from four to six become prominent. A single much longer stylode is appended to the tip of the acicular papilla but is frequently wanting and is probably caducous. Notocirrus separated from the papapodium by a rounded bay equalling the latter in width, pendant from a prominent swollen cirrophore or elytrophore and usually curved inward, short and thick, reaching scarcely more than half way to the neuropodium and very densely ciliated on one (normally inner) face. Ciliated pads or ctenidia three, two occupying the notopodial bay, the ventral one on the dorsum of the notopodium; middle one nearly twice the length of the dorsal which exceeds the ventral. Neurocirrus arises by a short cirrophore near base of neuropodium; style rather slender, tapered and reaching beyond base of ventralmost setæ; dorsal side curiously irregular, at the base a short, blunt, spur-like process followed by a shallow depression and just proximad of the middle by a low swelling beyond which the dorsal side exhibits a crenulated outline gradually deepening toward the tip which is composed of two or three moniliform articulations.

Caudally the parapodia become relatively longer and anteriorly the first four or five are directed more and more forward and become longer, the first two pointing directly forward. Neurocirrus of II about twice as long as the others.

Acicula single in each ramus, stout, tapered, slightly curved, the tip projecting a little. Notopodial setæ in a dense olbique row, becoming much longer toward the dorsal and posterior end from which they rise in a long falcate pencil over the outer margin of the elytra. All simple, capillary, very slender, and very finely setose with minute, mostly opposite hairs. Neuropodials in a flattened horse-shoe-shaped series open anteriorly, besides which there is an outer ventral curved series reaching farther dorsad in front and a small, detached dorsal tuft. The latter consists of three to five delicate, acutely pointed, simple setæ with tapering shaft and spirally wound fringe of twelve to fifteen conspicuous turns, diminishing and becoming obsolete distally (Pl. XXXIII, fig. 120). Associated with these there is often present on anterior parapodia one or rarely two compound setæ with the distal end of the shaft provided with a spiral fringe of several turns and the very long, slender, articulated appendage ending in a simple delicate point (fig. 117). Most remaining neuropodial setæ are compound and on anterior segments have slender, tapering, articulated appendages terminating in bifid tips which, however, may be so weak and obscure on some of the more slender ones that this character may appear doubtful. The largest and stoutest setæ are in the posterior side of the principal series and have short, few-jointed appendages and obscurely bifid tips (fig. 116). The dorsal arc is formed of setæ of moderate thickness with the end of the shaft often ornamented with several antrorse pectinæ or spinulose rows and the elongated and slender appendages with ten to fifteen articulations and distinctly bifid tips. Those of the main ventral arc have quite smooth shafts and appendages of intermediate length. Setæ composing the outer ventral arc are very slender with smooth (or anteriorly slightly spinulose), rather strongly curved shafts and appendages with the number of joints increasing from one on ventral to seven or eight on the most dorsal and anterior setæ and varying correspondingly in length. These have the tips conspicuously hooked and bifid (fig. 118). Two stout dark-colored setæ with short unjointed strongly hooked and bifid appendages (fig. 119) occur about the middle of the posterior row regularly on parapodia behind XXX. On the cotype one of these was found on V but none could be detected on other anterior parapodia. Proceeding caudally all articulated setæ tend to have fewer joints.

Elytra occur on II, IV, V and alternate segments to XXVII and after that on every consecutive segment to the end of the piece. They are thin, only moderately arched and in the type devoid of pigment, though anterior ones of the cotype are each marked with a short curved dusky bar near the median border; posteriorly most of them are covered with a light ferruginous deposit. They are of the usual broadly lunate form (Pl. XXXIII, fig. 114), becoming narrower behind XXVII, truncate laterally where they are fimbriated with rather sparse but moderately long processes, often arranged in small groups with minute papillæ between (fig. 115*b*). The elliptical scar lies laterad of the middle, the third of the elytron external to its outer edge being noteworthy for its rich supply of branching nerves and the absence of surface nodules except for a narrow area adjacent to the umbilicus. The remainder of the surface is thickly studded with small hard trihedral nodules or spines, becoming slightly larger toward the posterior border (fig. 115*a*).

Stations 4,343, south of South Coronada Island, vicinity of San Diego, 55–155 fathoms, fine gray sand (type); 4,552, off Point Pinos Light-house, Monterey Bay, 66–73 fathoms, green mud and rocks (two cotypes).

This species resembles *Sthenelais blanchardi* Kinberg, of the coast of Chile, in having all of the compound neuropodial setæ bifid at the tips, but differs in having those of the ventral group much less slender and with fewer articulations than figured by Kinberg, the median tentacle relatively longer and the smooth lateral area of the elytra decidedly broader.

Explanation of Plates XXVIII–XXXIII.

Unless stated otherwise, all figures are drawn, with aid of the camera lucida, from the types.

PLATE XXVIII—*Eunoë barbata*—Figs. 1–6.

Fig. 1—Neuropodial seta from middle of somite X, × 250.
Fig. 2—End of a middle notopodial seta from X, × 250.
Fig. 3—Nearly smooth tip of a ventral notopodial seta from X, × 250.
Fig. 4—Third elytron of right side, × 9.
Figs. 5 and 6—Portions of the same elytron at points respectively indicated by A and B, × 56.

Eunoë cæca—figs. 7–12.

Fig. 7—Head region from above, the prostomium slightly tipped up in front, tentacular cirri shown on left side only, × 9.
Fig. 8—Posterior view of parapodium X without setæ, × 17.
Fig. 9—Neuropodial seta from middle of fascicle of somite X, × 56.
Fig. 10—Tip of the same, × 250.
Fig. 11—End of middle notopodial of X, × 56.
Fig. 12—Tip of the same, × 250.

Harmothoë scriptoria—figs. 13–17.

Fig. 13—Head region from above, median tentacular style missing and tentacular cirri shown on left side only, × 24.
Fig. 14—Anterior aspect of parapodium XX without setæ, × 33; 14*a*, tip of acicular process of neuropodium of the same viewed from behind, more highly magnified.
Fig. 15—Elytron from somite XI, × 9; 15*a*, a small portion of the surface at A, × 56.
Fig. 16—End of a neuropodial from middle of fascicle of X, × 440.
Fig. 17—Tip of middle notopodial of X, × 250.

PLATE XXIX—*Harmothoë triannulata*—figs. 18–22.

Fig. 18—Prostomium and peristomium with appendages, from above, × 24.
Fig. 19—Parapodium X without setæ or notocirrus, caudal aspect, × 33.
Fig. 20—An anterior elytron, × 33.
Fig. 21—Neuropodial seta from middle of fascicle of X, × 250.
Fig. 22—End of an average notopodial seta from X, × 440.

Harmothoë tenebricosa—figs. 23–28.

Fig. 23—Dorsal aspect of head region, tentacular cirri and palpus shown on left side only, × 9.
Fig. 24—Anterior aspect of parapodium X without setæ and notocirrus, × 24.
Fig. 25—Neuropodial seta from middle of fascicle of X, × 56.
Fig. 26—Tip of the same, × 250.
Fig. 27—Middle notopodial from X, × 56.
Fig. 28—Tip of the same, × 250.
Figs. 25–28—drawn from cotype.

Harmothoë (*Evarne*) *fragilis*—figs. 29–30.

Fig. 29—Dorsal aspect of prostomium and peristomial parapodia, lacking median tentacular style and right tentacular cirri, × 24. Left tentacular cirri from a cotype.
Fig. 30—Neuropodial seta from middle of fascicle of X, × 250.

PLATE XXX—*Harmothoë fragilis*—figs. 31–33.

Fig. 31—Anterior aspect of parapodium X of a cotype (Sta. 4,418), × 33.
Fig. 32—Third elytron of the same cotype, × 24.
Fig. 33—Tip of average notopodial of X, × 250.

Antinoë anoculata—figs. 34–40.

Fig. 34—Cephalic region from the dorsum, × 9.
Fig. 35—Posterior aspect of parapodium X without setæ, × 9.
Fig. 36—Fourth right elytron (VII), × 9.
Fig. 37—Neuropodial setæ from X; *a*, dorsal, *b*, middle, and *c*, ventral, × 56.

Fig. 38—Tips of three of the same more highly magnified; *b* and *c*, middle and ventral setæ respectively, × 250; *d*, a ventral seta with peculiarly bifid tip, × 440.
Fig. 39—Distal portion of an average notopodial from X, × 56.
Fig. 40—Tip of the same, × 250.

Nemidia microlepida—figs. 42–44.
Fig. 42—Dorsal aspect of cephalic region with base of protruded proboscis; left ventral tentacular cirrus only represented, × 17.
Fig. 43—Anterior aspect of parapodium X, × 24; *a*, posterior aspect of tip of the neuropodium, × 33.
Fig. 44—Elytron from somite XVII, × 24.

Plate XXXI—*Nemidia microlepida*—figs. 45, 46.
Fig. 45—Complete neuropodial seta from LXXX, × 250.
Fig. 46—Worn neuropodial seta as usually found, from a posterior segment, × 250.

Polynoë(?) *remigata*—figs. 47–51.
Fig. 47—Incomplete and distorted head region, × 17.
Fig. 48—Anterior aspect of a middle parapodium without setæ or cirri, × 24.
Fig. 49—End of a notopodial from middle region, × 250.
Fig. 50—Neuropodial from middle segment, × 33.
Fig. 51—Tip of a neuropodial, × 250.

Polynoe(?) *filamentosa*—figs. 52–56.
Fig. 52—Anterior aspect of parapodium XXIII, without setæ or notocirrus, × 24.
Fig. 53—Tip of a long notopodial seta from XVIII, × 250.
Fig. 54—A short notopodial from XVIII, × 33.
Fig. 55—An average neuropodial seta from XVIII, × 33.
Fig. 56—Tip of the same, × 250.

Polynoe(?) *aciculata*—figs. 57, 58.
Fig. 57—A much retracted parapodium without setæ or neurocirrus but with notocirrus, anterior view, × 24.
Fig. 58—End of a dorsal neuropodial seta, × 250.

Polynoe(?) *renotubulata*—figs. 59–64.
Fig. 59—Head lacking some of the appendages, × 9.
Fig. 60—Posterior aspect of parapodium from behind middle of body, without setæ, and showing the greatly elongated nephridial papilla (*n*), × 9.
Fig. 61—First elytron, × 9.
Fig. 62—Average neuropodial seta from XXIII, × 33.
Fig. 63—End of the same, × 250.
Figs. 64*a* and 64*b*—Side and face views respectively of end of a ventral neuropodial from XXIII, × 250.

Aphrodita armifera—figs. 65, 66.
Fig. 65—Dorsal finbriated organ from XII, × 56.
Fig. 66—Two dorsal papillæ, × 250.
Figs. A and B—Free-hand sketches of tips of average neuropodial and notopodial setæ from somite X of *Harmothoë yokohamiensis*.

Plate XXXII—*Aphrodita armifera*—figs. 67–75.
Fig. 67—Head from above, × 9.
Fig. 68—Medium sized notopodial seta from ventral fascicles of X, × 24.
Fig. 69—Tip of the same showing the asperities which are largest near the end, × 56.
Fig. 70—Two neuropodial setæ of the dorsal row of X, one in profile and another in face view, × 56.
Fig. 71—Neuropodial seta of middle row of X, × 56.

Fig. 72—Two setæ of ventral neuropodial row of X, × 56.
Fig. 73—Tip of the smaller seta shown in fig. 72, slightly turned to show flattened concave surface, × 250.
Fig. 74—End of one of the more dorsal pinnate setæ from the ventral neuropodial fascicle of II, × 250.
Fig. 75—Portion of a slender spinous neuropodial seta from a caudal parapodium, × 360.

Aphrodita refulgida—figs. 76–84.
Fig. 76—Dorsal papillæ, × 56.
Fig. 77—Dorsal fimbriated organ from XV, × 56.
Fig. 78—Head (peristomial parapodia of right side omitted; dorsal tentacular cirrus, added from cotype), × 9.
Fig. 79—notopodial seta (in two pieces) from dorsal fascicle of X, × 24.
Fig. 80—Tip of another of the same, showing the sheath sometimes present, × 250.
Fig. 81—*a*, *b* and *c*, outlines of ends of dorsal, middle and ventral neuropodial setæ respectively, from X, × 56.
Fig. 82—End of a seta from near dorsal part of ventral neuropodial fascicle of II, × 250.
Fig. 83—End of one of the shorter, slender spinous neuropodials from caudal parapodia, × 250.
Fig. 84—Portion of end of elongated neuropodial from caudal region, × 250.

Aphrodita castanea—figs. 85–97.
Fig. 85—Head of cotype (Sta. 4,468). The right peristomial foot exhibits an abnormal condition in the presence of two dorsal tentacular cirri, × 9.
Fig. 86—Fimbriated organ from XII, × 24.
Fig. 87—Two dorsal papillæ, × 250.
Fig. 88—Hooked tips of two notopodial setæ from dorsal fascicle of X (cotype sta. 4,482), × 250.
Fig. 89—Superficial roughening of small portion from middle of a dorsal notopodial of X (cotype), × 250.
Fig. 90—Tip and small portion of dorsal felt fiber of middle segment, × 600.
Fig. 91—Same of lateral fiber, × 600.
Fig. 92—*a*, *b* and *c*, dorsal, middle and ventral neuropodial setæ respectively (cotype sta. 4,482) of X, × 56.
Fig. 93—Pinnate seta from middle of ventral neuropodial fascicle of II, × 250.
Fig. 94—Short spinous ventral neuropodial of caudal region, × 250.
Fig. 95—Long same, × 250.
Fig. 96—Tip of notopodial from caudal region showing the sticky hairy surface, × 600.
Fig. 97—Portion of middle of lateral fiber from caudal region showing same condition, × 600.
Figs. 85, 88, 89, 92, 93, 94, 95, and 98 were drawn from a cotype (sta. 4,482).

Plate—XXXIII.
Fig. 98—Ventral neuropodial seta from somite X of *A. castanea*, × 250.

Leanira alba—figs. 99–104.
Fig. 99—Dorsal view of anterior end, with second right and third left elytra in place, right side not completed, × 9.
Fig. 100—*a*, *b* and *c*, parapodia II, XXV and L, respectively, anterior views without seta, × 17.
Fig. 101—*a* and *b*, outlines of elytra IX and XXXIX, respectively, × 9.
Fig. 102—Profile view of an average, anterior, subacicular neuropodial seta of XXV, × 250.
Fig. 103—An extreme dorsal neuropodial seta from XXV, × 250.
Fig. 104—*a* and *b*, basal and middle portions of a notopodial seta from XXV, × 440.

Sthenelanella uniformis—figs. 105–112.

Fig. 105—Head from above, × 24.

Fig. 106—Anterior view of parapodium X, × 56.

Fig. 107—Posterior view of parapodium XX, × 56.

Fig. 108—Elytron V, × 24. The light and dark stippling represent somewhat crudely the distribution of brown and fuscous pigment.

Fig. 109—Small portion of lateral border of elytron II, × 250.

Fig. 110—Ends of dorsal neuropodial setæ, *a*, profile view of one from XX, *b*, posterior view of one from V, × 440.

Fig. 111—Neuropodial setæ from XX; *a*, middle one with imperfect articulation, *b*, a fully compound ventral one, × 440.

Fig. 112—Small portion of plumose notopodial seta from XX, × 440.

Sthenelais tertiaglabra—figs. 113–120.

Fig. 113—Head from dorsum, × 24.

Fig. 114—Elytron XXV, × 17.

Fig. 115—*a*, four trihedral horny papillæ from near posterior border of elytron; *b*, portion of lateral margin with cirriform and minute ovate papillæ, × 250.

Fig. 116—Stout posterior neuropodial seta of usual type, from XX, × 360.

Fig. 117—Slender dorsal neuropodial of XX, × 360.

Fig. 118—Neuropodial seta of outer ventral arc, from X; *a*, tip of another, × 360.

Fig. 119—Stout neuropodial with unjointed appendage from posterior series of XXXV of cotype, × 250.

Fig. 120—Simple dorsal neuropodial seta from XX, × 360.

A NEW FISH OF THE GENUS PARALEPIS FROM NEW JERSEY.

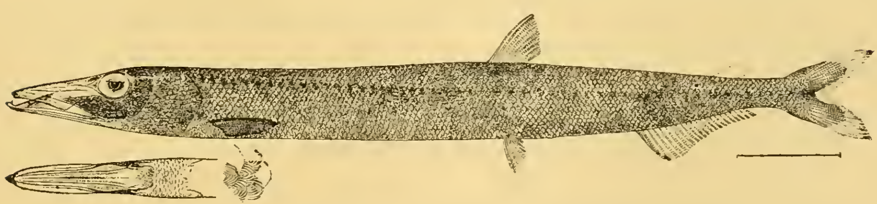
BY HENRY W. FOWLER and DR. RICHARD J. PHILLIPS.

Paralepis barracudina sp. nov.

Head $4\frac{1}{10}$; depth 10; D. ii, 8, I; A. iii, 21, I; P. i, 13; V, i, 8; scales in lateral count along lateral line to caudal base (squamation damaged) estimated about 120?; 18 scales (several lost) ir slight oblique series down from dorsal origin to that of ventral; about 70? predorsal scales; head width $5\frac{1}{4}$ its length; greatest head depth 3; depressed dorsal length 3; pectoral $2\frac{7}{8}$; ventral 5; least depth caudal peduncle $6\frac{2}{5}$; anal base about $1\frac{3}{4}$; mandible 2; snout $2\frac{1}{5}$ in head, measured from upper jaw tip; eye $6\frac{1}{6}$; maxillary 3; interorbital $8\frac{1}{4}$.

Body elongate, slender, well compressed, edges convex, though lower more constricted than upper. Greatest depth about dorsal origin, body slightly tapering forward from this point, and more suddenly behind. Sides of body flattened. Caudal peduncle small, well compressed, and least depth nearly half its length.

Head attenuated, well compressed, lower profile nearly straight, and upper slightly concave anteriorly. Snout long, depressed or



flattened above, and sides slightly convex. Eye rounded, little longer than deep, high or close to upper profile, and placed slightly behind middle in head length. Mouth terminal superiorly, moderately long, and gape not extending back more than half length of maxillary. Jaws thin, mandible large, well projecting beyond tip of upper jaw and with slight symphyseal knob fitting in a corresponding shallow emargination above, though latter quite broad so that front edge of upper jaw laterally appears to ensheath it. Mandibular rami with entire low prominent longitudinal external ridges. Maxillary thin, moderately broad, slipping under thin preorbital edge above, and end slightly more than $\frac{2}{3}$ to eye. Uniserial minute, short, close-set, rather robust, compressed and backwardly-curved teeth along upper jaw edge, which begin anteriorly at each side of anterior emargination and extend back short space from distal maxillary end. Anterior end of upper jaw thin and entirely edentulous. Uniserial teeth on each palatine, anteriorly nearly large as symphyseal canines, and gradually decreasing in size posteriorly. No other teeth on roof of mouth. On each side of mandibular symphysis a small and nearly erect canine. Just behind these and well inside 1 or 2 smaller canines. A short space still posterior uniserial small mandibular teeth begin on each ramus along edges, nearly uniform, small, and similar to those above except more erect, or even slightly leaning forward at anterior region. Mandibular teeth continue well back inside mouth. Rami of mandible well elevated inside mouth posteriorly. Tongue elongately spatulate, well free in front, extending forward nearly opposite tip of upper jaw, and with one series of recurved teeth, similar to those on front of palatines, along each upper edge, and posteriorly these series become slightly approximated. At tongue base each side a knob, opposite and posterior to which surface smooth and edentulous. Lips extremely thin, membranous, but little developed along jaw edges. Nostrils inconspicuous, 2 small pores near last third in snout length or nearly opposite distal maxillary end, and close to upper profile. Interorbital region depressed, concave medianly. Occipital region with even convex surface. Frontal, prefrontal, supraorbital and preorbital ridges prominent. Upper postorbital ridge prominent to each opercle, and preopercular ridge sloping down in wide curve to mandible. Lower surface of head convexly constricted.

Gill-opening large, extending well forward or about last $\frac{2}{5}$ in snout length, and behind well above eye. Epibranchial region $\frac{1}{3}$ combined cerato-hypobranchial. Rakers slender, conic, single, bifid and often trifid, on epibranchials about 8, or 1 or 2 more + 25 cerato-hypobranchials, also several more sometimes. Longest rakers about $\frac{2}{5}$ longest filaments, and latter about $\frac{2}{3}$ horizontal eye. Pseudobranchiæ large, nearly equal largest filaments. Isthmus anteriorly long thin frenum, and posteriorly still narrow with convex surface. Peritoneum with outer membranes bronzed, and inner lining blackish.

Scales small, cycloid, caducous, and with conspicuous striæ on exposed surfaces enlarged, very distinct, extending to edges, and more or less curved in approximation toward median axis. Body scaly, except upper front portion of head before eyes, mandible, all fins except caudal base, and narrow area below shoulder-girdle nearly to ventrals. This latter as a very narrow naked strip over which the scales do not seem to pass. Scales on trunk arranged in longitudinal series, those above lateral line slope down obliquely parallel with its course, and those below in nearly even horizontal series. About 4 rows of scales on cheek extending well forward on preorbital region nearly opposite gape of mouth. Top of head scaly nearly to interorbital. Opercles entirely scaly, scales extending down over branchiostegals, at least above. Breast sides covered with small scales, at least a little smaller than others. No scaly axillary flaps. Small scaly flap between bases of ventrals. Small scales on caudal base. Lateral line inconspicuous, continuous, sloping gradually down from shoulder to caudal base, and scales in its course not enlarged. Where scales have fallen its course is very evident by enlarged pigmented pockets, but showing indistinctly through perfect squamation. Tubes very inconspicuous, simple, short, little exposed, and rather sparse, or alternately skipping 1 or more scales.

Dorsal origin inserted little nearer caudal base than hind preopercle edge, small, graduated down from second simple ray, and base about $\frac{2}{3}$ its depressed length. Anal inserted little nearer dorsal origin than caudal base, first branched rays longest (edges damaged) and posterior half of fin much lower. Adipose dorsal not determined (damaged). Caudal (damaged) small, and 7 rudimentary rays both above and below well developed. Pectoral small, low, inserted close after end of opercle, and uppermost rays longest. Ventral inserted about opposite base of fourth branched dorsal ray, small, rounded, and depressed fin about $3\frac{1}{2}$ to anal. Vent just after tips of depressed ventrals.

Color when fresh in alcohol deep lilac or leaden-grayish generally, with more or less dull neutral shades and silvered reflections. Coloration largely uniform, scarcely paler below. Edges of bones of head above with more or less blackish pigment. Inside mouth, tongue, and within gill-opening blackish. Fins all dull pale grayish, dorsal and caudal slightly dusky. Iris shining leaden-dusky.

Length $8\frac{1}{4}$ inches (caudal damaged).

Type, No. 37,627, A. N. S. P. Corson's Inlet, Cape May County, N. J. March 27th 1910. Dr. R. J. Phillips.

This is the only example obtained, and was found on the beach. Though in fair preservation, it had been disturbed a little by some crabs, which damaged part of the back in the region of the adipose dorsal. Our species appears related to the European *P. coregonoides*, differing chiefly in the smaller scales and having the teeth in the jaws all minute except the anterior palatines and mandibular canines. According to Moreau[1] the scales of *P. coregonoides* are about 64 in the

[1] *Poiss. France*, III, 1881, p. 519, fig. 205.

lateral line, and his rough figure shows nearly as many intended to represent a lateral count. We have examined a single poorly preserved Mediterranean example from the Bonaparte collection, evidently the basis of the latter's figure and description of his *P. coregonoides.*[2] It shows about 60 scale pockets, in the course of the lateral line, which do not extend very much posterior to the anal base. Though the snout and mandible are considerably damaged they show much larger teeth along edges of the latter, than on edges of the upper jaw. The ventrals are inserted behind dorsal origin and the A. iii, 24? A specimen from Lat. 28° 43′ N., Long. 87° 14′ 30″ W., figured by Goode and Bean as *P. coregonoides,*[3] differs considerably from our example in the nearly even jaws with canines in the front of both, maxillary extending quite close toward the eye, deeper body and but slightly emarginated caudal. *P. speciosus* Belloti differs according to the original account and figure[4] in having the ventrals inserted slightly before the dorsal. *P. borealis* Reinhardt, said to range south in the Atlantic to Cape Ann, has been referred to a different genus, chiefly as the ventrals are inserted entirely behind the dorsal. Goode and Bean figure an example they refer to *P. borealis*[5] which shows the head $4\frac{2}{3}$, depth nearly $13\frac{1}{2}$, dorsal origin nearly last third in total length, A. iii, 26 and nearly 200 scales in a lateral count from shoulder to caudal base. It may be here noted in this connection that *Paralepis,* usually credited to Risso in 1826, cannot date from then, as it first occurs in Bosc, this author virtually naming Cuvier's account, which is not tenable as proposed in the French vernacular.[6] In Bosc's first account, under *Coregonus,* he says "le genre Paralepis de Cuvier enlève l'espèce de ce nom à celui-ci,"[7] and if this be considered inadmissible his next account[8] must be taken. As the first species, *P. coregonoides* Risso,[9] has been virtually allowed the type, it may be so considered still. The occurrence of *Paralepis barracudina* on our Atlantic shores is of interest not only as a new form and addition to our fauna, but also in further mapping out the distribution of the genus.

(*Barracudina,* diminutive of *Barracuda* or *Sphyræna,* to which the species of *Paralepis* bear a close superficial resemblance.)

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[2] *Faun. Italica,* III, pt. I, xxix, 1840, descr., Pl. fig. 2.
[3] *Ocean Ich.,* 1895, p. 119, Pl. 39, fig. 149.
[4] *Atti Soc. Ital. S. N.,* XX, 1877, pp. 54, 57, fig. Nice.
[5] *Ocean. Ich.,* 1895, p. 119, Pl. 38, fig. 143.
[6] *Régne Animal,* II, 1817, p. 290.
[7] *Nouv. Dict. S. N.,* VIII, 1817, p. 59.
[8] *L. c.,* XXIV, 1818, p. 520.
[9] *Journ. Phys. Chim. H. N.,* XCI, 1820 (Oct.), p. 253. Nice. (This is the earliest available reference to this species.)

A REVISION OF THE NORTH AMERICAN SPECIES OF THE GENUS ISCHNOPTERA (ORTHOPTERA).

BY JAMES A. G. REHN and MORGAN HEBARD.

Some months ago the study of a considerable series of specimens of this genus from North Carolina furnished the incentive for a careful examination of all the material on hand at that time, as well as a study of the literature bearing on the genus as present within the limits of the United States and Canada. The results were so interesting that a number of appeals were made for additional material to enable us to make our examination as complete as possible, and the cordial responses placed in our hands for study an extensive and very valuable series from the collections of the United States National Museum, the Brooklyn Institute of Arts and Sciences, and the private collections of Profs. Lawrence Bruner, A. P. Morse and W. S. Blatchley, to all of whom our hearty thanks are given for their coöperation. Primarily this work rests upon the material in the collection of the junior author, this representing about one-half of the five hundred and fifty-two specimens examined.

The two greatest difficulties encountered in studying the genus were the lack of sex correlation on account of the usually great sexual dimorphism, most of the females being considered species of other genera, such as *Temnopteryx* and *Loboptera* (*Kakerlac*), and the confusion or non-recognition of certain of the older species. In the present paper every species of the genus known from within our limits has the sexes correlated, with the result that *Loboptera* and *Temnopteryx* are entirely eliminated from our fauna, with the exception of one species of the latter genus known only from the female, the discovery of the male of which probably will prove its membership in the genus here treated.

The extent of individual variation in species of the genus is considerable, both in size and to a less extent in coloration. The length of the tegmina is the most variable dimension, although its ratio to the general size always remains much the same, only departing decidedly in this particular in specimens which are really intermediate in character between two geographic races. Coloration seldom varies except along the lines of intensification and dilution, the cases of presence or absence of a decided pattern within a species being few. The descriptions have been drawn up to cover as fully as possible the extremes, the measurements in all cases representing these except in a few dimensions where the most extreme specimens of a species examined have an identical measurement.

The form of the tegmina in the female sex furnishes one of the most interesting phases of specific divergence in this genus and it proved to be the rock on which a number of species were split off on one side into *Loboptera* and on the other into *Temnopteryx*. It is quite apparent that the form of these appendages is much less important in these species than was formerly supposed to be the case, as species very similar in general appearance, other structures, including genital appendages, and in coloration will differ considerably in tegminal form, although the form and proportions of these are quite constant within specific limits. Several of the species are difficult to separate in the male sex, while the females are quite easy to distinguish; in one case the females of two forms do not appear separable while the males are typically easy to distinguish. The greater diversity in the females when considered with their pronounced adaptation for life under stones and bark is in decided contrast to the more generalized structure of the males.

In the case of two forms it has been found advisable to use a trinomial, as sufficient evidence of intergradation exists in the territory where the ranges overlap, to demonstrate beyond a doubt that one is but a geographic form or race of the other. In these instances the trinomial shows close relationship, while a binomial would imply a unit distinction which does not exist.

As several authors have shown the great amount of variability in the number of complete and incomplete rami of the ulnar vein of the wing within specific limits in a number of genera of the *Pseudomopinæ* (*Phyllodrominæ* of authors), we have not used this character in separating species, contenting ourselves with giving in the specific descriptions the ramus extremes of the series examined.

The range of each species has been carefully mapped from the specimens and literature and the distribution of each species is given from its particular chart.

The exact position of *Temnopteryx desertæ* Rehn and Hebard[1] is doubtful, but as the discovery of the male will probably show its

[1] *Proc. Acad. Nat. Sci. Phila.*, 1909, p. 116, fig. 1. [Johnstone, Valverde County, Texas.]

true position to be in *Ischnoptera*, we have placed it, at least provisionally, in this genus.

ISCHNOPTERA Burmeister.

Distribution in North America.—Extending from southwestern Maine, southwestern Quebec, southeastern Ontario, Lake Superior, Minnesota and Oregon, south to southern Florida, Gulf Coast, extreme southern Texas, southern Arizona and California, apparently absent from the Cordilleran region from Colorado north and from the greater portion of the Great Basin.

Species Groups.

Deropeltiformis group.—General dark coloration. Supra-anal plate of male more or less truncate distad.

Subgroup with subquadrate tegmina in female.

1. *I. deropeltiformis* Brunner.
2. *I. nigricollis* Walker.

Subgroup with sublobiform or lobiform tegmina in female.

3. *I. johnsoni* Rehn.
4. *I. americana* (Scudder).

Pensylvanica group.—Pronotum of male always with dark discal area, usually indicated in female. Supra-anal plate of male with produced median portion rotundato-truncate or obtuse-angulate, lateral margins of same production distinctly arcuato-emarginate.

5. *I. pensylvanica* (De Geer).

5*a*. *I. p. inæqualis* (Sauss. and Zehntner).

6. *I. divisa* Sauss. and Zehntner.

Uhleriana group.—General pale coloration, very rarely with disk of pronotum darkened. Tegmina of female short, more or less subquadrate.

7. *I. couloniana* Sauss.
8. *I. uhleriana* Sauss.

8*a*. *I. u. fulvescens* Sauss. and Zehntner.

Notha group.—General pale coloration. Supra-anal plate of male broadly truncate. Tegmina of female covering greater portion of abdomen.

9. *I. notha* n. sp.

Borealis group.—General pale coloration. Supra-anal plate of male broadly arcuate.

Subgroup. Short, attingent tegmina in ♀.

10. *I. borealis* Brunner.

Subgroup. Lateral lobiform tegmina in ♀.

11. *I. bolliana* Sauss. and Zehntner.

Subgroup. Elongate tegmina, longer than body in ♀.

12. *I. insolita* n. sp.

Occidentalis group.—General coloration ferruginous to blackish-brown. Supra-anal plate of male produced, obtuse-angulate emarginate distad.

13. *I. occidentalis* Sauss.

Key to Species.

Males.

A.—Dorsal color uniform brownish or brownish-black or pronotum alone entirely of that color; tegmina paler, approaching burnt sienna. (Supra-anal plate produced mesad into a broad subtruncate process, lateral angles more or less rounded.)

B.—Tegmina same color as pronotum.

C.—Size larger (male tegmina 16 to 18 mm. in length)................. *deropeltiformis* (Brunner).

CC.—Size smaller (male tegmina 11.5–15 mm. in length).

D.—Color pitch black or blackish brown. Pronotum somewhat produced cephalad, with greatest length contained one and one-third times in greatest width. Supra-anal plate with distal extremity truncate.......... *johnsoni* Rehn.

DD.—Color ferruginous (rarely olivaceous). Pronotum transverse subelliptical, with greatest length contained about one and one-half times in greatest width. Supra-anal plate with distal extremity rounded.......... *americana* (Scudder).

BB.—Tegmina pale, pronotum dark........................*nigricollis* Walker.

AA.—Dorsal color not uniform deep brownish or blackish-brown, pronotum with pale lateral margins if center is dark brown.

B.—Pronotum with decided central discal dark brown or blackish-brown area of variable size, with lateral margins, at least, translucent or hoary-white. Tegmina dark with translucent or subtranslucent costal region.

C.—Supra-anal plate with median produced portion broad. (General color darker.)

D.—Median area of pronotum usually not so sharply defined, uniform in color or so broadly confluent with caudal margin; pale lateral portions often very narrow.

Tegmina with pale proximal portions of costal field strongly contrasted in none but darkest individuals.. *pensylvanica* (De Geer).

DD.—Median area of pronotum uniform, sharply defined and broadly and solidly confluent with caudal margin; pale lateral portions broad. Tegmina with pale proximal portion of costal field decidedly contrasted with remainder of tegmina... *pensylvanica inæqualis* (Saussure and Zehntner).

CC.—Supra-anal plate with median produced portion narrower. (General color paler.)........*divisa* Saussure and Zehntner.

BB.—Pronotum without a very decided central dark brown discal area on the pronotum[2] or when this area is dark it is occupied by paired dark brown subarcuate bars. Tegmina pale red brown or brownish with the costal region less translucent (except in *couloniana*).

C.—Size large (♂ tegmina 19–22 mm.). Supra-anal plate rotundato-trigonal..............................*couloniana* Saussure.

CC.—Size medium or small.

D.—Supra-anal plate rotundato-trigonal or more or less truncate or emarginate distad.

E.—Distal margin of supra-anal plate not obtuse emarginate.

F.—Supra-anal plate rotundato-trigonal.

G.—Pronotum transverse elliptical, rarely with slight cephalic production, greatest width of same distinctly less than greatest width of single tegmen, whole pronotum small in proportion to general size. Tegmina distinctly wider one-third length from apex than at one-third of distance from base................................*uhleriana* Saussure.

GG.—Pronotum always slightly produced and narrowed cephalad, large, greatest width of same, equal to the greatest width of single tegmen, whole pronotum large in proportion to general size. Tegmina hardly wider one-third length from apex than at one-third of distance from base............. *uhleriana fulvescens* Saussure and Zehntner.

FF.—Supra-anal plate produced and broadly truncate mesad with angles rounded, distal portion of plate distinctly depressed and forming an angle with proximal portion...........*notha* n. sp.

EE.—Distal margin of supra-anal plate obtuse-angulate emarginate..............................*occidentalis* Saussure.

[2] Occasionally in *I. couloniana* the middle of the pronotum is quite dark, but the color of the tegmina and remainder of the body shows the proper position of these specimens.

DD.—Supra-anal plate of male with apical portion arcuate, not trigonal.

E.—Coloration uniform pale ochraceous. Size medium.

F.—Costal field of tegmina moderate in width. Size medium. Pronotum rarely as wide as greatest width of tegmen.................... *borealis* Brunner.

FF.—Costal field of tegmina narrow. Size small. Pronotum wider than greatest width of tegmen.. *insolita* n. sp.

EE.—Color of pronotum usually more or less blackish brown, often bimaculate with same, very rarely uniform in color with tegmina. (Pronotum strongly sulcate and less transverse ovate than in alternative category.)... *bolliana* Saussure and Zehntner.

Females.

A.—Tegmina shorter than body.

B.—Dorsal color uniform deep brownish or brownish black or pronotum alone entirely of that color with tegmina ferruginous.

C.—Tegmina subquadrate, attingent mesad.

D.—Size larger (12.5–17.5 mm. in length). Tegmina uniform in color with or nearly uniform in color with remainder of dorsal surface................................ *desmopeltiformis* (Brunner).

DD.—Size smaller (12.5 mm. in length). Tegmina ferruginous in color, distinctly contrasted with blackish color of remainder of dorsum.........*nigricollis* Walker.

CC.—Tegmina lobiform, acuminate, lateral, decidedly not attingent mesad.

D.—Size medium. Tegmina separated by less than width of single tegmen, apex reaching to second abdominal segment...*johnsoni* Rehn.

DD.—Size small. Tegmina separated by more than width of single tegmen, apex hardly exceeding mesonotum, (Vide infra *bolliana*.) *americana* (Scudder).

BB.—Dorsal color not uniform deep brownish or blackish-brown, pronotum having pale lateral margins if center is dark brown (except in *bolliana*).

C.—Pronotum with decided central discal dark brown or blackish-brown area of variable size (or with at least more or less complete evidence of same); lateral margins translucent or hoary white.

D.—Supra-anal plate rectangulate produced. (Pronotum usually with pronounced and sharply defined discal area.)

E.—Tegmina covering all or greater portion of abdomen. Color pattern moderately contrasted, discal area on pronotum usually somewhat paler mesa.......... *pensylvanica* (De Geer).

EE.—Tegmina rarely exceeding second abdominal segment. Color pattern strongly contrasted, discal area on pronotum uniform.. *pensylvanica inæqualis* (Sauss. and Zehntner).

DD.—Supra-anal plate subrectangulate produced with apex rounded. (Pronotum with discal area poorly contrasted and poorly defined) .... *divisa* Sauss. and Zehntner.

CC.—Pronotum without a decided central discal dark brownish area.[3]

D.—Size larger (tegmina 5.5 to 7.5 mm. in length). Tegmina ovate, distal margin rounded...*couloniana* Sauss.

DD.—Size medium or small (tegmina 1.5 to 4.8[4]). Tegmina obliquely truncate distad (*uhleriana* and *u. fulvescens*), rounded distad (*notha* and *borealis*) or lobiform (*bolliana* and *desertæ*).

E.—Tegmina attingent, not lobiform and lateral.

F.—Tegmina subquadrate, distal margin more or less obliquely subtruncate.

G.—Size medium. Supra-anal plate subsinuate laterad................................*uhleriana* Sauss.
uhleriana fulvescens Sauss. and Zehntner.

GG.—Size small. Supra-anal plate regularly trigonal................................*borealis* Brunner.

F.—Tegmina little shorter than abdomen, ovate..... *notha* n. sp.

EE.—Tegmina lobiform, lateral.

F.—Tegmina reaching only to base of metanotum and separated by considerably more than their width. Supra-anal plate broadly obtuse-angulate, color pitch black................................ *bolliana* Sauss. and Zehntner.

FF.—Tegmina reaching to base of proximal abdominal segment and separated by no more than their own width. Supra-anal plate rectangulate. Color ochraceous.....*desertæ* (Rehn and Hebard).

AA.—Tegmina longer than body. (Coloration uniform.)

B.—Length of tegmina 11 mm. General color ochraceous............... *insolita* n. sp.

BB.—Length of tegmina 16.2 to 20 mm. General color brownish black or ferruginous...............................*occidentalis* Sauss.

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[3] Rarely such a maculation is present in very dark individuals of *I. couloniana*, but in these cases the form of the supra-anal plate and of the tegmina is diagnostic.

[4] In *I. notha* 9.5 mm. is the length of tegmen.

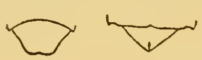
Treatment of Species.

Ischnoptera deropeltiformis (Brunner).

1865. *T[emnopteryx] deropeltiformis* Brunner, Nouv. Syst. Blatt, p. 87. [North America.]
1894. *Temnopteryx deropeltiformis* Blatchley, Proc. Indiana Acad. Sci., 1892, p. 160. [Vigo County, Indiana.]
1903. *Temnopteryx deropeltiformis* Blatchley, The Orthoptera of Indiana, p. 177, fig. 24. [Vigo, Marshall and Crawford Counties, Indiana.]
1905. *Temnopteryx deropeltiformis* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1905, p. 32. [Miami, Florida.]
1907. *Themnopteryx deropeltiformis* Tucker, Kansas Univ. Sci. Bull., IV, No. 2, p. 71. [Douglas County, Kansas.]
1908. *Temnopteryx deropeltiformis* Brimley, Ent. News, XIX, p. 16. [Raleigh, North Carolina.]

Description.—♂. Size medium; body moderately depressed; form elongate-elliptical when wings are in repose. Head not completely hidden under pronotum; ocelli moderate in size, interocellar and interocular interspaces subequal; antennæ longer than body. Pronotum semi-elliptical, moderately flattened, caudal margin subtruncate, lateral angles narrowly rounded and lateral portions decidedly deflected, cingulate, disk with usual convergent sulci more or less distinct. Tegmina exceeding apex of abdomen by more than length of head and pronotum, elongate, subequal, greatest width contained about three and one-half times in length, apex well rounded; venation distinct, costal field short, narrow, punctate. Wings as long as tegmina when in repose, apex well rounded; ulnar vein with from three to five complete rami reaching apex of wing, incomplete rami varying from four to six in number. Supra-anal plate somewhat produced, subquadrate, lateral margins obliquely convergent, apex truncate, lateral angles narrowly rounded; cerci depressed, fusiform-terete, apex acute.

General color seal brown on the dorsum becoming blackish on pronotum, tegmina paler distad. Abdomen, coxæ and head shining pitch black. Wings hyaline with veins raw umber and costal margin and apical portion clouded with same color. Eyes blackish to mars brown; supra-antennal spots more or less ochraceous; antennæ blackish. Limbs ochraceous, femora occasionally black, except at genicular extremity[5]. Abdominal appendages black.



Figs. 1 and 2.—*Ischnoptera deropeltiformis* (Brunner). Supra-anal plate of ♂ and ♀ (× 3). Male; Sulphur Springs, N. C.: female; Raleigh, N. C.

♀. Body considerably depressed; form elliptical-ovate, greatest width abdominal; surface glabrous. Head almost entirely hidden under pronotum; antennæ somewhat shorter than body. Pronotum much as in male but more

[5] This is the case with the males seen from Indiana, while rather curiously all the individuals from other localities have the limbs uniform ochraceous.

transversely arcuate and with lateral portions less deflected; sulci not evident. Tegmina subquadrate, reaching to the base of abdomen, attingent mesad; costal margin slightly arcuate, distal margin slightly oblique sinuato-emarginate, apex broadly rounded and costal in position. Wings almost as long as tegmina. Supra-anal plate transverse trigonal, more or less carinate mesad, apex obtuse-angulate[6]; cerci depressed fusiform, apex acute.

General color uniform shining pitch black, tegmina occasionally somewhat approaching bistre and very rarely burnt umber. Limbs colored as in male, with same exception occurring in the case of one specimen.[7]

Measurements.—♂. Length of body 14–15 mm; length of pronotum 3.5–3.8 mm.; greatest width of pronotum 4.8–5 mm.; length of tegmen 16–18 mm.; greatest width of tegmen 4.8–5.6 mm.

♀. Length of body 12.5–17.5 mm.; length of pronotum 3.9–4.5 mm.; greatest width of pronotum 5–6.5 mm.; length of tegmen 3.5–5.8 mm.; greatest width of tegmen 3–4 mm.

Distribution.—This species is now known from localities extending from southern Florida (Miami) north to southern Pennsylvania (Wayne and Enola) and northern Indiana (Marshall County), west to eastern Kansas (Douglas County) and south to Texas. The only exact datum for the latter State is the capture of one specimen at Paris in the northeastern portion of the State. From the known records the species appears to be an inhabitant of the Upper and Lower Austral Zones.

Remarks.—The males of this species from a number of localities are uniform in size and coloration, although the ulnar vein of the wing is variable in the number of complete and incomplete rami which it bears. The females vary considerably in size, but there appears to be no correspondence between this and locality. The largest specimens are from Raleigh, N. C., and Miami, Fla., the smallest from Raleigh and Jacksonville, Fla.

The mature specimens were taken or bred out on date in May, June, July and August, the only specimens taken the latter month being from Miami, Fla. The immature specimens were secured in March, April, May and September, the last month being represented by one specimen taken at Sulphur Springs, N. C.

Specimens examined.—Thirty-nine; fourteen males, twenty females and five immature specimens.

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[6] Rarely by aberration sinuato-emarginate.

[7] This is also from Indiana.

Enola, Cumberland County, Pa. One immature specimen. (Penna. State Dept. Zoöl.)

Wayne, Delaware County, Pa. One immature specimen. (Penna. State Dept. Zoöl.)

Plummer's Island, Maryland. Two males. (U. S. N. M.)

Cabin John, Maryland. One immature specimen (U. S. N. M.)

Washington, D. C. One female. (U. S. N. M.).

Great Falls, Va. One female. (U. S. N. M.)

Montgomery County, Va. One male. (Hebard Collection.)

Virginia. One male, one female, one immature specimen. (Bruner Coll.)

Crawford County, Ind. Four males, two females. (U. S. N. M., A. N. S. P. and Hebard Collection.)

Raleigh, N. C. Eleven females. (A. N. S. P., U. S. N. M. and Hebard Collection.)

Sulphur Springs, N. C. Two males, two immature specimens. (Hebard Collection.)

Tryon, N. C. One male. (U. S. N. M.)

North Carolina. One male. (Bruner Collection.)

Jacksonville, Fla. One female. (Bruner Collection.)

Miami, Fla. One female. (Hebard Collection.)

Texas. One male. (U. S. N. M.)

Paris, Tex. One male. (U. S. N. M.)

No locality. One female. (Morse Collection.)

Ischnoptera nigricollis Walker.

1868. *Ischnoptera nigricollis* Walker, Catal. Spec. Blatt. Brit. Mus., p. 118. [Georgia.]

1903. *Ischnoptera nigricollis* Rehn, Ent. News, XIV, p. 125. [Enterprise, Florida.]

Description.—♂. Size small; body somewhat depressed; form elongate elliptical when the wings are in repose. Head but little visible beyond pronotum; antennæ but little longer than body. Pronotum in shape much as in *I. deropeltiformis* but more rotundate, caudal margin more arcuate and angles more rounded, moderately depressed but still slightly transverse arcuate; lateral portion decidedly deflected, more strongly cingulate than dorsum; sulci of disk well marked. Tegmina considerably exceeding apex of abdomen, elongate, subequal, the greatest width contained about three and one-half times in length, apex rounded; venation distinct, costal field narrow, proximal, punctate. Wings as long as tegmina when in repose; ulnar vein with three to four complete rami reaching apex of wing, incomplete rami varying from three to four in number. Supra-anal plate and cerci essentially as in *deropeltiformis*.

Head, pronotum, dorsum of abdomen, venter and coxæ shining pitch black. Tegmina burnt sienna, darkening to blackish chestnut proximad and fading to tawny distad and along costal margins. Wings tawny infuscate. Limbs and mouth-parts ochraceous. Antennæ and abdominal appendages blackish.

♀. Size small; body depressed; form elliptical-ovate. Head completely hidden under pronotum; antennæ shorter than body. Pronotum semi-elliptical, caudal margin subtruncate, almost imperceptibly produced mesad, somewhat truncate cephalad, depressed dorsad, lateral deflected portions rather broad; oblique sulci not evident. Tegmina subquadrate, reaching base of abdomen; costal and sutural margins arcuato-truncate, distal margin slightly oblique subsinuate, apex broadly rounded and costal in position. Wings reaching to apex of tegmina. Supra-anal plate transverse trigonal, angle obtuse; cerci depressed, fusiform, acute.

Figs. 3 and 4.—*Ischnoptera nigricollis* Walker. Supra-anal plate of ♂ (×4) and ♀ (5). Male; Jacksonville, Florida: female; Florida.

Coloration exactly as in male, tegmina darkened proximad and along the costal field.

Measurements.—♂. Length of body 11–13.2 mm.; length of pronotum 3–3.5 mm.; greatest width of pronotum 4–4.2 mm.; length of tegmen 12.5–15 mm.; greatest width of tegmen 3.8–4.6 mm.

♂. Length of body 12.3 mm.; length of pronotum 3.5 mm.; greatest width of pronotum 4.5 mm.; length of tegmen 3.2 mm.; greatest width of tegmen 3 mm.

Distribution.—The only previous records for the species are given in the leading references, while the material now in hand from De Funiak Springs, Jacksonville and St. Augustine, Fla., and "Florida," carries the range to the south and west. The species is now known from Georgia and Florida, all the definite records being from the northern half and western extension of the latter State.

Remarks.—The junior author, while in London several years ago, examined the type of *nigricollis* in the British Museum and the association of the material in hand with this species is warranted by his notes and recollections. His notes are as follows: "*I. nigricollis*, Ga. Abdomen absent. Right half of pronotum damaged. Pronotum uniform dark brown same shade as central part of pronotum of dark *I. pensylvanica*. Wings shining pale (color of *I. johnsoni* legs), toward the base and extending up the middle they are slightly darker. Legs same color as those of *I. johnsoni*." Several sketches accompany the notes, making the identity even more positive.

The small series of this species examined by us is sufficient to show that its relationship is very close to *I. deropeltiformis*, the males also looking like pale editions of *I. johnsoni*, from which, however, the female can immediately be separated by the shape of the tegmina. The only specimen we have examined with date was taken in April.

Specimens examined.—Six; five males, one female:

Jacksonville, Fla. Two males. (U. S. N. M. and Bruner Collection.)

St. Augustine, Fla. One male. (Morse Collection.)

De Funiak Springs, Fla. One male. (U. S. N. M.)

Florida. One male, one female. (Bruner Collection.)

Ischnoptera johnsoni Rehn.

1903. *Ischnoptera johnsoni* Rehn, Ent. News, XIV, p. 234. [St. Augustine, Florida.] (Date of issue September 3, 1903.)

1903. *Ischnoptera intricata* Blatchley, Orthopt. of Ind., p. 186, fig. 28. [Wyandotte, Crawford County, Steuben County, Indiana.] (Date of issue September 5, 1903.)

1905. *Ischnoptera johnsoni* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1904, p. 779. [Thomasville, Georgia.] (Adult only.)

1907. *Ischnoptera johnsoni* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1907, p. 282. [Pablo Beach, Florida.]

1908. *Ischnoptera johnsoni* Brimley, Ent. News, XIX, p. 16. [Raleigh, N. C.]

Description.—♂. Size small; form moderately depressed, elongate elliptical when wings are in repose. Head with only edge of occiput visible from dorsum; antennæ hardly longer than body. Pronotum similar to *deropeltiformis* in shape with sulci of equal variability. Tegmina exceeding apex of abdomen by from half of pronotal length to more than length of same, narrow, subequal; costal margin with little proximal arcuation; greatest width contained about three and one-half times in length, apex rounded; venation distinct; costal field quite narrow, proximal. Wings as long as tegmina when in repose; ulnar vein with three to four complete rami reaching the apex of the wing, incomplete rami varying from two to eight in number. Supra-anal plate and cerci almost identical with those parts in *deropeltiformis*.

Head, pronotum, dorsum of abdomen, venter and coxæ pitch black or brownish-black, tegmina paling from this shade proximad to tawny-olive distad, darkest along humeral trunk. Wings hyaline, veins brownish and costal margin suffused with same. Limbs tawny ochraceous. Abdominal appendages blackish.

♀. Size rather small; form moderately depressed, elliptical, greatest width abdominal. Head completely hidden under pronotum; antennæ somewhat shorter than body. Pronotum subtrigonal in outline, greatest length contained one and one-half times in width, cephalic margin narrow, subarcuate, rounding to the oblique gently arcuate lateral margins, caudal margin subtruncate, caudo-lateral angles rounded rectangulate; disk in transverse section subarcuate, slightly more bent laterad and subdepressed dorsad; margins strongly cingulate laterad; surface with no distinct sulci. Tegmina sublanceolate, non-attingent, about as long as pronotum, reaching to apex of first abdominal segment, greatest width contained one and one-quarter to one and one-third times in length, apex rounded acute, costal margin considerably arcuate; interspace between tegmina equal to a third of width of tegmen; venation reduced, anal sulcus distinct and reaching more than half way to apex. Wings abbreviate, almost as long as tegmina. Supra-anal plate transverse trigonal, apex rounded, margins very slightly concave; cerci depressed, fusiform.

General color varying from uniform pitch black to pitch black and burnt sienna, the latter in extreme form most distinct on head, antennæ, pronotum, mesonotum, metanotum, costal field of tegmina, proximal portions of proximal abdominal segments and venter of abdomen. Limbs varying from blackish brown to tawny ochraceous. Eyes blackish; supra-antennal spots quite small, pale yellowish. Abdominal appendages blackish.

Figs. 5 and 6.—*Ischnoptera johnsoni* Rehn. Supra-anal plate of ♂ and ♀ (×3). Male; Raleigh, N. C.: female; Chestertown, Md.

Measurements.—♂. Length of body 12.5–18.5 mm.; length of pronotum 3–3.5 mm.; greatest width of pronotum 4–4.8 mm.; length of tegmen 11.5–14.6 mm.; greatest width of tegmen 3.5–4.6 mm.

♀. Length of body 10.5–13.5 mm.; length of pronotum 3.5–3.8 mm; greatest width of pronotum 5–5.6 mm.; length of tegmen 3.8–4.5 mm; greatest width of tegmen 2.8–3 mm.

Distribution.—The range of this species is now known to extend from eastern Massachusetts (Wellesley) and northeastern Indiana (Steuben County) south to southern Florida (Dade County) and west to eastern Texas (Hockley). Its zonal distribution appears to be Upper and Lower Austral, trespassing on the lower portion of the Transition.

Remarks.—In the male sex this species appears to decrease in size southward, Georgia and Florida material of that sex being considerably smaller than New Jersey and North Carolina individuals, although the single Texan male seen is equal in size to North Carolina specimens In the female sex, however, this geographic variation is not apparent, and it is possible that the apparent size correlation in the male may be due to the rather small size of the series examined. The dates on material range from February to October, the form being from New Jersey, the latter from Maryland.

Specimens examined.—Twenty-three; fourteen males, nine females:

Wellesley, Mass. One female. (Morse Collection.)

Dauphin, Pa. One female. (Penna. Div. of Zoöl.)

Haddonfield, N. J. One female. (A. N. S. P.)

New Jersey. One male. (Bruner Collection.)

Chestertown, Md. One female. (A. N. S. P.)

Plummer's Island, Md. One female. (U. S. N. M.)

Washington, D. C. One female. (U. S. N. M.)

Sulphur Springs, N. C. One female. (Hebard Collection.)

Raleigh, N. C. Four males. (U. S. N. M.and A. N. S. P.)

Wilmington, North Carolina. One male. (Brooklyn Inst. Art and Sci.)

Nashville, Tenn. One female. (Bruner Collection.)

Thomasville, Ga. One male. (Hebard Collection.)

Pablo Beach, Fla. One female. (Hebard Collection.)

St. Augustine, Fla. One male. (A. N. S. P.) *Type.*

Florida. One male. (Bruner Collection.)

Cedar Keys, Fla. One male. (U. S. N. M.)

Enterprise, Fla. One male. (U. S. N. M.)

Dade County, Fla. One male. (U. S. N. M.)

Hockley, Tex. Two males. (U. S. N. M.)

Ischnoptera americana (Scudder).

1900. *Loboptera americana* Scudder, Proc. Davenp. Acad. Nat. Sci., VIII, p. 93, pl. 2, fig. 4. [Ehrenberg, Colorado River, Arizona.]

1900. *Loboptera americana* Scudder, Canad. Entom., XXXII, p. 329. [Cahon Pass, Cal.]

1905. *Ischnoptera consobrina* Baker (not of Saussure), Invertebrata Pacifica, I, p. 72. [Claremont, Cal.]

1910. *Ischnoptera consobrina* Rehn and Hebard (not of Saussure), Proc. Acad. Nat. Sci. Phila., 1909, p. 415. [Pasadena, Cal.]

Description.—♂. Size small; form elongate-elliptical, depressed; surface glabrous. Head but slightly projecting cephalad of cephalic margin of pronotum; interspace between eyes but very slightly less than that between antennal scrobes; antennæ slightly longer than body. Pronotum in outline transverse subovate, slightly flattened caudad and more decidedly arcuate cephalad, lateral margins rounding into slightly arcuate caudal margin, greatest width distinctly caudad of middle; oblique diverging sulci deeply and broadly impressed; lateral portions considerably deflected ventrad. Tegmina elongate, lanceolate, apex rounded, length about four and a half to five times that of pronotum, greatest width contained about three times in length; costal margin gently arcuate, costal field narrow, subpunctate. Wings with three to five complete and three to four incomplete rami to ulnar vein. Supra-anal plate truncate distad, laterad obliquely concavo-emarginate, rounding into distal margin, greatest (proximal) exposed width almost twice greatest exposed length; cerci depressed fusiform.

General color varying from tawny-ochraceous to prout's brown, uniform dorsad except for pale costal field of tegmina; venter more mars brown, becoming bistre distad on abdomen; eyes clove brown, supra-antennal spots pale yellow; wings slightly washed with clay color.

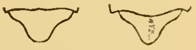
♀. Size small; form elliptical-ovate, moderately depressed; surface subglabrous. Head but slightly projecting cephalad of cephalic margin of pronotum; interspace between eyes greater than that between antennal scrobes; antennæ distinctly longer than body. Pronotum semicircular, cephalic and lateral margins regularly arcuate, caudal margin subtruncate, moderately arcuate in transverse section, disk with no oblique sulci. Tegmina short, hardly exceeding caudal margin of mesonotum, subacuminate, lobiform, separated by an interspace equal to one and one-half times width of single tegmen, apex bluntly rounded; costal field very broad proportionately, punctate. Wings absent. Supra-anal plate trigonal, sub-produced, slightly sinuate laterad, apex moderately acute; cerci rather short, stout, fusiform, depressed, internal margin more arcuate excised proximad than external margin.

General color uniform, varying in shade from burnt umber to seal brown, limbs very slightly paler.

Measurements.—♂. Length of body 13.5–14.5 mm.; length of pronotum 3–3.3; greatest width of pronotum 3.5–4; length of tegmen 13.2–16; greatest width of tegmen 4.2–5.

♀. Length of body 10–11 mm.; length of pronotum 2.9–3.5; greatest width of pronotum 4–4.8; length of tegmen 1.5–1.9; greatest width of tegmen 1.5–1.6.

Distribution.—The published records and the material in hand show that the present species ranges from Oregon (no specific locality known) to Lower California (no specific data), extending east to Ormsby County, Nevada, and the lower Colorado Valley (Ehrenberg, Arizona). Its maximum vertical elevation seems to be reached in Ormsby County, Nevada. Nothing is known regarding the habits of the species. The available dates are in June, July and August.



Figs. 7 and 8.—*Ischnoptera americana* (Scudder). Supra-anal plate of ♂ and ♀ (×7). Male; Pasadena, Cal.: female; Humboldt County, Cal.

Remarks.—Mr. A. N. Caudell has compared one of the female specimens before me with Scudder's type and his notes show them to be the same. The correlation of the sexes is made with a considerable degree of certainty, chiefly, however, on account of the absence of any other species of native roach belonging to this subfamily in a good portion of the territory over which this species is distributed. From the material in hand the species appears to decrease in size southward, as a male from Lower California is considerably smaller than individuals of the same sex from the Los Angeles region and much inferior in size to Ormsby County, Nevada, and one of two Oregon specimens. This, however, may not be more than individual variation, as the other Oregon male has the tegmina but little longer than the Lower California specimen, although the pronotum is very appreciably larger.

Specimens examined.—Thirteen; ten males, three females:

Oregon. Two males. (Bruner Collection.)

Ormsby County, Nev. One male. (Morse Collection.)

Bair's Ranch, Redwood Creek, Humboldt County, Cal. One female. (U. S. N. M.)

San José, Cal. One male. (U. S. N. M.)

Los Angeles, Cal. One male. (U. S. N. M.)

Los Angeles County, Cal. One male. (U. S. N. M.)

Pasadena, Cal. One male. (A. N. S. P.)

California. Two males, two females. (U. S. N. M.)

Lower California. One male. (Bruner Collection.)

Ischnoptera pensylvanica (De Geer).

1773. *Blatta pensylvanica* De Geer, Mém. l'Hist. Ins., III, p. 537, pl. 44, fig. 4. [Pennsylvania.]

1835. *Blatta pensylvanica* Harris, in Hitchcock, Rep. Geol. Mass., 2d ed., p. 576. [Massachusetts.]

1862. *Bl[atta] borealis* Saussure, Révue et Magasin de Zoologie, 2e Ser., XIV, p. 166. [North America.]

1862. *I[schnoptera] nortoniana* Saussure, *ibid.*, p. 169. [North America.]

1862. *Platamodes pennsylvanica* Scudder, Boston Journ. Nat. Hist., VII, p. 417. (Part.) [Indiana; Maryland.]

1862. *Ectobia flavocincta* Scudder, *ibid.*, p., 419. (Part.) [Massachusetts; western States; Lake Superior.]

1864. *Ischnoptera translucida* Saussure, Mém. l'Hist. Nat. Mex., III, p. 85. [North America.]

1864. *Blatta borealis* Saussure, *ibid.*, p. 96, pl. 1, fig. 13. [North America.]

1865. *Ph[yllodromia] borealis* Brunner, Nouv. Syst. Blatt., p. 101. [North America.]

1865. *I[schnoptera] pensylvanica* Brunner, *ibid.*, p. 135. (Part.) [Colombia; North America; Indiana; Maryland.]

1868. *Ischnoptera pennsylvanica* Walker, Catal. Blatt. Brit. Mus., p. 113. [Canada; North America.]

1870. *Blatta (Phyllodromia) borealis* Saussure, Miss. Scient. Mex., Rech. Zool., VI, p. 42. [North America.]

1870. *Ischnoptera pennsylvanica* Saussure, *ibid.*, p. 63, pl. II, fig. 35. [North America.]

1872. *Ischnoptera pensylvanica* Walker, Canad. Entom., IV, p. 30. [Canada.]
1888. *Ischnoptera pennsylvanica* Caulfield, Rep. Entom. Soc. Ontario, XVIII, p. 72. [Montreal; Abbottsford, Quebec.]
1888. *Temnopteryx marginata* Caulfield (not of Scudder), *ibid.*, p. 72. [Montreal.]
1889. *Platamodes pennsylvanica* Davis, Ent. Amer., V, p. 81. [Staten Island, N. Y.]
1890. *Ischnoptera pennsylvanica* Smith, Catal. Ins. N. J., p. 406. [New Jersey; Caldwell, N. J.]
1894. *Ischnoptera pennsylvanica* Beutenmüller, Bull. Amer. Mus. Nat. Hist., VI, p. 259. [New York.]
1894. *Ectobia borealis* Beutenmüller, *ibid.*, p. 261. [New York.]
1894. *Ectobia flavocincta* Blatchley, Proc. Ind. Acad. Nat. Sci., 1892, p. 161. [Marshall, Putnam and Vigo Counties, Indiana.] (Part.)
1896. *Ectobia borealis* Davis, Proc. Nat. Sci. Asso. Staten Island, V. p. 97. [Staten Island, N. Y.]
1897. *Ectobia flavo-cincta* Blatchley, Proc. Ind. Hortic. Soc., 1896, p. 20. [Indiana.] (Part.)
1897. *Ischnoptera pennsylvanica* Blatchley, *ibid.*, pp. 7 and 20. [Indiana.] (Part.)
1900. *Ischnoptera pennsylvanica* Smith, Ins. N. J., p. 150. [Staten Island, Palisades, Caldwell, Westville, Angelsea, N. J.]
1900. *Phyllodromia borealis* Smith, *ibid.*, p. 150. [Staten Island, Greenwood Lake, Ft. Lee, Ocean County, N. J.]
1900. *Ischnoptera pennsylvanica* Scudder, Psyche, IX, p. 99. [Winthrop, Massachusetts; Montreal.]
1900. *Phyllodromia borealis* Scudder, *ibid.*, p. 100. [Prout's Neck, Scarboro, Maine; Boston, Mass.; Conn.]
1900. *Ischnoptera pennsylvania* Henshaw, Psyche, IX, p. 119. [Rhode Island.]
1903. *Ischnoptera pennsylvania* Blatchley, Orth. of Ind., p. 179. [Indiana.] (Part.)
1907. *Ischnoptera pennsylvania* Tucker, Sci. Bull. Kans. Univ., IV, no. 2, p. 71. [Oil City, Venango County, Pa.]

Description.—♂. Size large (for the genus); form elongate-lanceolate, moderately depressed; surface subglabrous. Head with edge of occiput visible cephalad of pronotal margin; interocular space slightly less than that between antennal scrobes; antennæ considerably exceeding the body in length. Pronotum transversely subovate, very slightly produced and narrowed cephalad, cephalic margin subtruncate, lateral margins gently arcuate, caudal margin arcuate, caudo-lateral angles rounded, placed caudad of medio-transverse line of pronotum, greatest length contained one and one-third to one and one-half times in greatest width; disk of pronotum distinctly deplanate, deflected laterad, divergent oblique sulci distinctly indicated. Tegmina elongate lanceolate, lateral margins subparallel, length four and one-half to five times that of pronotum, greatest width contained three and one-quarter to three and one-half times in length; costal margin arcuate proximad, nearly straight beyond, apex rather narrowly rounded. Wings ample, ulnar vein with four to six complete and one to three incomplete rami. Supra-anal plate transverse, truncate to very obtuse-angulate distad, obliquely emarginate laterad, the angles rounded; cerci terete, moniliform.

General dorsal color varying from clay color to prout's brown, pronotal maculation and general suffusion of tegmina varying from raw umber to clove brown, pronotal disk occasionally much darker than tegmina; discal maculation of pronotum with lateral margins sinuate, in some cases reaching, in others not reaching, cephalic and caudal margins, lateral portions subhyaline to opaque buff.[8] Head clove brown or with face alone that color or vandyke brown; supra-ocular spots dull yellow; antennæ same as general color. Tegmina with costal margin, particularly of costal field, pale, usually subhyaline; humeral trunk darker than any other portion. Wings slightly infumate. Abdomen varying from tawny-olive to bistre, on the venter usually paler laterad and mesad. Limbs varying with general coloration, spines darker.

Figs. 9 and 10.—*Ischnoptera pensylvanica* (De Geer). Supra-anal plate of ♂ (×3) and ♀ (×2½). Male; Pennsylvania: female; Camp Hill, Pa.

♀. General size rather large (for genus); form elliptical, depressed, tegmina reaching or falling slightly short of apex of abdomen; surface glabrous. Head hardly visible cephalad of pronotal margin; interspace between eyes subequal to or very slightly wider than that between antennal scrobes; antennæ very slightly longer than body. Pronotum considerably broader than long, lateral and cephalic margins arcuate, slightly subtruncate meso-cephalad, very slightly oblique subtruncate laterad, caudal margin subarcuate to arcuato-truncate, caudo-lateral angles rounded obtuse-angulate; disk moderately deplanate, declivent laterad, oblique sulci hardly indicated. Tegmina from two to two and one-half times length of pronotum, greatest width subequal to pronotal length; costal margin regularly arcuate, apex obliquely rotundato-subtruncate; costal field moderately broad, rather short, costal veins regularly oblique subparallel, anal sulcus reaching to slightly proximad or distad of middle of sutural margin. Wings either distinctly shorter than tegmina or reaching to tips of same; ulnar vein with four to five complete and one to two incomplete rami. Supra-anal plate trigonal, the apex acute,[9] more or less distinctly carinate medio-longitudinally; cerci depressed subensiform, acute.

General color varying from tawny-olive to mummy-brown, pronotal

[8] Rarely the pale lateral portions are reduced to mere lines and in two cases the disk has a paler medio-longitudinal line.

[9] In one specimen (Marion County, Ind.) it is blunter than in the others, but the length of tegmina, form of pronotum and general appearance seems to indicate its proper place in this species.

maculation from raw umber to seal brown. Head entirely or with at least dorsal portion of face darker than remainder and varying from ferruginous to blackish; antennæ varying in conformity with general coloration; supra-antennal and ocellar spots pale yellow. Pronotum with maculation confluent with caudal margin, confluent with or separated from cephalic margin,[10] lateral portions varying from buff to ochraceous. Tegmina with costal field subhyaline, pale yellowish. Abdomen seal brown dorsad, margined laterad with buffy; venter similar to dorsum of abdomen but slightly paler, margined in similar fashion. Limbs pale ochraceous, spined and lined with dark brown.

Measurements.—♀. Length of body, 20–22 mm.; length of pronotum, 4–5; greatest width of pronotum, 5.6–6.1; length of tegmen. 21–24.5; greatest width of tegmen, 6–7.

♀. Length of body 13.5–17 mm.; length of pronotum 4.5–5; greatest width of pronotum 5.5–7.2; length of tegmen 12.5;[11] greatest width of tegmen 5–5.5.

Distribution.[12]—The fact that *I. pensylvanica* and *I. inæqualis* are really geographic races of the same species merging one into the other, makes the delimiting of the range of either one quite difficult, and it has been necessary to restrict our consideration to material actually in hand, records based on the same and references beyond question on account of the occurrence of but one of the two forms in that region. From such evidence *I. pensylvanica* is known to range from Quebec Province, Canada (Montreal and Abbotsford) south to North Carolina

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[10] Occasionally the maculation is obsoletely divided medio-longitudinally by obscure ochraceous-rufous.

[11] The smallest specimen available has tegmina as long as the largest. The tegmina range in size down to 10.5 mm.

[12] Owing to the close relationship of *Ischnoptera pensylvanica* and *I. p. inæqualis* and the intergradation of the same in the central West, it is extremely difficult and sometimes impossible to properly place references. The references here given cannot be satisfactorily located without securing the material on which they are based, this being impossible in a number of cases.

1787. [*Blatta*] *cincta* Fabricius, Mant. Ins., I, p. 226. [America.]
1862. *Platamodes pennsylvanica* Scudder, Boston Journ. Nat. Hist., VII. p. 417. (Part.) [Indiana; Maryland.]
1865. *Blatta pennsylvanica* Thomas, Trans. Ill. State Agric Soc., V. p. 440. [Illinois.]
1872. *Platamodes pennsylvanica* Glover, Ill., N. A. Ent., Orth., pl. I, figs. 1 and 3.
1891. *Ischnoptera pennsylvanica* McNeill, Psyche, VI, p. 78. [Southern Illinois.]
1894. *Ischnoptera pennsylvanica* Garman, Sixth Ann. Rep. Kentucky Exp. Sta., p. 10. [Kentucky.]
1894. *Ectobia flavocincta* Garman, *ibid.*, p. 10. [Lexington, Kent.]
1904. *Ischnoptera pennsylvanica* Mead, Ohio Nat., IV. No. 5, p. 111. [Cedar Point, Ohio.]

and northern Alabama (Decatur), east as far as southwestern Maine (Scarboro), coast of New Jersey and Raleigh, N. C., west at least to west-central Indiana (Putnam County), and western Wisconsin (Polk County). Its intergradation with *I. p. inæqualis* is known to take place in Indiana, as from that State typical material of each has been taken in addition to other almost intermediate in character. What the distribution of the species in the northern lake States and Ontario is can only be conjectured, but its presence in Polk County, Wisconsin, is evidenced by a typical though rather pale male example. Its vertical range appears to extend from sea-level to at least 2,500 feet (Sulphur Springs, N. C.).

The dates on the material before us range from May to August.

Remarks.—In size there is considerable variation in both sexes, apparently without relation to locality, and in coloration the range in intensity is considerable, equally individual in character as far as can be determined.

The synonymy given for the species had been established by previous authors.

Specimens examined.—Forty-two; twenty-one males, twenty-one females:

Ithaca, N. Y. One male. (U. S. N. M.)
Hudson, N. Y. One female. (Morse Collection.)
Staten Island, N. Y. One male. (Bruner Collection.)
Danville, Pa. One male. (Penna. Div. Zoöl.)
Fisher's Ferry, Pa. One male. (Penna. Div. Zoöl.)
Camphill, Pa. One female. (Penna. Div. Zoöl.)
Harrisburg, Pa. Two females. (Penna. Div. Zoöl.)
Lehigh Gap, Pa. One female. (A. N. S. P.)
Pennsylvania. One male. (A. N. S. P.)
Da Costa, N. J. One female. (Hebard Collection.)
Laurel, Del. One male. (A. N. S. P.)
Maryland. One female. (Bruner Collection.)
Glendale, Md. One female. (U. S. N. M.)
Near Lloyds, Md. One female. (U. S. N. M.)
Washington, D. C. One female. (Bruner Collection.)
District of Columbia. One male, two females. (Bruner Collection.)
Falls Church, Va. One male, two females. (U. S. N. M.)
Montgomery County, Va. One male. (Hebard Collection.)
Virginia. One male, two females. (U. S. N. M. and A. N. S. P.)
Tryon, N. C. Three males. (U. S. N. M.)

Raleigh, N. C. One male, one female. (U. S. N. M. and Hebard Collection.)

Asheville, N. C. One male. (U. S. N. M.)

Sulphur Springs, N. C. One male. (Hebard Collection.)

Decatur, Ala. One male. (Bruner Collection.)

Marion County, Ind. Two females. (Hebard and Blatchley Collections.)

Putnam County, Ind. One female. (Blatchley Collection.)

Steuben County, Ind. One female. (Blatchley Collection.)

Crawford County, Ind. Two males. (Blatchley Collection.)

Polk County, Wis. One male. (A. N. S. P.)

Ischnoptera pensylvanica inæqualis (Saussure and Zehntner).

1864. *Ischnoptera pennsylvanica* Saussure (not of De Geer), Mém. l'Hist. Nat. Mex., III, p. 84. [Kansas.]
1872. *Temnopteryx marginata* Scudder, Final Report U. S. Geol. Surv. Neb., p. 251. [Banks of Platte River.]
1876. *Ischnoptera pennsylvanica* Thomas (not of De Geer), Proc. Davenport Acad. Nat. Sci., I, p. 249. [Iowa.]
1876. *Platamodes pennsylvanica* Scudder (not of De Geer), Bull. U. S. Geol. Sur. Terr., II, p. 267. [Salina, Kan.]
1885. *Ischnoptera pennsylvanica* Bruner (not of De Geer), Bull. Washburn Coll., I, p. 125. [Topeka, Kan.]
1892. *Platamodes pennsylvanica* Osborn (not of De Geer), Proc. Iowa Acad. Sci., I, pt. 2, p. 117. [Iowa.]
1893. *Ischnoptera pennsylvanica* Bruner (not of De Geer), Publ. Neb. Acad. Sci., III, p. 21. [Eastern half of Nebraska.]
1893. *Blatta borealis* Bruner (not of Saussure), *ibid.*, p. 21. [Valentine, Neb.]
1893. *Ischnoptera inæqualis* Saussure and Zehntn., Biol. Cent.-Amer., Orth., I, p. 36, pl. VI, figs. 14–17. [Texas; North Mexico.]
1894. *Ischnoptera pennsylvanica* Blatchley (not of De Geer), Proc. Ind. Acad. Sci., 1892, p. 158. [Indiana.]
1894. *Ectobia flavocincta* Blatchley, Proc. Ind. Acad. Nat. Sci., 1892, p. 161. [Marshall, Putnam and Vigo Counties, Indiana.] (Part.)
1897. *Ischnoptera pennsylvanica* Ball (not of De Geer), Proc. Iowa Acad. Sci., IV, p. 235. [Iowa.]
1897. *Ectobia flavo-cincta* Blatchley, Proc. Ind. Hortic. Soc., 1896, pp. 18 and 20. [Indiana.] (Part.)
1897. *Ischnoptera pennsylvanica* Blatchley, *ibid.*, pp. 7 and 20. [Indiana.] (Part.)
1898. *Ischnoptera pennsylvanica* Lugger (not of De Geer), Bull. 55, Minn. Agr. Exp. Sta., p. 186, fig. 58. [Minnesota.]
1902. *Ischnoptera pennsylvanica* Caudell (not of De Geer), Trans. Amer. Entom. Soc., XXVIII, p. 83. [Creek Nation, Indian Territory; Stillwater, Oklahoma.]
1903. *Ischnoptera pennsylvanica* Blatchley, Orth. of Ind., p. 179. [Indiana.] (Part.)
1903. *Ischnoptera inæqualis* Blatchley, *ibid.*, p. 182. [Crawford County, Indiana.]
1904. *Ischnoptera couloniana* Caudell (not of Saussure), Sci. Bull. Mus. Brooklyn Inst. Arts Sci., I, no. 4, p. 105. [Esperanza Ranch and San Tomas Ranch, Brownsville, Texas.]
1905. *Ischnoptera pennsylvanica* Isely (not of De Geer), Trans. Kansas Acad. Sci., XIX, p. 239. [Clearwater, Wichita and Fairview, Kan.]

1907. *Ischnoptera inæqualis* Hart, Bull. Ill. State Labor. Nat. Hist., VII, art. VII, p. 230. [Devil's Neck, Devil's Hole and Havana, Illinois; Iowa.]

1909. *Ischnoptera inæqualis* Tucker, Ent. News, XX, p. 296. [Plano, Collin County, Tex.]

Description.—♂. Size, shape and surface similar to *I. pensylvanica* from which differential characters alone will be given. Tegmina four to five times length of pronotum. the width as in *pensylvanica.* Wings with from two to six complete and none to two incomplete rami. Supra-anal plate similar to that of *pensylvanica* but with distal margin more distinctly obtuse-angulate.

General dorsal color varying from prout's brown to seal brown, pale borders of pronotum and costal field buff, this color less extensive on tegmina than in *pensylvanica* and much more contrasted. Pronotal maculation solid, broadly confluent with caudal margin and narrowly so with cephalic margin, lateral outlines of maculation sharply defined, more or less sinuate mesad. Tegmina in paler specimens with humeral trunk somewhat darker than general color. Abdomen varying from burnt umber to seal brown, darker laterad and distad. Limbs varying from pale ochraceous to burnt umber.

♀. Size, shape and surface similar to *I. pensylvanica* but tegmina normally reaching only to middle of abdomen.[13] Pronotum with even less trace of oblique sulci than in *I. pensylvanica.* Tegmina from one and one-half times to twice[13] pronotal length, sub-acuminate ovate or very rarely subquadrate,[14] costal margin rather strongly arcuate, apex more or less narrowly rounded; anal sulcus reaching to or slightly distad of middle of sutural margin; costal field rather broad, reaching almost to middle of tegmen. Wings very small, hardly more than half of pronotal length. Supra-anal plate trigonal; cerci as in *I. pensylvanica.*

General color seal brown, rarely burnt umber, pronotal maculation very similar in shape to that of male, but margins usually less sinuate, lateral borders pale ochraceous including also costal field of tegmina, the latter strongly contrasted with remainder of dorsum; abdomen uniform seal brown dorsad;[15] venter vandyke brown; limbs pale ochra-

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[13] One female from Steuben County and two females from Crawford County, Indiana, have tegmina reaching to within a very short distance of the apex of the abdomen, but this is due to intergradation with typical *I. pensylvanica.*

[14] This is true of one female from Vigo County, Indiana. In this the tegmina are obliquely sinuato-truncate distad.

[15] The single Steuben County, Indiana, female and three others of the same sex from Crawford County, Indiana show an approach to true *I. pensylvanica* in having the margins of the abdomen dull clay color.

ceous washed distad with brownish; face more or less completely seal brown, usually pale ventrad of line between antennæ.

Figs. 11 and 12.—*Ischnoptera pensylvanica inæqualis* (S.-Z.). Supra-anal plate of ♂ (×4) and ♀ (3). Male; Columbus, Tex.: female; Plano, Tex.

Measurements.—♂. Length of body 16–19 mm.; length of pronotum 4–4.8; greatest width of pronotum 5.2–5.8; length of tegmen 17–22.5; greatest width of tegmen 5.2–6.5. ♀. Length of body 13.5–15.5 mm.; length of pronotum 4.5–5; greatest width of pronotum 6–6.5; length of tegmen 6.2–11;[16] greatest width of tegmen 4–4.5.

Distribution.—From the material in hand and undoubted references this form is known to range from Minnesota, Illinois, Indiana and Nebraska south to northern Mexico, having been recorded from Iowa, Kansas, Oklahoma and Texas in addition to the States previously mentioned. It is quite probable that this race will be found to occupy the greater portion of the Mississippi Valley, intergradating to the east with *I. pensylvanica* and westward extending to the edge of the Great Plains, penetrating the sandhill country of Nebraska along the river valleys, as records from Badger and Valentine testify. Typical material has been examined from Crawford, Lake, Marshall, Marion and Vigo Counties, Ind. Other material from Crawford County approaches *I. pensylvanica.* Its vertical distribution appears to be from near sea-level (Columbus, Tex.) to the above mentioned Nebraska localities, situated two thousand to two thousand five hundred feet above the sea. Its seasonal appearance extends from May to September according to data in the material examined.

Remarks.—The typical condition of this race is rather decidedly marked and but for the presence of intermediate material it would have to be considered a valid species. However, the testimony of such material as we have been able to examine from Indiana demonstrates intergradation with the eastern and northern *I. pensylvanica.* There is no doubt about the identity of Scudder's *Temnopteryx marginata* with this species, as the description absolutely fits the adult female, but unfortunately a prior *Ischnoptera marginata* (Brunner, 1865) precludes the use of the name for this species.

Specimens examined.—Thirty-seven; nineteen males, eighteen females:

Minnesota. One male. (Bruner Collection.)

St. Joseph, Ill. One female. (U. S. N. M.)

Illinois. One male. (A. N. S. P.)

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[16] The maximum measurements are only found in Steuben and Crawford County, Indiana, specimens.

Crawford County, Ind. Two males, seven females. (U. S. N. M., Hebard and Blatchley Collections.)

Steuben County, Ind. One female. (U. S. N. M., Hebard and Blatchley Collections.)

Vigo County, Ind. Three males, one female. (Blatchley Collection.)

Lake County, Ind. One female. (Blatchley Collection.)

Pine, Lake County, Ind. One male. (Blatchley Collection.)

Marshall County, Ind. One female. (Blatchley Collection.)

Marion County, Ind. One male. (Blatchley Collection.)

Missouri. One male. (U. S. N. M.)

St. Louis, Mo. One male. (U. S. N. M.)

Iowa City, Ia. One female. (Bruner Collection.)

Onaga, Kan. One male. (U. S. N. M.)

Fort Riley, Kan. One male. (U. S. N. M.)

Hiawatha, Kan. One female. (U. S. N. M.)

Valentine, Neb. One female. (Bruner Collection.)

West Point, Neb. One male. (Bruner Collection.)

Badger, Neb. One female. (Bruner Collection.)

Lincoln, Neb. One male. (Bruner Collection.)

Nebraska City, Neb. One male, one female. (Bruner Collection.)

Dallas, Tex. One male. (U. S. N. M.)

Plano, Tex. One female. (U. S. N. M.)

Columbus, Tex. One male. (U. S. N. M.)

Esperanza Ranch, Brownsville, Tex. One male. (Brooklyn Inst. Art and Sci.)

Texas. Two males. (U. S. N. M.)

Ischnoptera divisa Saussure and Zehntner.

1893. *Ischnoptera divisa* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 40. [Georgia; North Mexico.]

1908. *Ischnoptera couloniana* Brimley (not of Saussure), Ent. News, XIX, p. 16. [Raleigh, North Carolina.]

Description.—♂. Size rather small; form elongate elliptical, moderately depressed; surface glabrous. Head slightly projecting cephalad of pronotal margin; interspace between eyes distinctly narrower than that between antennal scrobes; antennæ considerably exceeding body in length. Pronotum transverse elliptical in shape, very rarely slightly produced and narrowed cephalad; cephalic and caudal margins arcuato-truncate, broadly rounded laterad; disk with more or less decided divergent oblique sulci, frequently with a few pairs of median indentations; lateral portions more or less distinctly deflected. Tegmina elongate, subequal, exceeding apex of abdomen by at least length of pronotum, greatest width contained about three and one-half times in length, which is four to four and one-half times that of pronotum; apex very slightly rotundato-angulate; costal field moderately broad, translucent. Wings with four to five complete and one to three incomplete rami to ulnar vein. Supra-anal plate subtrigonal, with median portion narrower than in *I. pensylvanica*, more decidedly concavo-emarginate laterad; cerci depressed, moniliform, slightly fusiform.

General color much as in *I. pensylvanica* but with lighter shades on pronotum and tegmina much paler, subhyaline cream-buff, humeral trunk very narrowly indicated. Discal maculation on pronotum as in *pensylvanica* but frequently with pale medio-longitudinal dividing line, maculation vandyke brown. Venter prout's brown, occasionally bistre cephalad, limbs similar to venter but in part at least slightly paler; supra-antennal spots yellowish; antennæ of ventral color. Pale border on pronotum occasionally buff.

♀. Size medium; form much as in same sex of *I. pensylvanica*. Head with but extreme occiput visible cephalad of pronotum; inter-space between eyes but slightly less than that between antennal scrobes; antennæ very slightly longer than body. Pronotum semi-elliptic, cephalic and lateral margins regularly arcuate, caudal margin arcuato-truncate, caudo-lateral angles rounded rectangulate, greatest length about two-thirds greatest width; disk deplanate, lateral portions considerably deflected. Tegmina about one and two-thirds times length of pronotum, apices reaching to third abdominal segment, sublanceolate, subacute, costal margin regularly and considerably arcuate; costal field rather short, comparatively broad, anal sulcus joining sutural margin slightly distad of middle of latter, costal veins regular, obliquely parallel. Wings aborted, functionless, not reaching caudad of first abdominal segment. Supra-anal plate trigonal, margins concavo-emarginate, apex well rounded; cerci depressed fusiform.

General coloration much as in *I. pensylvanica* but paler; pronotal maculation indicated more or less distinctly[17] by a hazel wash, occasionally clouded with bistre and frequently divided medio-longitudinally, margins buff or ochre yellow; tegmina ochraceous, tawny ochraceous or raw umber, subhyaline costad; abdomen olive to clove brown, margined laterad with buff or clay color; limbs pale ochraceous, spines and carinæ burnt umber; face usually

Figs. 13 and 14.—*Ischnoptera divisa* S.-Z. Supra-anal plate of ♂ (×5) and ♀ (×4). Raleigh, N. C.

[17] Almost lacking in one specimen (Rives, Tenn.) which has the disk ochre yellow and margins almost hyaline.

marked mesad with vandyke brown, extending from interocular space to mouth parts, usually involving latter.

Measurements.—♂. Length of body 13.5–17.5 mm.; length of pronotum 3.5–4; greatest width of pronotum 4.5–5; length of tegmen 15.8–18.5; greatest width of tegmen 4.8–5.5.

♀. Length of body 11.5–16.5 mm.; length of pronotum 3.8–5; greatest width of pronotum 5–6; length of tegmen 7–9; greatest width of tegmen 3.5–4.8.

Distribution.—Available data show that the present species ranges from Southern New Jersey (Anglesea) to Georgia, west to North Mexico, and northward in the Mississippi Valley at least as far as Northwestern Tennessee (Rives). The data are so meagre that almost no idea of its vertical range can be formed.

The dates on the material range from May 22 to July 23.

Remarks.—After careful comparison this name has been placed on this species and in all the characters but two given in the brief original diagnosis the males in the present series agree, the two being the number of rami of the ulnar vein of the wing and the shape of the supra-anal plate. Saussure and Zehntner give for the former "*ramis apicalibus 3, incompletis 1–2, instructa*," the latter holding true for the material in hand (three sometimes present), but the number of complete rami is four to six, suggesting that even greater variability than our specimens exhibit is present in the species, or that the original "3" was a typographical error for five. Regarding the supra-anal plate, it is produced to a certain extent mesad with the margin rotundato-truncate, and Saussure and Zehntner's "*lamina supra-anali rotundata*" probably means in contradistinction to the more markedly trigonal form found in some species of the genus.

This form is very closely related to *I. pensylvanica*, but what position it should bear in reference to the latter species can only be determined when more material and information is available. The very pale color or almost absence of coloration, combined with the decided pronotal maculation makes the males appear quite distinct while the supra-anal plate has a different facies, although the form of the latter portion is occasionally approached in otherwise quite typical *pensylvanica*. The tegminal characters of the female, the form of the pronotum and of the subgenital plate differentiate that sex, although some individuals of *pensylvanica* are hard to separate. However, no female individuals of the latter species have been seen with tegmina as short or as acute or with a subgenital plate as blunt and as sinuate laterad as in *divisa*.

Specimens examined.—Twelve; six males, six females:

Anglesea, N. J. One female. (Hebard Collection.)

Delaware. One male. (A. N. S. P.)

Plummer's Island, Md. One female. (U. S. N. M.)

Raleigh, N. C. Five males, three females. (U. S. N. M., A. N. S. P. and Hebard Collection.)

Rives, Tenn. One female. (U. S. N. M.)

Ischnoptera couloniana Saussure.

1862. [*Ischnoptera*] *Couloniana* Saussure, Révue et Magasin de Zoologie, 2e ser. XIV, p. 169. [North America.]
1864. *Ischnoptera Couloniana* Saussure, Mém. l'Hist. Nat. Mex., III, p. 83. [United States.]
1865. *I*[*schnoptera*] *lata* Brunner, Nouv. Syst. Blatt., pp. 135, 413. [North America; St. Domingo.[18]] (Exclusive of synonymy.)
1869. *Ischnoptera hyalina* Scudder, Trans, Amer. Ent. Soc., II, p. 307. [Delaware.]
1870. *Ischnoptera Couloniana* Saussure, Miss. Scient. Mex., Recherch. Zool., VI, p. 63. [United States; Mexico.]
1893. *Ischnoptera couloniana* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I. p. 40. [Texas; Mexico.]
1893. *Temnopteryx major* Saussure and Zehntner, Biol, Cent.-Amer., Orth., I, p. 54. [Tennessee.]
1903. *Temnopteryx major* Rehn, Ent, News, XIV, p. 126. [Chestertown, Md.]
1903. *Ischnoptera major* Blatchley, Orthoptera of Ind., p. 183. [Wyandotte, Crawford County, Ind.]
1903. *Ischnoptera hyalina* Rehn, Ent. News, XIV, p. 325. [Examination of type.]
1905. *Ischnoptera inæqualis* Rehn and Hebard (not of Saussure and Zehntner), Proc. Acad. Nat. Sci. Phila., 1904, p. 779. [Thomasville, Ga.]
1905. *Ischnoptera major* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1904, p. 780. [Thomasville, Tyty and Ocklockonee River, Thomas County, Ga.]
1908. *Ischnoptera major* Brimley, Ent. News, XIX, p. 16. [Raleigh, N. C.]

Description.—♂. Size large (for genus); form lanceolate, moderately depressed; surface glabrous. Head with portion of occiput visible cephalad of pronotum when viewed from dorsum; interspace between eyes varying considerably in width, distinctly narrower than to as broad as that between antennæ; antennæ somewhat longer than body. Pronotum transverse ovate, cephalic margin more arcuate than caudal, supra-cephalic portion subtruncate, lateral angles very broadly rounded; lateral portions more or less deflected; oblique sulci distinct, the disk bordered cephalad of same with several impressions on each side. Tegmina elongate, sublanceolate, three and one-half to four and one-half times length of pronotum, their greatest width contained three to three and one-half times in length; costal margin considerably arcuate proximad, nearly straight mesad and

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[18] Latter in error, due to wrong association of synonymy.

distad, apex rotundato-acuminate; costal field moderately broad, anal sulci joining sutural margin about two-fifths distance from base. Wings from three to five complete and two to five incomplete rami. Supra-anal plate produced rotundato-trigonal, arcuato-emarginate laterad, apex rounded; cerci subdepressed, subequal proximad, tapering distad.

General color varying from very pale ochraceous to tawny, lateral portions of pronotum buffy or whitish, costal field and portion of remainder of costal margin of tegmina translucent, slightly tinted with general color. Head with more or less distinct pale yellow supra-antennal spots. Disk of pronotum frequently darker than general color, varying from clay color to chestnut, usually distributed over the disk as paired blotches or lines on base color, very rarely sub-uniformly colored. Abdomen varying from ochraceous to vandyke brown, darker caudad and laterad. Limbs ochraceous varying in shade.

♀. Size large (for genus); form elliptical, depressed; surface glabrous. Head hardly visible cephalad of margin of pronotum; inter-ocular space very slightly narrower than that between antennæ. Pronotum decidedly transverse, greatest length contained one and three-fifths to one and three-fourths times in greatest width, regularly arcuate laterad and cephalad, very slightly subtruncate dorsad of head, caudal margin varying from arcuato-truncate to subtruncate, lateral angle rounded; disk in section subarcuate, very slightly deflected laterad. Tegmina subquadrato-ovate, slightly longer than pronotum, greatest width but slightly less than tegminal length, distal margin broadly rounded;[19] costal field broad, reaching slightly distad of middle of tegmen, anal sulcus reaching to about one-fourth length of sutural margin from apex. Wings nearly as long as tegmina. Abdomen broad, greatest width slightly exceeding that of pronotum; supra-anal plate produced trigonal, apex acute, very rarely sub-fissate, lateral margins arcuato-emarginate, surface considerably carinate cephalo-caudad; cerci depressed subfusiform.

General color of head, pronotum, tegmina and limbs varying from ochraceous to burnt umber, lateral portions of Pronotum more or less distinctly ochraceous, costal portion of tegmina pale translucent ochraceous. Abdomen seal brown, segments when extended seen to be bay or maroon at bases. Face more or less distinctly maculate with dark brown mesad.

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[19] Very rarely subtruncate or as rarely narrowly rounded.

Measurements.—♂. Length of body 18.5–21.5 mm.; length of pronotum 4–5; greatest width of pronotum 5.2–6.5; length of tegmen 18–25; greatest width of tegmen 5.5–7:

♀. length of body 15.5–22.5 mm.; length of pronotum 4.8–6; greatest width of pronotum 6.8–8.2; length of tegmen 6.2–8; greatest width of tegmen 4.5–5.5.

Figs. 15 and 16.—*Ischnoptera couloniana* Saussure. Supra-anal plate of ♂ (× 4) and ♀ (× 2½). Male; Sulphur Springs, N. C.: female; Chestertown, Md.

Distribution.—This species is now known to range from Delaware and Maryland (Chestertown and Laurel) south to at least northern Florida (Jacksonville), west to at least eastern Texas (Hockley), north to Iowa and southern Indiana (Crawford County). Outside of our limits it is also found in Mexico. Its vertical distribution extends from sea-level to twenty-five hundred feet elevation (Sulphur Springs).

The dates on the material in hand range from January to August.

Remarks.—The synonymy of this species has been established after a very critical examination of the descriptions and the study of an extensive series of specimens, including the type of *hyalina*. The possibility of *couloniana* and *major* being the same has been suggested by Blatchley,[20] but no attempt has been made up to the present time to determine the true status of the names here synonymized. Saussure and Zehntner's *Temnopteryx major* was, of course, based on the short-winged female and Brunner himself has shown the identity of *lata* with *couloniana*,[21] while the possession of the type of *hyalina* enables us to place Scudder's species with certainty.

There is a very perceptible amount of color variation in this species, of which the more usual type is that described by Blatchley[22] and found in the type of *hyalina*, the disk of the male pronotum being pale reddish ochraceous, while the other extreme, to which belonged the type of *couloniana*, has this area more or less infuscate, particularly cephalad. The depth of this infuscation is variable and it is sometimes only suggested by points and lines. In the female much the same thing occurs as in the male, but usually less clearly defined.

Such variation in size as is found appears to be purely individual and has no geographic correlation.

Some male specimens of this species bear a considerable resemblance to individuals belonging to the *pensylvanica-inæqualis* type, but we

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[20] *Orthopt. of Indiana*, p. 183 (1903).
[21] *Nouv. Syst. Blatt.*, p. 413 (1865).
[22] *Vide supra*, p. 183.

have experienced little difficulty in placing them. However, no true intermediate specimens have been examined, although it is possible that the species intergradate.

Specimens examined.—Seventy; thirty-three males, thirty-seven females:

Delaware.[23] One male. (A. N. S. P.) Type of *hyalina*.

Chestertown, Md. Two females. (A. N. S. P.)

Glendale, Md. One female. (U. S. N. M.)

Laurel, Md. Two females. (Bruner Collection.)

Falls Church, Va. One female. (U. S. N. M.)

Chain Bridge, Va. One female. (U. S. N. M.)

Ocean View, Va. One female. (U. S. N. M.)

Raleigh, N. C. Sixteen males, twenty-one females. (U. S. N. M. and Hebard Collection.)

Sulphur Springs, N. C. Two males, one immature female. (Hebard Collection.)

Tryon, N. C. One male. (U. S. N. M.)

Calhoun, S. C. One female. (U. S. N. M.)

Thomasville, Ga. One male, one immature female. (Hebard Collection.)

Thomson Mills, Ga. One male. (U. S. N. M.)

Jacksonville, Fla. One male. (Bruner Collection.)

Florida. Two males, one female. (U. S. N. M. and Bruner Collection.)

Alabama. One male. (Morse Collection.)

Crawford County, Ind. One male, four females. (A. N. S. P., U. S. N. M.; Hebard Collection.)

Iowa. Two males. (U. S. N. M.)

Hockley, Tex. One male. (U. S. N. M.)

Texas. Three males. (U. S. N. M.)

Ischnoptera uhleriana Saussure.[24]

1862. *I[schnoptera] uhleriana* Saussure, Revue et Magasin de Zoologie, 2e ser, XIV, p. 169. [Pennsylvania.]

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[23] This specimen probably came from near Newark, Delaware, the home of Dr. T. B. Wilson, who presented considerable Delaware collections.

[24] The following references are of uncertain application, as great confusion has existed regarding *I. uhleriana*, *u. fulvescens* and *borealis*. The material in hand furnishes evidence enough to justify their removal from the Saussurean species' references.

1876. *Ischnoptera unicolor* Thomas, Proc. Davenport Acad. Nat. Sci., I, p. 250. [Iowa.]

1893. *Temnopteryx virginica* Bruner, Publ. Neb. Acad. Sci. III. p. 21. [Eastern part of Nebraska.]

1862. *P*[*latamodes*] *unicolor* Scudder, Boston Journ. Nat. Hist., VII, p. 417. [Massachusetts.]
1862. *E*[*ctobia*] *lithophila* Scudder, *ibid.*, p. 418. [Massachusetts.]
1864. *Ischnoptera uhleriana* Saussure, Mém. l'Hist. Nat. Mex., III, p. 82. [Pennsylvania.]
1865. *T*[*emnopteryx*] *virginica* Brunner, Nouv. Syst. Blatt., p. 86. [Draper's Valley, Va.]
1865. *I*[*schnoptera*] *unicolor* Brunner, *ibid.*, p. 134. [Massachusetts; North America.]
1870. *Ischnoptera uhleriana* Saussure, Miss. Scient. Mex., Rech. Zool., VI, p. 55. [East Coast of North America.]
1870. *Ischnoptera unicolor* Saussure, *ibid.*, p. 56. [North America.]
1888. *Ectobia lithophila* Caulfield, Rep. Ent. Soc. Ontario, XVIII, p. 71. [Welland, Ontario and westward.]
1889. *Platamodes unicolor* Davis, Ent. Amer., V. p. 81. [Staten Island, N. Y.]
1894. *Ischnoptera unicolor* Beutenmüller, Bull. Amer. Mus. Nat. Hist., VI, p. 259. [New York.]
1894. *Temnopteryx virginica* Beutenmüller, *ibid.*, p. 261. [New York.]
1896. *Temnopteryx virginica* Davis, Proc. Nat. Sci. Asso. Staten Island V. p. 97. [Staten Island, N. Y.]
1900. *I*[*schnoptera*] *unicolor* Smith, Ins. N. J., p. 150. [Palisades, Westville, Clementon, Anglesea and Lahaway, N. J.]
1900. *I*[*schnoptera*] *uhleriana* Smith, *ibid.*, p. 150. [Anglesea, Newark and Jamesburg, N. J.]
1900. *Temnopteryx virginica* Smith, *ibid.*, p. 150. [Staten Island; Westville, N. J.]
1900. *Ischnoptera uhleriana* Scudder, Psyche, IX, p. 100. [Massachusetts; Connecticut.]
1908. *Ischnoptera uhleriana* Brimley, Ent. News. XIX, p. 16. [Raleigh, N. C.]

Description.—♂. Size rather small; form elongate lanceolate; surface glabrous. Head with occiput hardly projecting cephalad of pronotum; interspace between eyes distinctly narrower than that between antennæ; antennæ hardly surpassing tips of tegmina. Pronotum transverse elliptical, subtruncate cephalad, regularly arcuate caudad, very slightly oblique-subtruncate cephalo-laterad, lateral angles well rounded, slightly caudad of middle; oblique sulci strongly marked, occasionally joined by an arcuate sulcus caudad; lateral portions subdeclivent. Tegmina lanceolate, slightly widening to about one-fourth of length from apex, length four and one-half to five times length of pronotum, greatest width of tegmen contained two and two-thirds to three times in length of same, greatest

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1893. *Ischnoptera unicolor* Bruner, *ibid.*, p. 21. [Eastern Nebraska.]
1894. *Ischnoptera unicolor* Blatchley, Proc. Ind. Acad. Sci., 1892, p. 160. [Terre Haute, Ind.]
1897. *Ischnoptera unicolor* Ball, Proc. Iowa Acad. Sci., IV, p. 235. [Ames and Oskaloosa, Ia.]
1898. *Ischnoptera unicolor* Lugger, Bull. 55, Minn. Agr. Exp. Sta., p. 187. fig. 59. [Minnesota.]
1903. *Ischnoptera uhleriana* Blatchley, Orth. of Ind., p. 184. (Part.) [Crawford, Vigo, Putnam, Marion, Kosciusko and Lake Counties, Ind.]
1904. *Ischnoptera uhleriana* Mead, Ohio Nat., IV, No. 5, p. 111. [Ohio.]
1907. *Ischnoptera uhleriana* Tucker, Sci. Bull. Kansas Univ., IV, No. 2, p. 71. [Douglas County, Kan.]

width at third of length from apex, breadth there appreciably greater than at one-third of length from base; costal margin arcuate, less so mesad and distad than proximad, apex rotundato-acuminate, anal sulcus reaching sutural margin one-third of length of latter from base. Wings with from four to six complete and two to four incomplete rami of ulnar vein. Supra-anal plate moderately produced, trigonal, apex rather broadly rounded; cerci subdepressed, tapering distad, subequal in width proximad.

General color ochraceous, varying toward tawny ochraceous in some individuals, lateral portions of pronotum and costal field of tegmina frequently translucent, abdomen becoming prout's brown distad, eyes blackish, face marked more or less solidly with prout's brown.

♀. Size rather small; form elliptical-ovate, subdepressed; surface subglabrous. Head almost completely hidden under pronotum; interspace between eyes slightly greater than that between antennal bases; antennæ very slightly exceeding apex of abdomen. Pronotum strongly arcuate laterad and cephalad, very narrowly subtruncate dorsad of head, caudal margin truncato-arcuate, lateral angles rounded rectangulate; disk in section arcuate, oblique sulci absent. Tegmina subquadrate, costal margin gently arcuate, discal margin slightly oblique subtruncate, occasionally subsinuate, apex costal and well rounded, disto-sutural angle rounded, anal sulcus reaching to disto-sutural angle; costal field moderately broad. Wings as long as tegmina. Supra-anal plate moderately produced, trigonal, lateral margins more or less distinctly arcuato-emarginate, apex rounded, a more or less decided medio-longitudinal carina present; cerci subdepressed, subfusiform, apex acute.

General color ochraceous, abdomen with distal portions of segments and often almost entire abdomen seal brown; eyes blackish. Tawny occasionally suffuses disk of pronotum and entire tegmina aside from costal field.

Measurements.—♂. Length of body 13.5–17.5 mm.; length of pronotum 3–3.2; greatest width of pronotum 4.2–4.8; length of tegmen 15.5–19.5; greatest width of tegmen 5.5–6.

♀. Length of body 12–15; length of pronotum 4–4.5; greatest width of pronotum 5–6.2; length of tegmen 3.8–4.5; greatest width of tegmen 3.2–4.5.

Figs. 17 and 18.—*Ischnoptera uhleriana* Saussure. Supra-anal plate of ♂ (× 5) and ♀ (× 4). Male; Delaware County, Pa.: female; Lakehurst, N. J.

Distribution.—Positive data for this species show the range to be more limited than is usually supposed to be the case. It is now known to range from Massachusetts, New York, and southeastern Ontario (Welland), south to North Carolina (Sulphur Springs, Tryon, Raleigh and Wilmington[25]), and as far as available material is concerned not extending west of the Appalachians, all the specimens examined from west of that range belonging to other forms, while it is quite possible that Caulfield's Welland, Ontario, record belongs to *I. borealis*. At Raleigh it meets the range of *I. uhleriana fulvescens*, typical specimens of each and others about intermediate and not easy to place being in the series from that locality. The months represented in the series examined extend from April to July.

Remarks.—The identity of *unicolor* with *uhleriana* has been established by Scudder, and breeding experiments by Caudell have demonstrated the specific identity of *uhleriana* and *Temnopteryx virginica*, which latter was based on the short-winged female. The size variation in the species is moderate, and in color the large series examined is quite uniform, at least in the male sex. Saussure's *uhleriana* appears to be limited to the costal plain, Piedmont country and mountain valleys replaced to the southward and in the middle and lower Mississippi Valley region by *I. u. fulvescens*, which reaches its extreme development in Texas, and with which it apparently intergradates.

Specimens examined.—One hundred and twenty-three; one hundred and seventeen males, seven females:

Lakehurst, N. J. Two males, one female. (Brooklyn Inst. Arts and Sci.)

New Jersey. One male. (A. N. S. P.)

Ridley Township, Delaware County, Pa. One male. (A. N. S. P.)

Delaware. Three males. (A. N. S. P.)

Plummer's Island, Md. One male. (U. S. N. M.)

Tryon, N. C. Six males. (U. S. N. M.)

Raleigh, N. C. Seven males, five females.[26] (Hebard Collection.)

Sulphur Springs, N. C. Ninety-two males. (Hebard Collection.)

Wilmington, N. C. One female.[26] (Brooklyn Inst. Arts and Sci.)

North Carolina. Five males (Bruner Collection.)

Ischnoptera uhleriana fulvescens Saussure and Zehntner.

1877. *Ischnoptera unicolor* Scudder (not of Saussure, 1862), Proc. Boston Soc. Nat. Hist., XIX, p. 92. [Fort Reed, Fla.]

1893. *Ischnoptera uhleriana* var. *fulvescens* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 36, pl. III, figs. 2 and 3 (♂). [Georgia; Texas; New Mexico.[27]]

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[25] The latter record is a tentative one, as it is based on a female, and *I. u. fulvescens* is separated only with great difficulty in that sex.

[26] Females from these localities are only tentatively assigned to typical *uhleriana*, as in that sex no valid character for separating *u. fulvescens* has been found.

[27] The localities given are for the species, no particular locality being cited for the variety.

1893. *Temnopteryx texensis* Saussure and Zehntner, *ibid.*, p. 52, pl. III, fig. 31. [New Mexico; Tex.]
1902. *Ischnoptera unicolor* Blatchley, A Nature Wooing, p. 216. [Ormond, Fla.]
1903. *Ischnoptera uhleriana* Blatchley (not of Saussure, 1862), Orth. of Ind., p. 184. (Part.) [Crawford, Vigo, Putnam, Marion, Kosciusko and Lake Counties, Ind.]
1903. *Ischnoptera uhleriana* Caudell (not of Saussure 1862), Proc. U. S. Nat. Mus., XXVI, p. 778. [Victoria, Texas.]
1904. *Ischnoptera uhleriana* Caudell (not of Saussure, 1862), Sci. Bull. Mus. Brooklyn Inst., I, p. 106. [Esperanza Ranch, Brownsville, Tex.]
1905. *Ischnoptera uhleriana* Caudell (not of Saussure, 1862), Proc. U. S. Nat. Mus., XXVIII, p. 462. (Part.) [Patagonia Mountains, Santa Rita Mountains, and Huachuca Mountains, Ariz.]
1905. *Ischnoptera uhleriana* Rehn and Hebard (not of Saussure, 1862), Proc. Acad. Nat. Sci., Phila., 1904, p. 780. [Thomasville, Ga.]
1909. *Ischnoptera uhleriana* Tucker (not of Saussure, 1862), Ent. News, XX, p. 296. [Plano, Collin County, Tex.]

Description.—♂. Very similar to same sex of *I. uhleriana*, differing in the following points: pronotum ovate, greatest length contained one and one-third to one and two-fifths times in greatest width, lateral and cephalic margins regularly arcuate aside from subtruncate supra-occipital portion, caudal margin arcuate or broadly sub-obtus-angulate, lateral angles very broadly rounded; tegmina four to four and one-half times as long as pronotum, greatest width subequal to that of pronotum, median third of tegmina subequal in width; wings with four to five complete and one to three incomplete ulnar rami.

Coloration as in *I. uhleriana,* but usually more inclined toward pure ochraceous, and with translucent lateral portions of pronotum and costal section of tegmina more contrasted.

♀. Does not appear to be separable from *I. uhleriana* by any one character or set of characters. Coloration as in *uhleriana,* but rarely pronotum is margined laterad and cephalad with a broad yellowish area, which in a weakened character colors costal field of tegmina; disk of pronotum rarely with an indefinite pattern.

Measurements.—♂. Length of body 12–18 mm.; length of pronotum 2.8–3.8; greatest width of pronotum 3.6–4.8; length of tegmen 12.5–17; greatest width of tegmen 4–4.8.

♀. length of body 12.5–16.8; length of pronotum 4–4.5; greatest width of pronotum 5.5–6.2; length of tegmen 4.1–4.8; greatest width of tegmen 3.8–4.

Distribution.—This austral race of *I. uhleriana* is known to range from southeastern Virginia (Lake Drummond), east central North Carolina (Raleigh), and southern Indiana (Crawford County), south to at least central Florida (Ormond, Eustis and Fort Reed) and southern

Texas (Brownsville), west to south-eastern Arizona (Huachuca Mountains). The material examined was taken on dates ranging from March to August.

Figs. 19 and 20.—*Ischnoptera uhleriana fulvescens* Sauss. and Zehntner. Supra-anal plate of ♂ (× 5) and ♀ (× 4). Male; Shovel Mount., Tex.: female; Ormond, Fla.

Remarks.—Saussure and Zehntner's *Temnopteryx texensis* appears to be an absolute synonym of their *fulvescens*, which has page precedence to warrant its usage, *texensis* having been based on the female, while *fulvescens* was applied to the male. The center of maximum differentiation of this form is in Texas, individuals from that State usually having the characters separating the race from *uhleriana* most decided. The size does not vary greatly in Texas and North Carolinan individuals, but in southern Georgia and Florida there is a great diversity in size of males, quite small specimens being in the minority in the Thomasville series, and in the majority in the Jacksonville lot, while the single Eustis, Florida male is the smallest seen and furnishes the minimum measurements given above. From this it appears probable that the form decreases in size southward in Florida.

The coloration varies but little, the most striking type being that seen in the figure of *Temnopteryx texensis* (*vide supra*), which is almost matched in a female before us from Brownsville, Texas, otherwise inseparable from Florida individuals. There is, it might be added, some slight variation in the amount of sinuation to the distal margin of the female tegmina. The specimen from Lake Drummond, Va., shows strong tendencies toward true *uhleriana*.

Specimens examined.—Forty-seven; forty males, seven females:

Lake Drummond, Va. One male. (U. S. N. M.)

Raleigh, N. C. Seven males. (Hebard Collection.)

South Carolina. One male. (U. S. N. M.)

Thomasville, Ga. Six males. (A. N. S. P. and Hebard Collection.)

East Florida. One male. (U. S. N. M.)

Fernandina, Fla. One male. (A. N. S. P.)

Lake Harney, Fla. One male. (U. S. N. M.)

Jacksonville, Fla. Six males, two females. (Bruner Collection.)

St. Augustine, Fla. Two females. (A. N. S. P. and Morse Collection.)

Ormond, Fla. One female. (Hebard Collection.)

Eustis, Fla. One male. (U. S. N. M.)

Warrington, Fla. One female. (Morse Collection.)

Crawford County, Ind. One male. (Blatchley Collection.)

Dallas, Tex. One male. (U. S. N. M.)

Shovel Mountain, Tex. Two males. (A. N. S. P.)

Round Mountain, Tex. One male. (A. N. S. P.)

Brownsville, Tex. One male, one female. (U. S. N. M. and Brooklyn Inst. Arts and Sci.)

Texas. Four males. (A. N. S. P. and U. S. N. M.)

Huachuca Mountains, Ariz. One male. (Brooklyn Inst. Arts and Sci.)

Santa Rita Mountains, Ariz. One male. (U. S. N. M.)

Galiuro Range, Ariz. One male. (U. S. N. M.)

Patagonia Mountains, Ariz. One male. (U. S. N. M.)

Ischnoptera notha n. sp.

1893. *Ischnoptera uhleriana* Saussure and Zehntner (not of Saussure, 1862), Biol. Cent.-Amer., Orth., I, p. 36, pl. III, figs. 21 and 22. (♀) (Part.) [Georgia; Texas; New Mexico.[28]]

1903. *Ischnoptera uhleriana* Caudell (not of Saussure, 1862), Proc. Ent. Soc. Wash., V, p. 165. [Madera Canyon, Ariz.]

1905. *Ischnoptera uhleriana* Caudell (not of Saussure, 1862), Proc. U. S. Nat. Mus., XXVIII, p. 462. (Part.) [Patagonia Mountains, Santa Rita Mountains, and Huachuca Mountains, Ariz.]

1907. *Ischnoptera uhleriana* Rehn (not of Saussure, 1862), Proc. Acad. Nat. Sci. Phila., 1907, p. 25. [Palmerlee, Huachuca Mountains, Ariz.]

Type: ♂; Huachuca Mountains, Ariz., August 22, 1903. (Oslar) [U. S. N. M.]. ♀; Palmerlee, Huachuca Mountains, Ariz. (Schaeffer.) [Brooklyn Inst. Arts and Sciences.]

Characters.—♂. Size rather small; form lanceolate, moderately depressed; surface glabrous. Head almost entirely hidden beneath pronotum; interspace between eyes considerably narrower than that between antennal bases; antennæ considerably exceeding apex of abdomen. Pronotum transverse subovate, greatest width contained one and one-third times in greatest length, cephalic and lateral margins arcuate, subtruncate dorsad of head, caudal margin slightly arcuate, lateral angles caudad of middle and very broadly rounded; disk in transverse section subarcuate deplanate, rather narrowly declivent laterad, oblique sulci distinct, connected caudad by a short less distinct arcuate impression. Tegmina elongate, narrow, subequal in greater portion of length, four times length of pronotum, greatest width contained three and one-half times in length of tegmen; costal margin hardly arcuate except proximad and toward apex, latter narrowly rounded; anal sulcus joining sutural margin two-fifths length of same from base. Wings with four complete and three incom-

[28] Without the examination of the original material it is impossible to say which of the localities cited refer to this species.

plete ulnar rami. Supra-anal plate transverse, median portion produced into a broad, deflected lobe which is separated from body of plate by a decided transverse fold, projection with margin subarcuate; cerci elongate, depressed, terete.

General color very dull buff, approaching ochraceous; lateral portions of pronotum and costal field of tegmina translucent; eyes blackish.

♀. Size rather small; form elliptical, subdepressed; surface glabrous. Head not extending cephalad of pronotum; interspace between eyes distinctly wider than that between antennal bases; antennæ moderate in length. Pronotum semi-ovate, greatest length contained about one and one-half times in greatest width; lateral and cephalic margins regularly and strongly arcuate, caudal margin slightly arcuate, lateral angles well rounded; disk in transverse section slightly arcuate; slightly declivent laterad, oblique sulci hardly indicated. Tegmina lanceolate-elliptical, twice length of pronotum, greatest width contained about two and one-quarter times in length, covering all but supra-anal plate, ultimate and penultimate abdominal segments; costal margin regularly arcuate, sutural margin very slightly so, apical rather narrowly oblique subtruncate, apex costal in position, rotundato-rectangulate; anal sulcus meeting sutural margin slightly distad of middle of latter. Wings as long as tegmina. Supra-anal plate trigonal, angle obtuse and apex hardly rounded, indication of transverse ridge similar to that of male present, slight medio-longitudinal carina indicated; cerci unknown (broken); subgenital plate with margin arcuate.

Figs. 21 and 22.—*Ischnoptera notha* n. sp. Supra-anal plate of ♂ (× 5) and ♀ (× 3). Male; Huachuca Mountains, Arizona (*type*): female; Palmerlee, Arizona (*type*).

General color tawny, tegmina ferruginous with costal field tawny, pronotum, head, venter and limbs buffy, abdomen tawny ventrad; eyes black.

Measurements.—♂. Length of body 12.5–16*[29]mm.; length of pronotum 3.2–3.8*; greatest width of pronotum 4.2–4.8*; length of tegmen 13–16.5*; greatest width of tegmen 4.2–4.5*;

♀. Length of body 13.5*mm.; length of pronotum 4.5*; greatest width of pronotum 6*; length of tegmen 9.5*; greatest width of tegmen 4.2.*

Distribution.—The material in hand shows the range of this species

[29] Asterisks indicate type measurements.

to extend from the Huachuca Mountains, south-eastern Arizona to the central San Joaquin Valley of California (Riverdale, Raymond and Fresno). It is very probable that Saussure and Zehntner's New Mexican record belongs to this species, in which case its range is carried eastward some distance. The only dates on material are in July and August.

Remarks.—This is one of the most interesting species of the genus seen by us, its supra-anal characters in the male being quite peculiar. The real relationship of the female has, as witnessed by the references to Saussure and Zehntner and the present author, been entirely misunderstood, and the examination of the male enables us to assign it to a position apart from the interrelated *uhleriana* group. Saussure and Zehntner's *Ischnoptera uhleriana* (*vide supra*) was a composite, not including the true *uhleriana*, and it is impossible to assign the localities to the respective components.

Specimens examined.—Six; four males, one female, one immature individual:

Huachuca Mountains, Ariz. One male (type). (U. S. N. M.)

Palmerlee, Ariz. One female (type), one immature specimen. (Brooklyn Inst. Arts and Sci.)

Fresno, Cal. One male. (U. S. N. M.)

Riverdale, Cal. One male. (U. S. N. M.)

Raymond, Cal. One male. (Morse Collection.)

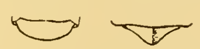
Ischnoptera borealis Brunner.

1865. *I[schnoptera] borealis* Brunner, Nouv. Syst. Blatt., p. 133. [North America.]
1892. *Ischnoptera borealis* Osborn, Proc. Iowa Acad. Sci., I, pt. 2, p. 117. [Central Iowa.]
1893. *Ischnoptera borealis* Brunner, Publ. Nebr. Acad. Sci., III, p.21. [Eastern Nebraska.]
1903. *Ischnoptera uhleriana* Blatchley (not of Saussure, 1862), Orth. of Ind., p. 184. (Part.) [Crawford, Vigo, Putnam, Marion, Kosciusko and Lake Counties, Indiana.]
1905. *Ischnoptera borealis* Rehn, Trans. Kansas Acad. Sci., XIX, p. 221. [Clark County, Kansas.]

Description.—♂. Size small; form elongate-ovate; surface glabrous. Head hardly projecting cephalad of pronotum, interspace between eyes narrower than that between antennæ; antennæ reaching slightly beyond apex of tegmina. Pronotum transverse ovate, greatest length contained one and one-third to one and one-half times in greatest width, which latter is slightly caudad of middle, margin cephalad of same regularly arcuate, slightly subtruncate dorsad of head, lateral angles very broadly rounded, caudal margin very slightly arcuate; disk deplanate with distinctly declivent, lateral portions, oblique sulci decided. Tegmina elongate-lanceolate, greatest width at about third of length from apex, length four to four and one-half times that of pronotum, greatest width contained two and two-thirds to three times in length; costal margin arcuate proximad and distad, apex rounded; anal sulcus reaching sutural margin slightly distad of one-third length of same. Wings with two to five complete and two to four incomplete ulnar rami. Supra-anal plate decidedly transverse, margin hardly produced, arcuate; cerci terete.

General color pale ochraceous, pronotum and costal field of tegmina translucent, disk of former rarely clouded with splotches of brownish; eyes hair brown; abdomen washed distad with dilute prout's brown.

♀. Size small; form elliptical, depressed; surface glabrous. Head hardly visible cephalad of pronotum; interspace between eyes slightly greater than that between antennal bases; antennæ about equal to body in length. Pronotum semi-ovate, greatest length contained about one and one-half times in greatest width, lateral and cephalic margins strongly arcuate, slightly subtruncate dorsad of head, caudal margin arcuato-truncate, lateral angles caudad of middle and narrowly rounded obtuse-angulate; disk slightly arcuate in transverse section. distinctly declivent laterad, oblique sulci not or but slightly indicated, Tegmina subquadrate, hardly longer than pronotum, attingent but hardly overlapping; costal margin moderately arcuate, distal margin obliquely sinuato-truncate, apex costal and well rounded; anal sulcus reaching to disto-sutural angle, which latter is very broadly rounded. Wings minute. Supra-anal plate sub-trigonal, angle obtuse, lateral margins slightly concavo-emarginate, immediate apex narrowly rounded; cerci depressed, rather broad mesad, subfusiform.



Figs. 23 and 24.—*Ischnoptera borealis* Brunner. Supra-anal plate of ♂ (× 8) and ♀ (× 5). Male; Boykins, Va.: female; Lillington, N. C.

General color tawny becoming seal brown caudad, latter color covering dorsum and frequently venter of abdomen, rarely seal brown is uniform color of dorsum. Head often with face seal brown, more rarely tawny. Pronotum occasionally with disk darker than general color, thus forming a broad lateral pale margin on pronotum and sometimes on costal field of tegmina.

Measurements.—♂. Length of body 13–14 mm.; length of pronotum 3–3.5; greatest width of pronotum 3.8–4.5; length of tegmen 12–18; greatest width of tegmen 3.8–5.8:

♀. Length of body 10.5–11.5 mm.; length of pronotum 3.2–3.5;

greatest width of pronotum 4.2–5; length of tegmen 3.5; greatest width of tegmen 2.5–3.2.

Distribution.—The material before us proves that this species has the most extensive range of any form of the genus found in North America. The localities represented extend from Massachusetts (Wellesley), northern Indiana (Lake and Kosciusko Counties), northern Illinois, Iowa and eastern Colorado, south to northern Florida (Fernandina), Alabama (Auburn), and western Arkansas (Mena). Its vertical range extends from sea-level to twenty-five hundred feet elevation (Sulphur Springs). The zonal distribution of the species appears to be Upper and Lower Austral, slightly, and probably more extensively, encroaching on the Transition region. The dates represented are all in the months of May, June and July.

Remarks.—It is most remarkable that this species should have been so generally overlooked, but few authors having reported it when it is the most generally distributed of any single form of the genus in our region. Its great superficial resemblance to *I. uhleriana* has no doubt caused its confusion with that species, but the shape of the supra-anal plate will readily distinguish the males of the two. The female is distinctly smaller and with usually more rounded tegmina than the same sex of *uhleriana*, but otherwise is much the same.

There is considerable individual variation in size in the male sex and probably equally as much in the female, but the size of the series of the latter sex is not sufficient to determine this.

Specimens examined.—Eighty-seven; seventy-seven males, ten females:

Wellesley, Mass. One female. (Morse Collection.)

Waterbury, Conn. One male. (A. N. S. P.)

Peermont, N. J. One male. (A. N. S. P.)

New Jersey. One male, one female. (Bruner Collection.)

Harrisburg, Pa. One male. (Penna. State Div. of Zoöl.)

McConnellsburg, Pa. One female. (A. N. S. P.)

Ashebourne, Pa. One male. (A. N. S. P.)

Mt. Airy, Pa. One male. (Hebard Collection.)

District of Columbia. One male. (Bruner Collection.)

Boykins, Va. One male. (A. N. S. P.)

Virginia. One male, two females. (Bruner Collection.)

Sulphur Springs, N. C. Forty-one males. (Hebard Collection.)

Tryon, N. C. Six males. (U. S. N. M.)

Lillington, N. C. One female. (Hebard Collection.)

Fernandina, Fla. Two males. (A. N. S. P. and Georgia State Entom. Coll.)

Auburn, Ala. One male. (Morse Collection.)

Terre Haute, Ind. One male. (Blatchley Collection.)

Lake County, Ind. One male. (Blatchley Collection.)

Turkey Lake, Kosciusko County, Ind. One male. (Blatchley Collection.)

Marion County, Ind. Two males. (Blatchley and Hebard Collection.)

Crawford County, Ind. One male, one female. (Hebard Collection.)

Northern Illinois. One male. (Bruner Collection.)

Ashland, Neb. One male. (Bruner Collection.)

Lincoln, Neb. Two males. (Bruner Collection.)

Nebraska City, Neb. Seven males, one female. (A. N. S. P. and Bruner Collection.)

Fort Lupton, Col. One female. (U. S. N. M.)

Kansas. One male. (U. S. N. M)

Mena, Ark. One female. (Morse Collection.)

Ischnoptera bolliana Saussure and Zehntner.

1893. *Ischnoptera bolliana* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 40. [New Mexico; Tex.]
1902. *Ischnoptera bolliana* Blatchley, A Nature Wooing, p. 217. [Ormond, Fla.]
1903. *Ischnoptera bolliana* Rehn, Ent. News, XIV, pp. 325 and 330. [Round Mountain, Blanco County, Texas.] (Part.)
1904. *Kakerlac schaefferi* Rehn, Psyche, p. 72. [Esperanza Ranch, Brownsville, Tex.]
1907. *Ischnoptera bolliana* Tucker, Sci. Bull. Univ. Kansas, IV, No. 2, p. 71. [Douglas County, Kansas.]
1908. *Kakerlac schaefferi* Brimley, Ent. News, XIX, p. 16. [Raleigh, N. C.]

Characters.—♂. Size small; form elongate-lanceolate, very moderately depressed; surface glabrous. Head but slightly projecting cephalad of cephalic margin of pronotum; interspace between eyes considerably less than that between antennal bases; antennæ slightly exceeding tips of tegmina. Pronotum transverse trigonal-ovate, greatest length contained about one and one-half times in greatest width ; narrow supra-occipital margin arcuato-truncate, lateral margins oblique arcuato-truncate, caudal margin moderately arcuate, lateral angles subobtuse; disk deplanate, considerably deflected laterad, oblique sulci very decided and connected caudad by a short transverse arcuate impression. Tegmina elongate-lanceolate, four and one-quarter to four and one-half times pronotal length, greatest width situated at third of length from apex and contained two and two-thirds to three times in length of same; costal margin moderately arcuate proximad and distad apex well rounded; anal sulcus reaching sutural margin slightly distad of one-third of entire length from base. Wings with two to four complete and two to five incomplete ulnar rami. Supra-anal plate with distal margin considerably and broadly arcuate; cerci terete.

General color dull raw sienna or very rarely pale ochraceous, venter of abdomen becoming seal brown distad, limbs and more or less of basal portion of abdomen clay color. Head seal brown, eyes varying from black to hair brown; antennæ very dark. Pronotum with disk more or less seal brown, sometimes developed as a pair of very broad subparallel bars, again suffusing the whole dorsum except a pale median area, or present as a pair of trigonal blotches on caudal portion, and very rarely (in pale ochraceous individuals) almost unsuffused; lateral portions never suffused.

Figs. 25 and 26.—*Ischnoptera bolliana* Saussure and Zehntner. Supra-anal plate of ♂ (× 8) and ♀ (× 5). Raleigh, N. C.

♀. Size small; form elliptical, slightly broader caudad than cephalad; surface glabrous. Head projecting very slightly cephalad of cephalic margin of pronotum; interspace between eyes distinctly broader than that between antennal bases; antennæ shorter than body. Pronotum semi-ovate, greatest length contained one and one-half times in greatest width; cephalic margin subtruncate, lateral margin oblique truncato-arcuate, caudal margin subtruncate, lateral angles rotundato-rectangulate; disk in transverse section arcuate, oblique sulci absent. Tegmina lobiform, lateral, at base separated by interspace equal to one and one-half times their width, very slightly longer than half of pronotal length, very slightly surpassing caudal margin of mesonotum, apex well rounded. Wings absent. Supra-anal plate very broadly obtuse-angulate, apex rounded, with blunt medio-longitudinal carina; cerci depressed, rather broad proximad, terete.

General color pitch-black, pronotum, mesonotum, metanotum and tegmina margined with ferruginous, pronotum very narrowly so.

Measurements.—♂. Length of body 8.5–12 mm.; length of pronotum 2–3; greatest width of pronotum 2.8–4.1; length of tegmen 10–13.5; greatest width of tegmen 3.5–4.5:

♀. Length of body 9–9.5 mm.; length of pronotum 2.8–3; greatest width of pronotum 4.3–4.6; length of tegmen 1.5–1.7; greatest width of tegmen 1.5.

Distribution.—The published records and available material show that the present species ranges from eastern central (Raleigh) and western (Sulphur Springs and Tryon) North Carolina and eastern Kansas (Douglas County), south to at least north-central Florida (Ormond) and extreme southern Texas (Brownsville), westward to New Mexico. Its known vertical range is thus seen to be from sea-level to at least two thousand and five hundred feet (Sulphur Springs), and probably considerably higher on the strength of the New Mexican record, but lack of exact locality in the latter case deprives it of much of its importance. The specimens were all taken in the months of May and June.

Remarks.—There seems to be little doubt in our minds as to the propriety of synonymizing *Kakerlac schaefferi* with this species, as while no breeding experiments have been made to verify the opinion, *schaefferi* possesses the characters and coloration one would expect in the female of *bolliana* after having studied the sexes of forms like *johnsoni, deropeltiformis* and *americana,* the latter being an absolute parallel in the degree of differentiation of the sexes.

The pale form seems to be most prevalent in material from northeastern Texas, the only specimens seen by us in this phase being from Paris, Texas, and one from Texas (Belfrage) without further data.

Specimens examined.—Thirty-eight; thirty-three males, five females:

Sulphur Springs, N. C. Five males. (Hebard Collection.)

Tryon, N. C. Eight males. (U. S. N. M.)

Raleigh, N. C. Five males, two females. (A. N. S. P., Hebard Collection and U. S. N. M.)

North Carolina. Two males. (U. S. N. M.)

Swansea, S. C. One male. (U. S. N. M.)

Atlanta, Ga. One female. (A. N. S. P.)

Brunswick, Ga. One male. (A. N. S. P.)

Paris, Tex. Five males. (U. S. N. M.)

Round Mountain, Tex. Two males. (A. N. S. P.)

Hockley, Tex. One male. (U. S. N. M.)

Esperanza Ranch, Brownsville, Tex. Two males, one female. (U. S. N. M. and Brooklyn Inst. Arts and Sci.)

Port Isabel, Tex. One female. (U. S. N. M.)

Texas. One male. (U. S. N. M.)

Ischnoptera desertæ (Rehn and Hebard).

1909. *Temnopteryx desertæ* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1909, p. 116, fig. 1. [Johnstone, Valverde County, Texas.]

As this species has recently been well described and figured it seems unnecessary to redescribe it in this paper. The type is still unique, and the probability of its being the female of a species of *Ischnoptera* is so great that we have placed it, tentatively at least, as a valid species of the genus under consideration.

Ischnoptera insolita n. sp.

1903. *Ischnoptera bolliana* Rehn, Ent. News, XIV, pp. 325 and 330. [Shovel Mountain, Burnet County, Texas.] (Part.)
1903. *Ischnoptera uhleriana* Blatchley, Orthopt. of Ind., p. 185. [Crawford County, Indiana.[30]] (Part.)

Types: ♂. Shovel Mountain, Burnet County, Tex., June 21, 1901. (F. G. Schaupp.) [A. N. S. P.] ♀. Crawford County, Ind., June 30, 1902. (W. S. Blatchley.) [Blatchley Coll.]

♂. Size small; form sub-lanceolate; surface moderately polished. Head with very small portion of occiput visible cephalad of pronotum; interspace between eyes subequal to that between antennæ. Pronotum less transverse than usual in genus; caudal margin moderately arcuate, cephalic margin much shorter, arcuato-truncate, lateral margins oblique rotundato-truncate, greatest width distinctly caudad of middle, angles rotundato-rectangulate; disk subdeplanate, lateral portions declivent, oblique sulci distinct. Tegmina elongate sublanceolate, subequal in greater portion of length, pronotal length contained about three and one-half times in tegminal length, greatest width contained slightly less than three times in length, apex broadly rounded and extending caudad of apex of abdomen by nearly length of pronotum. Wings with four complete and two incomplete rami to ulnar vein. Supra-anal plate decidedly transverse, margin considerably arcuate; cerci short, terete.

General color buff, lateral portions of pronotum and costal section of tegmina whitish subhyaline; eyes clove brown; abdomen becoming russet disto-mesad.

Figs. 27 and 28.—*Ischnoptera insolita* n. sp. Supra-anal plate of ♂ and ♀ (× 8). Male; Shovel Mountain, Texas (*type*): female; Crawford County, Indiana (*type*).

♀. Size, form and surface as in male. Head and pronotum as in male, but latter proportionately larger and with extremely slight oblique sulci. Tegmina slightly more than three times length of pronotum, greatest length slightly less than three times greatest width, apices extending caudad of apex of abdomen a distance equal to two-thirds length of pronotum. Wings with three to four complete and two incomplete ulnar rami; median vein decidedly sinuate two-fifths of length from base of wing. Supra-anal plate produced trigonal, apex very narrowly rounded, slightly arcuato-emarginate laterad; cerci terete.

[30] This is the only locality of the number cited for *uhleriana* from which this species has been examined.

General coloration as in male, but more ochraceous.

Measurements.[31]—♂. Length of body (12)–12.2 mm.; length of pronotum (2.8); greatest width of pronotum (3.8); length of tegmen 11–(11.8); greatest width of tegmen (3.5)–3.8:

♀. Length of body 10–(12); length ofpronotum 3–(3.2); greatest width of pronotum 3.5–(4); length of tegmen (11.5); greatest width of tegmen (3.8).

Distribution.—This species is known from but three localities, viz., Tryon, N. C., Crawford County, Ind., and Shovel Mountain, Tex.

Remarks.—The opportunity to examine the female type of this species enabled us to clear up the perplexing problem raised earlier in the work by the other specimens. The male is not widely different from that of *bolliana* and the Tryon female was badly damaged, minus tegmina and repaired, so that one hesitated to found any conclusions upon it. The Crawford County female, however, removed this uncertainty and enabled us to properly place the material. This species is related to *I. occidentalis*, the only other North American species with long wings in the female sex, from which, however, it can be readily separated by the much smaller size and paler coloration.

Specimens examined.—Four; two males, two females:

Tryon, N. C. One female. (U. S. N. M.)

Crawford County, Ind. One female (type). (Blatchley Collection.)

Shovel Mountain, Tex. Two males (one type). (A. N. S. P.)

Ischnoptera occidentalis Saussure.

1862. *I[schnoptera] occidentalis* Saussure, Revue et Magasin de Zoologie, 2e ser., XIV, p. 170. [Nova.]

1862. *I[schnoptera] consobrina* Saussure, *ibid.*, XIV, p. 170. [No loc. given.]

1864. *Ischnoptera occidentalis* Saussure, Mém. l'Hist. Nat. Mex., III, p. 87. [New Orleans.]

1864. *Ischnoptera consobrina* Saussure, *ibid.*, p. 88. [Warm regions of Mexico; Cordova, Mexico.]

1870. *Ischnoptera consobrina* Saussure, Miss. Scient. Mex., Recherch. Zool., VI, p. 59. [Mexico and the southern United States.]

1893. *Ischnoptera consobrina* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 37, pl. 3, fig. 24. [Texas; Guerrero, Jalisco, Vera Cruz, Orizaba and Cordova, Mexico; Guatemala; Chontales, Nicaragua.]

Characters.—♂. Size medium; form elongate lanceolate, considerably depressed; surface glabrous. Head narrowly visible cephalad of pronotum; interspace between eyes but little more than half that between antennal bases; antennæ reaching about to end of tegmina. Pronotum subtrigonal, greatest length contained about

[31] The measurements enclosed in parentheses are those of the types.

one and one-third times in greatest width; cephalic margin narrowly subtruncate, lateral margins oblique sub-arcuate, caudal margins slightly arcuate, caudo-lateral angles well rounded, placed distinctly caudad of the middle; disk of pronotum deplanate dorsad, narrowly yet considerably declivent laterad, oblique sulci decided. Tegmina about four and one-third times length of pronotum and slightly more than three times as long as greatest tegminal width, subequal in width: costal margin straight except briefly proximad and distad where it is arcuate, apex rounded, costal field rather narrow, anal sulcus joining sutural margin about two-fifths length of same from base. Wings with four to five complete and six incomplete ulnar rami. Supra-anal plate large, produced, narrowing, apical margin shallowly obtuse-angulate emarginate, lateral angles rectangulate; cerci elongate, subdepressed, terete.

♀. Size medium to rather large; form elongate elliptical, moderately depressed; surface glabrous. Head with only portion of occiput visible from dorsum; interspace between eyes narrower than, or subequal to, interspace between antennal bases; antennæ not reaching to tips of tegmina. Pronotum as in male. Tegmina exceeding apex of abdomen, about three and one-third to three and one-half times length of pronotum or greatest tegminal width, form as in male but less elongate. Wings with three to five complete and five to six incomplete ulnar rami. Supra-anal plate sub-trigonal, produced mesad, produced portion broadly rounded and margin arcuato-emarginate laterad, distinct medio-longitudinal carina present; cerci as in male.

Figs. 29 and 30.—*Ischnoptera occidentalis* Saussure. Supra-anal plate of ♂ (× 3) and ♀ (2). Male; Fortin, Mex.: female; Atoyac, Mex.

General color varying from tawny ochraceous (♂) to dull ferruginous (♀), pronotum of female more or less marmorate with chestnut and costal portion of both sexes paler than general color. Limbs, ocelli and mouth parts ochraceous. Abdomen becoming more or less blackish distad.

Measurements.—♂. Length of body 14.5–16 mm.; length of pronotum 3.8–4; greatest width of pronotum 4.8; length of tegmen 17; greatest width of tegmen 5.2:

♀. Length of body 14.8–21.5[32] mm.; length of pronotum 4.2–5; greatest width of pronotum 5.2–6; length of tegmen 16.2–17.8; greatest width of tegmen 4.6–5.8.

[32] This specimen has the abdomen abnormally distended.

Distribution.—The only records of this species from the United States are from New Orleans and Texas, south of which it ranges through Mexico to at least Guatemala and Nicaragua.

Remarks.—As we have seen no material from the United States, it is not possible to comment on the variability of the species as found within our limits.

Specimens examined.—Five; two males, three females:

Fortin, Mex. One male. (Bruner Collection.)

Orizaba, Mex. One female. (Bruner Collection.)

Atoyac, Mex. One male, two females. (Bruner Collection.)

May 3.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Seventeen persons present.

The death of Lancaster Thomas, a member, April 2, 1910, was announced.

Henry Skinner, M.D., made a communication on insects injurious to shade and fruit trees. (No abstract.)

May 17.

Mr. Charles Morris in the Chair.

Forty-three persons present.

The death of Edward Van Beneden, a correspondent, April 28, 1910, was announced.

The Publication Committee reported the reception of papers under the following titles:

"Notes on Batoid Fishes," by Henry W. Fowler (May 5, 1910).

"Descriptions of four New Cyprinoids (Rhodeinæ)," by Henry W. Fowler (May 5, 1910).

"A Note regarding the Chinese Alligator," by Thomas Barbour (May 17, 1910).

The following communications were made under the auspices of the Mineralogical and Geological Section:

Chester A. Reed, on some geological features of the Arbuckle Mountains of Oklahoma. (No abstract.)

The Copper Deposits of Franklin and Adams Counties, Pennsylvania. —Edgar T. Wherry, Ph.D., remarked that the region is occupied by two Pre-Cambrian effusive igneous rocks, a rhyolite and a basalt, both considerably altered. The latter was probably the first to form, the acid rock being in part in dikes cutting through it, and a contact exposed during recent mining operations showing a rhyolite lava overlying basalt. The deposits consist chiefly of native copper in quartz veins in epidotized layers in the basalt lava. It is believed that the metal was originally distributed throughout this rock and has been concentrated, like the associated quartz, in obedience to the principle that large crystals grow at the expense of small ones, that the reduction to metallic copper was brought about by the ferrous iron of the rock constituents, that the copper was transported as a dilute solution of free metal by the circulating waters, and that the association with epidote is of physical rather than of chemical significance, in that the epidotized layers were the only ones of sufficiently resistant character to permit of the development of open cracks during the regional metamorphism. The workableness of the deposits depends upon the continuity of these epidote-bearing layers and their included quartz veins in depth, but since no explanation can be given for the epidotization of certain layers of the rock it seems impossible to predict this from present indications, and extended drilling is thought to be the only way to settle the question as to the future of the district.

Silas L. Schumo, on the pot holes of the Falls of Schuylkill, illustrated by photographs. (No abstract.)

F. Lynwood Garrison, on the copper deposit and mining operation near Bound Brook, N. J. (No abstract.)

Henry Leffman, M.D., exhibited the effect of polarized light on preparations of rock-sections by the Lumière color-process.

Edgar Madison Ledyard was elected a member.

The following were ordered to be printed:

STAURONEIS TERRYI D. B. Ward.

BY T. CHALKLEY PALMER.

The anomalous diatom here to be dealt with was first made known by Mr. William A. Terry, of Bristol, Conn., the veteran collector and student of the Diatomaceæ whose enterprise has brought to light so many new forms. He collected it on Fall Mountain, Conn., in 1890, and during the same year Dr. D. B. Ward made a number of arranged mounts of the valves. These were distributed, together with photographs showing two of the curious upper valves side by side, under the name *Stauroneis terryana* Ward. This name was almost immediately and very properly amended by Dr. Ward, at the suggestion of Prof. Hamilton L. Smith, to *Stauroneis terryi*. One of Dr. Ward's slides, and a vial of the Fall Mountain material containing the diatom, were sent by Mr. Terry, in 1892, to J. A. Tempère, who in turn forwarded a specimen to Prof. P. T. Cleve. The first literary result was the noting of a new variety in Cleve's monograph.[1]

Stauroneis acuta W. Smith. Var. **terryana,** Tempère.

The description is exceedingly short, being confined to a measurement of the length and breadth, and a counting of the striæ, the statement ending, curiously enough, "Brackish water: Connecticut!"

The second result was a figure in Schmidt's *Atlas*[2] with the legend "1. Connecticut? (Original expl. Tempère), *Stauroneis acuta* W. Smith, var. *Terryana*, Tempère."

Now the sparse characterization in Cleve's monograph would seem to point anywhere except toward a recognition of the essential characters of Mr. Terry's diatom, and the impression of an existing misconception is amply confirmed by the figure in Schmidt's *Atlas*. Whatever may finally be determined concerning the relationship between this diatom and *Stauroneis acuta*, a reduction to varietal rank must base itself on something more to the purpose than a one-line description and a single figure of some form other than that which was named *Stauroneis terryi* by Dr. Ward.

The only other publication relating to this diatom which is known

[1] *Synopsis of the Naviculoid Diatoms*, P. T. Cleve, 1894.
[2] A. Schmidt, *Atlas der Diatomaceen-Kunde*, Tafel 242, fig. 1, September, 1903.

to me is Mr. Terry's own account[3] of its discovery on Fall Mountain with some reference to the very odd features of the upper valve.

During July of 1909 I received from Mr. Terry sundry vials of diatoms collected on Fall Mountain in 1891, with a request for the preparation of a number of arranged mounts, each of which was to show the upper valve, the lower valve and the complete frustule of *Stauroneis terryi.* Some of this material was labelled "fossil" and some "recent." It consisted very largely of *Stauroneis acuta*, together with its varieties, among which one might easily imagine "var. *terryana*, Tempère." But the diatom so tardy in the matter of obtaining recognition, though present merely in traces, was in such marked contrast with all these that no special difficulty was experienced in culling it from its multitudinous associates. During the preparation of the slides a certain curious or even unprecedented feature was noticed in many of the intact frustules—a feature neither shown by Dr. Ward's preparations and photographs, nor mentioned in any previous reference to this diatom. This was brought to Mr. Terry's attention, and at his request I have had proper illustrations made of the whole form, and present the following description of the diatom.

Stauroneis terryi D. B. Ward (ined.).

Frustule fusiform, slightly arcuate in girdle view, the upper valve more convex than the lower. Valves dissimilar, the upper partly enclosing the lower. No girdle bands, the valves held in place by a broad external silicious ring at the middle part. Ring slightly cemented to the valves, easily detached, about one-eighth the length of the frustule, very thin, surface obscurely punctate. Upper valve 370–400 μ long, 55–60 μ broad. Strongly convex transversely, swollen at the middle, diminishing with concave outlines to long, bluntly rounded apices, and bearing a large oval depression toward each end wherein the raphe terminates in a fine waved line; axial hyaline area rectilinear, expanding spatulately around subterminal depressions. Lower valve slightly smaller in all dimensions, without subterminal depressions, apices more slender, with lumen formed by a conspicuous thickening of the inner terminal margin; raphe continued approximately to end of valve; hyaline area rectilinear to the lumen, then narrowing almost to a point. Stauros on both valves widening outward. Striæ 12 in 10 μ, nearly normal to periphery throughout, punctæ becoming coarser and striæ more sparse around ends of upper valve.

[3] W. A. Terry, *A Partial List of Connecticut Diatoms*, *Rhodora*, August, 1907, p. 126.

Fresh water. Fossil and recent.

Fall Mountain, Conn. W. A. Terry, 1890.

This diatom presents several curious features. It is the largest by far of the genus *Stauroneis.* It is the only one of the genus to show subterminal depressions on the valves. It is the only naviculoid diatom known to me that has a silicious belt about its middle part. For these and other reasons, it is of the greatest interest. The anomalous features specified might easily lead to the suspicion that we have here a monstrous form, a "sport," an abnormal condition of the species with which it is associated, *Stauroneis acuta* W. Smith. This idea might seem to find some confirmation in the fact that the striation and punctation, and the shape of the lower valve are approximately those of that species.

But monstrous forms do not, usually if ever, continue to produce themselves indefinitely, so that one shall find them in both the mud beneath and the water above. Monstrosities do not, like this form, recur not only for years and years in one place, but also in other ponds and streams of the same region.[4] Monstrosities are not, like this diatom, fairly uniform in characters, so that one picks out hundreds of quite similar specimens from the material. Whatever may be the relationship, Mr. Terry's diatom is something more than a teratological condition of *St. acuta.*

Some possibilities suggest themselves. Unquestionably the relationship is close. The peculiar silicious thickening at the ends of the lower valve is precisely alike in both, and this is a very significant fact. The striation and the beading are essentially similar. The lower valve, apart from its size, might upon superficial study be thought identical with the valves of *St. acuta.* The outline of this diatom, however, is different, even in the lower valve. Also, the walls of both valves are thinner, and the whole frustule is more nearly circular in cross-section. The size is relatively colossal, being more than twice as long as the ordinary *St. acuta.* There are no girdle-bands in any of the hundreds of frustules examined or mounted, nor were any bands found in the accompanying material that could possibly belong to this form. No instance of reduplication has been observed, and as a consequence, the ultimate fate of the unique silicious ring or belt is not known, though one must think its rupture a condition precedent to this process.

Some of these features might seem to point toward the conclusion

[4] Mr. Terry finds it in "three widely separated ponds in Bristol." *Rhodora,* August, 1907.

that we have here a sporangial condition. This view would carry with it an explanation of the comparative rarity of the diatom in the gatherings of Mr. Terry. But on such an hypothesis, one would expect to find, in this rich material, some indication of the process of return to normal form. Nothing of this sort has yet been seen. However, negative evidence answers no questions. Plainly enough, a study of the life-cycle of this diatom is a desideratum. Not only might such a study clear up the question of relationships within the genus,—in Mr. Terry's form we have extra-generic characters, and they may easily prove to be of great significance in solving the problem of the genetic connections of *Stauroneis*,—but such a study will necessarily be carried on with living material.

Explanation of Plate XXXIV.

Stauroneis Terryi, D. B. Ward.

Fig. 1—Complete frustule, girdle view, showing external ring.
Fig. 2—Upper valve with subterminal depressions.
Fig. 3—Lower valve.

Amplification, 500 diameters.

A NEW DIATOM.

BY T. CHALKLEY PALMER.

In April and May of 1905, and at about the same season in later years, gatherings from swampy pools near Media, Pa., often showed little groups of freely motile naviculoid diatoms. These groups attracted notice from the curious circumstance that they seemed always composed of four individuals. Also, they were essentially unlike any filamentous forms such as *Eunotia* and *Melosira*, and differ equally with the short blocks of *Gomphonema*, *Stauroneis*, etc., which may temporarily remain in contact after reduplication. All of these, and with them the chains or bands of infinitesimal Naviculæ of the group Diadesmis, are alike in that the contact between adjacent frustules is by the joining of valve to valve. But these were joined girdle to girdle, so that the group as a whole moved about with four parallel raphes in approximate contact with the substratum, while four other parallel raphes were in evidence on the top. Staining with Bismarck brown and tannin showed each group to be enclosed in a mass of coleoderm. This coleoderm, of varying consistency, sometimes coagulates in place under the treatment, and sometimes, being more fluid and expanded, collapses confusedly as a brownish cloud upon the supporting slide (Plate XXXV, fig. 1).

These groups were at first supposed to constitute merely a temporary condition of some well-known species, and search was made for the same diatom in the isolated state normal to the Naviculæ, especially to the species of the Pinnularia[1] division of the genus, to which the form obviously belongs. But the groups have continued to occur while the isolated diatom has been nowhere visible. Moreover, a closer study of the frustule has indicated a new and curious species.

In May, 1909, rich gatherings were made of this diatom from swampy pools near Media, several miles from the places where it had first been observed in 1905. Accompanying it were a few *Navicula major* and *N. viridis* Kütz., together with vast numbers of *Closterium* sp., long strands of *Hyalotheca* sp. and other desmids. Preparations were made

[1] Treatment of the Navicula-Pinnularia question herein is that of H. Van Heurck and most recent writers except P. T. Cleve.

by various methods, and primarily by burning on the cover-glass and mounting in Canada balsam. I owe to Mr. C. S. Boyer, who received some of this material, the first intimation that these groups of four frustules may come intact through a careful boiling in nitric acid and bichromate, continued long enough to destroy entirely all accompanying organic matter, and with it, of course, that belonging to the diatoms themselves—a fact I have confirmed by repeated trials. Disintegration of groups takes place only on vigorous boiling and agitation. This indicates the grouping to be maintained by silicious cementing of the edges of the valves. The peculiar habit of growth seems persistent, and this will appear more clearly in subsequent notes of the occurrence of these groups at widely separated places. The species may be described as follows:

Navicula socialis sp. nov. Pl. XXXV, figs. 1 and 2.

Frustules normally in motile groups of four, held with girdle-sides together by a silicious cementing of adjacent valve-edges, and enclosed in a common coleoderm. Valves linear-elliptic, sides slightly concave, ends obtusely rounded. Transverse costæ prominent, nearly parallel except around terminal nodules, alike on both valves, 8 in 10 μ, wider than intervening spaces, showing obscurely a longitudinal band. Raphe nearly straight and simple. Longitudinal hyaline area nearly one-third the width of valve, much contracted near terminal nodules, slightly and unsymmetrically expanded around central nodule. Length of valve, 60–120 μ, breadth 13–27 μ.

Fresh water: Swampy pools near Media, Pa. Type in cabinet of T. C. Palmer.

This species has a superficial resemblance to some forms of *Navicula viridis* Kütz. and the possibility is recognized that frustules isolated from normal grouping by usual methods of preparation may have been referred to that species. Certainly the list of forms grouped under that name by authors is long, and perhaps loose. *N. viridis*, however, which frequently accompanies this species in typical condition, always shows in marked contrast, as regards shape of valve, less parallel costæ and more curved, complex raphe, as well as in the absence of grouping into motile chains of four. *N. viridis* var. *commutata* Grunow has dissimilar valves; or, if we shall follow Cleve[2] in his rather puzzling rearrangement of this group of forms, var. *commutata* differs in its more approximate costæ (10 to 12 in 10 μ) and their divergent tendency in the middle portion. Still following Cleve, var. *fallax*, Cleve also

[2] P. T. Cleve, *Synopsis of the Naviculoid Diatoms*, II, p. 91.

differs in the closer costæ (10 to 12 in 10 μ) and in the frequent unlikeness of the valves by the unilateral interruption of the costæ on one of them, though there is here some agreement in the nearly parallel costæ. Neither in Cleve's descriptions, nor in the figures cited by him in Schmidt's *Atlas*[3], does the present form find convincing presentation. The nearest approach is in Schmidt's *Atlas*, pl. 42, figs. 11 and 12, but even in these, which are in outline an approach, there are recognizable differences, beyond that very notable one, which applies here as well as elsewhere—the normal grouping of the species herein described into motile chains. If such grouping has been heretofore observed in related species, it does not find mention in the usual authoritative works, nor is a similar condition of *N. viridis* known to me. Mounts of the diatom having been distributed to some extent, it was interesting to find Mr. W. A. Terry able to send material from Fall Mountain, Conn., which contained it in considerable abundance. This was received in July, 1909. It showed the usual grouping, and rather larger frustules than those collected by myself. Mr. F. J. Keeley, who had made fine gatherings in May, at the same time and place as myself, collected it also in characteristic condition during the summer at Dogtown Common, Cape Ann, Mass. He also detected it in the usual groups in some of his preparations of material from near Philadelphia. Near Media it is frequent in boggy places during the summer, and until the pools dry out, though seldom in much abundance.

It goes without saying that a history of the life-cycle of this diatom, which will necessarily include an account of the formation of these groups, is much to be desired. At present it is not easy even to understand the process of ordinary reduplication in the case of this form. If the groups do not multiply by simultaneous subdivision of their constituent frustules, there would soon be irregular groupings. If the subdivision is simultaneous, good gatherings should show superposed groups. Neither of these conditions have been seen.[4] Meantime, the practical advantage of the grouping is evident enough, so far as concerns a motility dependent to a great degree on contact of the raphe with the substratum. An isolated *Navicula* with considerable breadth of valve may easily find itself disadvantageously on its girdle, and no irregularity of the solid bottom within reach. A struggle to right itself is the usual consequence of such a condition.

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[3] A. Schmidt, *Atlas der Diatomaceen-Kunde.*

[4] Occasional groups of two or three frustules will be seen in rich gatherings, and a few containing six to eight, all in one plane, have been noted. But the normal number is unquestionably four.

But the shallow, tabular group of *Navicula socialis* is in very stable equilibrium upon its four raphes, and it does not readily fall a victim to such accidents.

Explanation of Plate XXXV.

Navicula socialis sp. nov.

Fig. 1—A motile group stained with Bismarck brown and tannin, showing the coleoderm, which invisibly encloses the group in life, collapsed upon the slide under treatment.

Fig. 2—A motile group burned upon the cover-glass to a low red heat, leaving only the silicious parts, and showing contact of valve-edges at six points.

Drawings are on a scale of 1000 diameters.

A NOTE REGARDING THE CHINESE ALLIGATOR.

BY THOMAS BARBOUR.

The existence of a true alligator in China is one of the most interesting and remarkable facts which has ever been brought to the notice of zoogeographers. Specimens are rare in collections, and it is probable that the example which has led to this note is the first one to be received by an American Museum. The Museum of Comparative Zoology received a few days ago a most excellent mounted specimen, with skull, of an alligator which was brought from the region near the mouth of the Yangtse River by Captain Thomas Golding, and given to Dr. W. T. Hornaday, who had it in his private collection for seven years. Dr. Hornaday very kindly gave it to the writer, and it is a great pleasure to thank him most heartily for what has proved an extremely welcome addition to the reptile collection of the Museum.

To the average American naturalist the fact that our American alligator has a close congener in the Yangtse in China is unknown, and for that reason I am presenting here a short history of our knowledge of this most interesting creature.

In 1870 Mr. Swinhoe, a well-known authority on Chinese zoology, wrote in the *Proceedings* of the Zoological Society of London (p. 410) the following: "In February, 1869, some Chinese were exhibiting in the native city of Shanghai what they called a dragon, which they declared had been dug out of a hole in the province of Shense. It was a young crocodile about four feet long, which they kept in tepid water. They made so much money by showing it, that they refused to sell it. I can not, of course, guess its species; but I nevertheless think the fact worth recording, as evidence that a species of this group does occur in China."

Nine years later Mr. A. A. Fauvel, of the Imperial Chinese Maritime Customs and the Honorary Curator of the Shanghai Museum, wrote a long description and historical account[1] of the Yangstze alligator. As this publication is not always easily obtainable, it may be well to note briefly some of the interesting points which Fauvel brings out. It apparently has been known since the earliest times in Chinese

[1] *Jour. No. China Br. Roy. Asiat. Soc.*, XIII, 1879, pp. 1–36f., 3 pl.

literature, and there is mention of its growing to over ten feet in length; and that its skin was formerly much used for drum-heads. It is, however, generally spoken of as being from five to six feet long. It may have existed formerly in various parts of China, and we are told that the "Canton Annals" say that the head can be cut off and dried before the animal dies, the muzzle can be broken into pieces and all the teeth pulled out, and still it lives, the Cantonese having a remarkable belief in the creature's great tenacity of life, the scales of the "dragon" are used as medicine. They are supposed to cure diseases of the heart and intestines, fevers and female disorders, diseases arising from fear, nose-bleeding and toothache. They are also valued as a vermifuge, as a remedy for goitre and skin diseases. Fauvel notes its history in Chinese literature since the Wu dynasty, or from about 222–27 A.D. Curiously enough it has been very little mentioned in foreign works on China. Marco Polo and Father M. Martini both knew of it; but the former spoke only from hearsay, while the priest derived his information from native literature (Martini, *Atlas Sinensis,* Amsterdam, 1656). In Martini we find the following: "Ad urbis ortum est lacus parvus Go, in quo olim Rex Pegao decem aluit crocodilos, quibus, ut devorarentur objicere solebat reos et sceleratos; ab iis innocentes numquam laesos fuisse narrant, adeoque, quos crocodili non occiderent, liberi eo ipso, tanquam vacantes omni culpa abire jubebantur." Martini also tells us that at Chingkiang they infested the river to the great terror of the people.

Morrison, in his monumental Chinese dictionary, states positively that crocodiles occur in the Yangtse River; and Wells Williams, in *The Middle Kingdom* also speaks of its occurrence; but his information also may have been derived from his studies of Chinese literature.

The Shanghai *Evening Courier* for March 17, 1869, contains a humorous account of several Englishmen who went to see a crocodile exhibited in the native city of Shanghai. The Chinese who had it said that it came from the mountains of Kiangsi. The Europeans presumed that it had been brought from Siam, however, and vaguely suggested that they might possibly be looking at a new species, little realizing that they actually were.

Fauvel has collected much other data. He states, for instance, that he received a letter from Mr. Reynolds, also in the Customs service, who saw a tame one in a temple pool near Nanking in April, 1853. Several were reported seen in the Yangtse near Chingkiang by officers of gunboats and river steamers; while others were said to have been kept alive in temples thereabouts. It seems that it has been considered an act of merit for Buddhist priests to buy the creatures from their captors whenever possible, and free them.

Fauvel got his first specimen in April, 1879, and he published an account of it in the North China *Daily News* on the 9th of May. This specimen was dug from the mud of the river bank near Wuhu. He later obtained a second specimen from Chingkiang, and later still got a skull in the native city of Shanghai. He mentions two being kept alive by Herr von Möllendorff, German Consul at Shanghai, who got his from Poyang Lake.

Fauvel discusses the fact that the creature is also spoken of in Korean literature, and seems rather to incline toward the belief that it will ultimately be found in rivers or lakes of southern Korea. This, however, is extremely unlikely, and it has only been definitely proved to exist in the lower Yangtse River and its affluents. Fauvel sent his type to Paris.

We next hear of it in Vaillant.[2] This was simply a condensed digest, translated into French, of Fauvel's original description. Von Möllendorff himself published a note[3] on the specimens which he procured. In 1888 Dr. Oscar Boettger[4] published a note regarding the history of the discovery of the species by Swinhoe and Fauvel, and regarding the living specimens belonging to von Möllendorff.

In 1890, Dr. G. A. Boulenger,[5] published a paper entitled "Remarks on the Chinese Alligator," a specimen having been received at the British Museum, and two others alive at the Gardens of the Zoological Society. He contributed some notes regarding variations among characters previously supposed to be diagnostic, but which were really inconstant. His figures are excellent.

Boettger mentions it again in the collection of Dr. Schmacker in "Materialien zur herpetelogischen Faune von China, III."[6]

In 1898 Vaillant[7] contributed an excellent account in his "Contribution a l'étude des Emydosauriens."

Up to the present time in these various publications but ten specimens altogether appear to have come to the collections of museums in the Old World. As a considerable number of specimens lack definite data, it is impossible as yet to limit its range with any degree of certainty. Most of the specimens have been taken near the two towns

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[2] *Ann. Sc. Nat.*, (6th) IX, Art. 8, 1880.
[3] *Sitz. Ber. Niederrhein. Ges. Bonn*, 1880, p. 32.
[4] *Ber. Offenbach. Ver. f. Nat.*, 1889 (1888), p. 111.
[5] *Proceedings of the Zoological Society of London*, p. 619, pls. 51, 52.
[6] *Ber. Senck. Nat. Ges.*, 1894. p. 142.
[7] *Nouv. Arch. Mus. Paris*, (3) X, 1898, p. 206, pl. 13.

of Wuhu and Chingkiang, though records exist for Poyang Lake and Nangking. Thus it will be seen that the distribution is peculiarly circumscribed. Gadon states that alligator remains have been found in European fluviatile deposits of the Upper Chalk age. In fact, they did not completely disappear from Europe until as late as the Pliocene. The Chinese alligator is a survivor in a limited area, as is our alligator, of some form which once had a holarctic distribution.

The present specimen agrees very closely with Fauvel's original description, and has the regular three pairs of nuchal plates. It is just forty-eight inches long, of which the head takes up one-sixth. Fauvel's adult specimen was five feet eight inches in length. Thus it will be seen that this might almost be spoken of as a dwarf species.

Since the above was written I have heard that Dr. Wolterstorff of Magdeburg, has a specimen (no data given) 145 cm. in length.

NOTES ON BATOID FISHES.

BY HENRY W. FOWLER.

The ray-like fishes contained in the collection of the Academy of Natural Sciences of Philadelphia are listed in this paper.

1. Some Preoccupied Names.

In looking over the literature on this subject a number of names were found to be preoccupied, which are not represented in our collection by specimens, and for them I have substituted the following:

Raja montagui nom. sp. nov. For *Raia maculata* Montagu, Mem. Wern. Soc., II, 1811–16, p. 426, preoccupied by *Raja maculata* Shaw, Gen. Zool., VII, 1803, p. 16, which is identical with *Raja torpedo* Linnæus.

Raja brachyurops nom. sp. nov. For *Raja brachyura* Günther, Rep. Challenger, Zool., I, 1880, p. 20, Pl. 6, preoccupied by *Raia brachyura* Lafont, Act. Soc. Linn. Bordeaux, XXVIII, 1871, p. 503, Pl. 28.

Raja bonæ-speiensis nom. sp. nov. For *Raja capensis* Müller and Henle, Syst. Besch. Plag., 1838, p. 151, preoccupied by *Raja capensis* Gmelin, Syst. Nat. Linn., 1788, p. 1512, which is identical with *Narke* Kaup.

Raja steindachneri nom. sp. nov. For *Raja chilensis* Steindachner, Zool. Jahrb. Suppl., IV, 1898, p. 332, preoccupied by *Raia chilensis* Guichenot, Gay's Hist. Chile, II, 1848, p. 367. This species appears close to *Raja lima* Poeppig.

Raja agassizi ribeiroi, nom. sub. sp. nov. For *Raja agassizi* var. *picta* Ribeiro, A Lavoura, Bol. Soc. Agric. Rio Janeiro, 1904, p. 19, preoccupied by *Raja picta* Lacépède, Hist. Nat. Poiss., IV 1803, p. 676.

Discotrygon nom. gen. nov. Type *Discobatis marginipinnis* Maclay and Macleay. For *Discobatis* Maclay and Macleay, Proc. Linn. Soc. N. S. Wales, X, 1885, p. 676, type *Discobatis marginipinnis* Maclay and Macleay, preoccupied by Garman, Proc. U. S. Nat. Mus., 1881, p. 523 for *Discobatidæ*, type *Rhina sinesis* Schneider. (Δίσκος, disk; τρυγών, *Trygon.*)

2. List of Species in the Collection.

PRISTIDÆ.

Pristis perotteti Müller and Henle.

Several saws, most likely this species, from Bahia, Gulf of Mexico and Surinam.

Pristis pectinatus Latham.

Many saws, from near Matamoras, Essequebo River, West Indies and Atlantic Ocean.

RHINOBATIDÆ.

Rhynchobatus djeddensis (Forskål).

One from Padang, Sumatra.

Rhinobatos rhinobatos (Linnæus).

(*Rhinobatus columnæ* Bonaparte, Icon. Faun. Ital., Pesc. III, pt. 2, XIV, XVII, 1835–36, descr., Pl. Italy.)

Cotypes of *R. columnæ* and dried example from Beirut, Syria. Four examples.

Rhinobatos leuoorhynchus (Günther).

One from Panama.

Rhinobatos productus (Girard).

One from Santa Barbara.

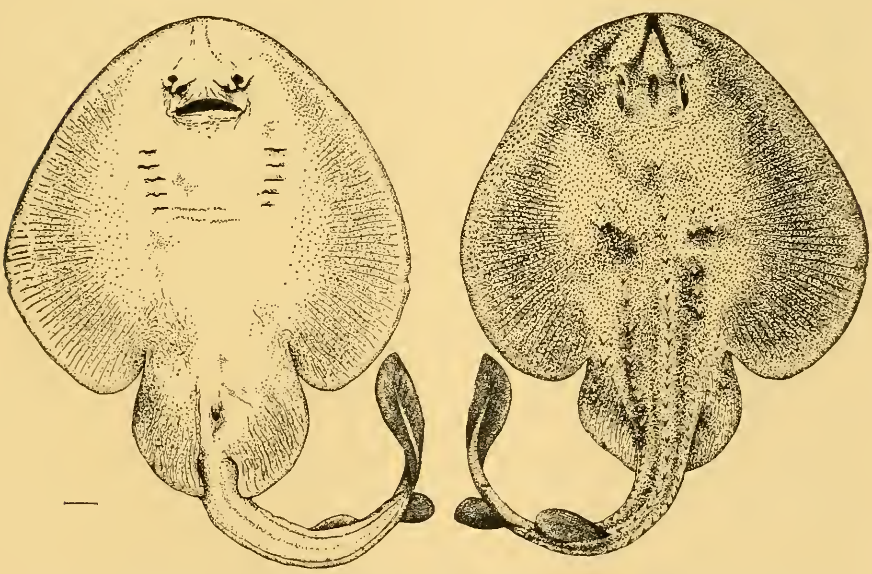

Fig. 1.—*Platyrhinoidis triseriatus* (Jordan and Gilbert). (Cotype of *Platyrhina triseriata* Jordan and Gilbert.)

Platyrhinoidis triseriatus (Jordan and Gilbert). Fig. 1.

(*Platyrhina triseriata* Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, p. 36. Santa Barbara, Cal.)

Cotype of *P. triseriata*, and two young from Monterey, Cal.

RAJIDÆ.

Raja erinacea Mitchill.

Ten examples from Castine (Me.), Wood's Holl (Mass.), Sea Isle City and Green Creek (N. J.).

Raja ocellata Mitchill.

Five examples from same localities as last.

Raja radiata Donovan.

Four egg-cases or "purses" from Manasquan, N. J., may in part refer to this species. All contain embryos, two having very long tails, thus seeming to agree with Goode and Bean's suggestion.[1] Three of egg-cases agree in having tendrils entire, and these contained long-tailed embryos. The other egg had the tendrils coarsely corrugated and contained a short-tailed embryo, which I cannot determine. The eggs are of nearly equal size, their bodies measuring about 2 inches. Another egg, labelled "Corsica," from Rev. R. H. Mossam, contained a fully-developed embryo, unquestionably close to, if not identical with, the present species. It differs from Goode and Bean's figure chiefly in the absence of spines on the posterior pectoral regions. If my determination be correct, the occurrence of this species on the New Jersey coast is interesting, as this will prove the first record. The New Jersey eggs were received from Dr. H. C. Everts.

Raja eglanteria Lacépède.

Four examples from Atlantic City, Sea Isle City, Grassy Sound and Green Creek (N. J.).

Raja binoculata Girard.

Two from Pacific Grove, Cal.

Raja stellulata (Jordan and Gilbert).

(*Raia stellulata* J. G., Proc. U. S. Nat. Mus., 1880, p. 133. Monterey, Cal.)

Cotype of *R. stellulata.*

Raja oxyrinchus Linnæus.

Five from Italy.

Raja macrorynchus Rafinesque.

Five from Italy.

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[1] *Ocean. Ich.*, 1895, p. 25.

Raja batis Linnæus.

One from Italy.

Raja rostrata Lacépède.

Six from Italy. This is *R. marginata* Bonaparte.

Raja clavata Linnæus.

Seven from Italy.

Raja brachyura (Lafont).

One from the Mediterranean in the Bonaparte Coll. This seems to be Lafont's species, and possibly *Raia blanda* Holt may be identical.

Raja punctata Risso.

Four from Italy. Wrongly identified by Bonaparte with *R. batis* L.

Raja rhomboidalis Tilesius.

Nine examples from Italy. Following Blainville's suggestion,[2] the account by Tilesius is very likely identical with that of Delaroche. Possibly *R. osbeckii* Walbaum[3] = *R. machuelo* W.[3] = *R. hispanica* Schneider[4] may be older synonyms?

Raja miraletus Linnæus.

Twelve examples from Italy.

Raja quadrimaculata Risso.

Two from Italy.

Raja circularis Conch.

(*R. falsavela* Bonaparte, Icon. Faun. Ital., Pesc. III, pt. 2, XXVI, 1839, descr., Pl. Italy.)

Type of *R. falsavela* in poor condition.

Raja radula Delaroche.

One from Italy.

Raja meerdervoortii Bleeker.

Two from Hakodate.

Psammobatis brevicaudatus Cope. Fig. 2.

(Proc. Am. Philos. Soc. Phila., XVII, 1877, p. 48. Bay of Pecasmayo, Peru.)

Type of *P. brevicaudatus*.

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[2] *Faun. Franc.*, Vert., 1825, p. 26.
[3] *Pet. Arted. Gen. Pisc.*, III, 1792, p. 532 (based on Osbeck).
[4] *Syst. Ich. Bloch.*, 1801, p. 369 (based on Osbeck).

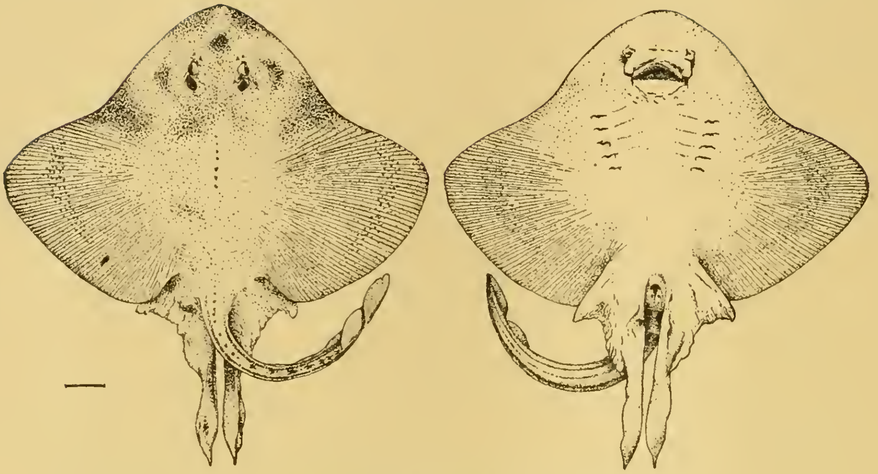

Fig. 2.—*Psammobatis brevicaudatus* Cope. (Type.)

NARCOBATIDÆ.

Narcobatus torpedo (Linnæus).

Ten from Italy.

EUNARCE subgen. nov.

Type *Torpedo narke* Risso.

Differs from subgenus *Narcobatus* in having the spiracle fringes as rudimentary papillæ, while in subgenus *Tetronarce* they are entirely absent.

(*Εὖ*, genuine; *ναρκη*, *Narce*, the ancient name of the typical species.)

Narcobatus narke (Risso).

Nine from Italy. In this case Risso and Rafinesque are synchronous, and I allow the former's name, as it is on an earlier page, besides having gained usage.

Narcobatus nobiliana (Bonaparte).

(*Torpedo nobiliana* Bon., Icon. Faun. Ital., Pesc. III, pt. 2, XII, 1835, descr., Pl. Italy.)

Cotypes of *T. nobiliana*. Twenty-three examples.

Narcobatus occidentalis (Storer).

Four from Pacific Grove and Soquel, Cal. Storer's figure shows a very large first dorsal, and its origin about over first fourth in entire ventral length, so that hind margins of both fins are on a line. His description says "it is situated at the posterior portions of the pectorals, one half of its base being posterior to those fins." Goode's figure shows an example from Wood's Holl with first dorsal origin well posterior, or about opposite posterior basal fourth of ventral. Jordan and Evermann pointed out differences between Atlantic and Pacific forms from North America, stating the former to be nearly uniform black, rarely spotted, and having the first dorsal over middle of ventrals, all of which can be found in my examples noted above from the Pacific. At the same time they reproduce Goode's figure and my Soquel specimen, the former certainly more in agreement with some of my Pacific examples, and the latter approaching nearer that of Storer. The question of spotted coloration does not seem to me reliable.

Narcine brasiliensis (Olfers).

One from Key West.

DASYATIDÆ.

Urolophus halleri Cooper.

One from San Pedro, Cal.

Urolophus nebulosus Garman.

One from San Diego, Cal.

Urolophus jamaicensis (Cuvier).

Two, from Florida and Cuba.

Urolophus mundus (Gill).

Three young from Panama.

Tæniura lymma (Forskål).

One from Padang, Sumatra.

Dasyatis uarnak (Forskål).

Three from Padang, Sumatra (one now in Stanford University).

Dasyatis centroura (Mitchill)?

Young without data, most likely this species.

Dasyatis aldrovandi (Risso).

Three tails, probably this species, from the Mediterranean.

Dasyatis akajei (Müller and Henle).

Four young from Onomichi, Japan.

Dasyatis say (Le Sueur).

Four from Delaware Bay off Green Creek, wrongly thought by me to be *D. centroura*.[5] The rediscovery of the present species in New Jersey is of considerable interest, as it has not before been correctly

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[5] *Proc. Acad. Nat. Sci., Phila.*, 1909, p. 407.

identified from there since Le Sueur's time. In 1838 Müller and Henle report one from New York, and in 1882 Garman notes it from the same locality with others from Florida and Brazil. The differences pointed out by the latter, in separating this species from *Trygon hastata* De Kay, do not seem to me to be altogether conclusive that the latter is really a species distinct from the present. My examples seem to cover the alleged points of difference to a great extent. Small examples seem to be entirely smooth, and others have three short rows of spines on middle of disk, when large. In the summer of 1907 I first thought these rays were most likely the present species, but the variation seemed to confuse them with *T. hastata.* The character of a broad fold above and below on the tail may be reliable, but my examples also show three series of tubercles on shoulders, at least the large ones. Others with broad tail folds also show the median vertebral row of thorns distinct and becoming enlarged posteriorly, besides a roughened tail. In fact, I have noted examples which agree with Le Sueur's figure of *Raja say* and De Kay's and Storer's of *Trygon hastata,* and that these are individual variations due to age and sex I have no doubt.

Dasyatis sabina (Le Sueur).

Two from Bayport, Fla., and another without data.

Dasyatis pastinaca (Linnæus).

Ten from Italy and one from Beirut, Syria.

Dasyatis ujo Rafinesque.

(*Trygon brucco* Bonaparte, Icon, Faun. Ital., Pesc. III, pt. 2, VI, 1834. descr., Pl. Italy.)

Cotypes of *T. brucco,* two examples.

PTEROPLATYTRYGON subgen. nov.

Type *Trygon violaceum* Bonaparte.

Disk width much greater than length, front margin broadly convex. No upper tail fold after caudal spines.

From *Hemitrygon* Müller and Henle this differs in the broad disk, obtuse in front, and suggesting *Pteroplatea.* The small snout tip is within a slight emargination of the front edge of the disk.

(*Πτερόν*, fin; *πλατύς*, broad; *τρυγών*, *Trygon.*)

Dasyatis violaceus (Bonaparte).

(*Trygon violaceum* Bon., Icon. Faun. Ital., Pesc. III, pt. 2, I, 1832, descr., Pl. Italy.)

Cotypes of *T. violaceum* Bon., two examples.

Pteroplatea altavela (Linnæus).

One from Italy.

Pteroplatea marmorata Cooper.

One from San Diego, Cal.

MYLIOBATIDÆ.

Myliobatis bovina G. St. Hilaire.

One from Italy.

Myliobatis aquila (Linnæus).

(*M. noctula* Bon., Icon. Faun. Ital., Pesc. III, pt. 2, II, 1833, descr., Pl. Italy.)

Cotype of *M. noctula*, three examples.

Myliobatis freminvillii Le Sueur.

Four from Newport, R. I., and Sea Isle City, N. J. One has two caudal spines.

Myliobatis californicus Gill.

Young from San Diego, Cal.

Aëtobatus narinari (Euphrasen).

One without data.

Rhinoptera bonasus (Mitchill).

Beaufort, N. C., and Ocean City, N. J., two examples.

MOBULIDÆ.

Manta birostris (Walbaum).

Eye of large example from Stone Harbor, N. J.

DESCRIPTION OF FOUR NEW CYPRINOIDS (RHODEINÆ).

BY HENRY W. FOWLER.

The following are all contained in the collection of the Academy of Natural Sciences of Philadelphia. Three other species, well known, are also listed for comparison in this connection to exhibit the variations, as represented by rather good series.

Rhodeus sericeus (Pallas).

Head $3\frac{3}{4}$ to 4; depth $2\frac{1}{2}$ to $2\frac{1}{5}$; D. usually iii, 9, I, rarely iii, 8, I; A. usually iii, 8, I, frequently iii, 9, I; scales 34 to 37, usually 6 tubes + 3; 10 to 12 transverse scales from dorsal; 14 to 17 predorsal scales; snout $3\frac{1}{5}$ to $3\frac{1}{2}$ in head; eye $2\frac{9}{10}$ to $3\frac{1}{4}$; maxillary $3\frac{1}{6}$ to $4\frac{1}{8}$; interorbital $2\frac{1}{4}$ to $2\frac{2}{5}$; teeth 5—5; length 2 to $2\frac{5}{8}$ inches. Europe; Italy (Bonaparte 427).

Rhodeus maculatus sp. nov. Fig. 1.

Acheilognathus imberbis J. F. Abbott, Proc. U. S. Nat. Mus., XXIII, 1901, p. 484, Pei Ho River, at Tien Tsin, China. (Part.)

Head $3\frac{3}{5}$; depth $2\frac{1}{5}$; D. iii, 10, I; A. iii, 10, I; P. I, 11?; V. I, 7; scales 30 + 2; tubes 5; 11 scales transversely, between dorsal and

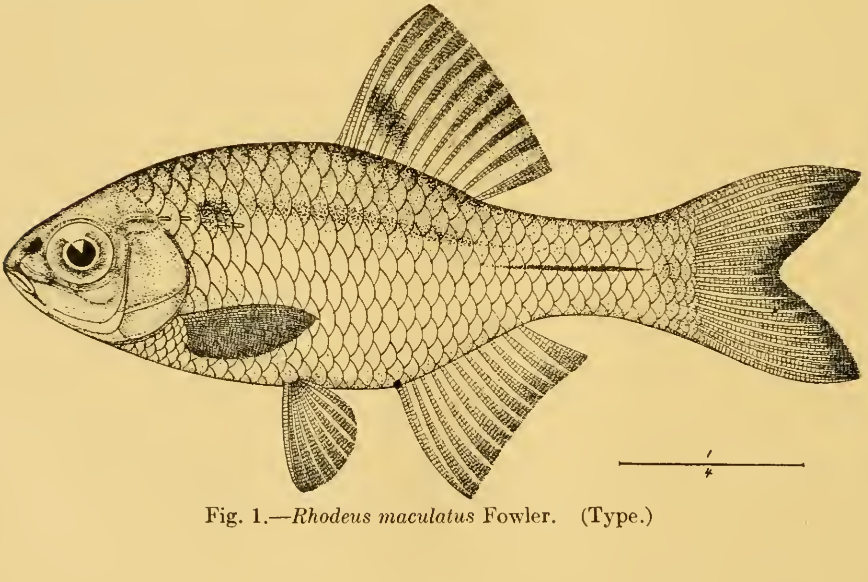

Fig. 1.—*Rhodeus maculatus* Fowler. (Type.)

anal origins; 12 predorsal scales; head width $1\frac{7}{8}$ its length; head depth at occiput $1\frac{1}{6}$; snout $4\frac{1}{2}$; eye $2\frac{4}{5}$; maxillary $3\frac{1}{2}$; interorbital $2\frac{1}{2}$; first branched dorsal ray $1\frac{1}{6}$; first branched anal ray $1\frac{1}{4}$; least depth of caudal peduncle 2; pectoral $1\frac{2}{7}$; ventral $1\frac{3}{4}$.

Body well compressed, deep, contour ovoid, edges convexly rounded, and greatest depth about ventral origin. Caudal peduncle compressed, least depth about $1\frac{1}{2}$ its length.

Head small, compressed, deep, flattened sides but slightly convergent below, and lower profile a little more inclined than upper. Snout short, convex over surface and end, projecting beyond mandible, and length about $\frac{3}{4}$ its width. Eye large, circular, scarcely elevated, and center about first $\frac{2}{5}$ in head. Mouth small, inferior, well inclined. Premaxillaries protractile down and forward. Lips rather thin, firm, moderate. Maxillary small, well inclined, more or less concealed, to hind nostril or scarcely to eye. Mandible depressed, small, included in upper jaw when closed, and rami well elevated inside mouth. Tongue obsolete, apparently adnate, fleshy, and scarcely differentiated from floor of mouth. Jaw edges firm, slightly trenchant. Nostrils large, together, anterior circular with rather broad posterior cutaneous margin exposing posterior in narrow crescent. Interorbital broadly and evenly convex. Preorbital small, trapezoidal, length $1\frac{4}{5}$ in eye. Postorbital width much less than infraorbital, latter about 3 in eye. Posterior preopercle margin convex, nearly vertical above.

Gill-opening forward to hind preopercle margin, or about last $\frac{2}{5}$ in head. Rakers about 2 + 8? short weak fleshy points, much less than filaments, and latter about $\frac{2}{3}$ of eye. Pseudobranchiæ a little shorter than filaments. Teeth 5–5, compressed, pointed, with slight grinding surfaces with entire edges.

Scales large, narrowly imbricated on sides of body, disposed in even longitudinal series, and but slightly smaller on edges of body and breast. Axillary scale short, rounded, not pointed. L. l. consisting of only 5 short tubes at shoulder, each extending over first half of scale exposure and in a straight series.

Dorsal origin about midway between snout tip and caudal base, third simple ray longest, though first branched subequal, depressed fin $1\frac{1}{2}$ to caudal base. Anal inserted about opposite first third of dorsal base, fin similar, depressed $1\frac{1}{3}$ to caudal base. Caudal forked, a little longer than head, lobes pointed, equal. Pectoral a little beyond ventral, upper rays longest. Ventral inserted a little before dorsal, to anal. Vent midway in postventral.

Color in alcohol faded largely uniform pale brownish, scarcely paler below. Upper surface of head and back above l. l. sprinkled with minute dusky dots, forming a patch just above gill-opening at shoulder, and another elongated area beginning shortly posterior and extending parallel with dorsal profile to caudal peduncle, where it is replaced a little below by a narrow median streak or line of dusky. Fins all pale brownish, a dusky blotch a little smaller than eye midway in height, and sloping down to its base, on front of dorsal. Iris slaty.

Length $1\frac{1}{2}$ inches.

Type, No. 29, 472, A. N. S. P. Pei Ho River, at Tien Tsin, China. N. F. Drake. From Stanford University.

Also No. 29, 473, paratype, same data, agrees in most respects.

This species is related to *R. sinensis* Günther, but differs in the absence of a narrow intensely black-edged anal fin, and having 5 tubes in its lateral line. *R. sinesis* is said to have l. l. tubes 3, though this character may be variable. From *R. ocellatus* (Kner) it differs in the dark dorsal blotch, though otherwise mostly agrees. Jordan and Seale's Shanghai example[1] differed in being almost uniform silvery and having l. l. tubes 3. From the Japanese species it also differs, as *R. oryzæ* Jordan and Seale,[2] *R. tanago* Tanaka[3] and *R. miobuta* Tanaka[4] all have barbels.

(*Maculatus*, spotted.)

Acheilognathus lanceolatus (Schlegel).

Head $3\frac{4}{5}$ to 4; depth $2\frac{3}{4}$ to 3; D. usually iii, 8, I, often iii, 9, I, rarely iii, 10, I; A. usually iii, 9, I or iii, 10, I, rarely iii, 11, I; scales usually 34, frequently 33, 35 or 36, seldom 32, rarely 31 + usually 2, seldom 3; usually 6 scales above l. l., rarely 5; 4 scales below l. l.; usually 16 predorsal scales, occasionally 15 or 17, rarely 13, 14 or 18; snout $3\frac{1}{5}$ to $3\frac{5}{6}$ in head; eye $2\frac{1}{5}$ to $3\frac{1}{5}$; maxillary 3 to 4; interorbital $2\frac{1}{4}$ to $2\frac{7}{8}$; teeth 5–5; length $1\frac{7}{8}$ to $3\frac{1}{4}$ inches. L. Biwa at Matsubara, Kurume, Katana (all Jordan and Synder), Jap. (Otaki.) A very large series.

Acheilognathus limbatus (Schlegel).

Head $3\frac{2}{7}$ to 4; depth $2\frac{4}{7}$ to 3; D. usually iii, 10, I, often iii, 11, I, or iii, 12, I or iii, 13, I; A. usually iii, 10, I, often iii, 9, I; scales 35 or 36 + usually 3, often 2; 6 scales above l. l.; usually 4 scales below l. l., rarely 5; 14 to 17 predorsal scales; snout $3\frac{1}{3}$ to 4 in head; eye $2\frac{3}{4}$ to $3\frac{1}{3}$; maxillary $3\frac{1}{4}$ to 4; interorbital $2\frac{2}{5}$ to $2\frac{1}{2}$; teeth 5–5; length

[1] *Proc. U. S. Nat. Mus.*, XXIX, 1905, p. 518.
[2] *L. c.*, XXX, 1906, p. 144.
[3] *Journ. College of Sci.*, XXVII, 1909, p. 10.
[4] *L. c.*, p. 12.

1½ to 3⅛ inches. Nagaya, Tsuruga and L. Biwa at Matsubara (all Jordan and Snyder), Jap.

RHODEOPS subgen. nov.

Type *Acheilognathus brevianalis* sp. nov.

This differs from the subgenus *Acheilognathus* Bleeker in the absence of maxillary barbels.

(*ʽΠόδον*, rose, hence *Rhodeus; ὤψ*, appearance.)

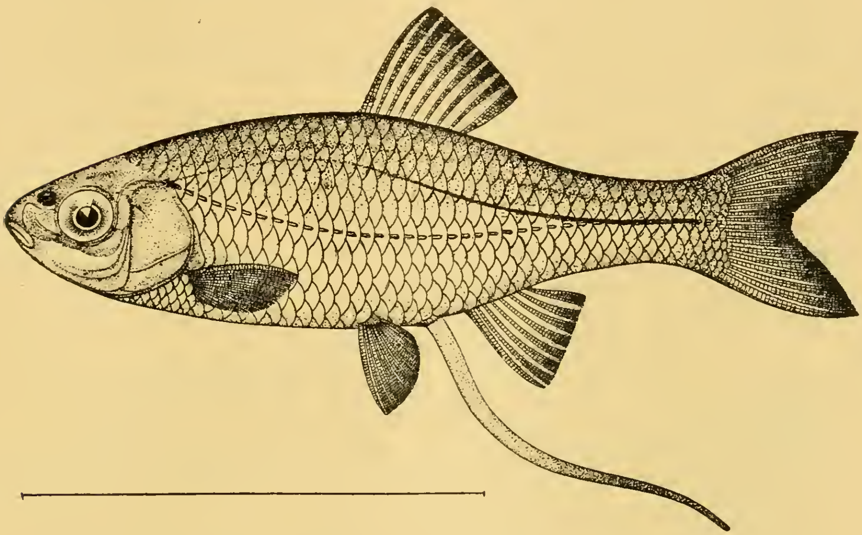

Fig. 2.—*Acheilognathus brevianalis* Fowler. (Type.)

Acheilognathus brevianalis sp. nov. Fig. 2.

Head $3\frac{2}{3}$; depth $3\frac{1}{5}$; D. iii, 8, I; A. iii, 7, I; P. I, 12?; V. I, 7; scales 37 in l. l. to caudal base, and 3 more on latter; 6 scales above l. l.; 4 scales below l. l.; 14 predorsal scales; head width $\frac{1}{2}$ its length; head depth at occiput $1\frac{1}{4}$; snout $3\frac{2}{5}$; eye $3\frac{2}{5}$; maxillary $4\frac{1}{5}$; interorbital $2\frac{4}{5}$; first branched dorsal ray $1\frac{1}{2}$; first branched anal ray $1\frac{7}{8}$; least depth caudal peduncle $2\frac{1}{5}$; pectoral $1\frac{4}{5}$; ventral 2.

Body well compressed, rather deep, contour nearly ellipsoid, edges convexly rounded, and greatest depth at dorsal origin. Caudal peduncle compressed, least depth $\frac{1}{2}$ its length.

Head small, deep, compressed, sides flattened and but slightly convergent below, and lower profile more inclined than upper. Snout short, convex over surface, end rather obtuse, projecting slightly beyond closed mandible, and length $\frac{3}{4}$ its width. Eye large, circular, scarcely high, and center near first $\frac{2}{5}$ in head. Mouth small, inferior, well inclined. Premaxillaries protractile down and forward. Lips thick, fleshy, rather broad. No barbel. Maxillary small, well inclined, more or less concealed, to front nostril. Mandible depressed, small, included in upper jaw, and rami well elevated inside mouth. Tongue obsolete, apparently adnate, fleshy, and scarcely differentiated from floor of mouth. Nostrils large, together, anterior circular with cutaneous posterior margin exposing posterior in narrow crescent. Interorbital broadly and evenly convex. Preorbital large, trapezoidal, length $1\frac{1}{4}$ in eye. Postorbital width about $\frac{2}{5}$ of eye, and other suborbitals moderately wide. Posterior margin of preopercle slightly inclined anteriorly.

Gill-opening forward about to hind eye margin, or nearly midway in head. Rakers about 2 + 8 short weak feeble points, about $\frac{1}{6}$ of filaments, and latter about $\frac{2}{3}$ of eye. Pseudobranchiæ little less than filaments. Teeth 5–5, compressed, broad, ends curved over in a slight hook, and with slight grinding-surfaces, their edges and surfaces entire. Intestine long. Peritoneum dark. Long ovipositor (female) nearly equal half of body length.

Scales large, rather narrowly imbricated on sides of body, and disposed in series parallel with l. l. Scales on edges of body a trifle smaller than elsewhere, and on breast much smaller. Short and rather pointed axillary ventral scale. L. l. complete, decurved a little, and tubes simple, extending over about first $\frac{2}{3}$ of each exposed scale.

Dorsal origin about midway between front nostril and caudal base, first branched ray highest, depressed fin about $\frac{6}{11}$ to caudal base. Anal inserted about opposite base of last dorsal ray, first branched ray longest, depressed fin about $1\frac{2}{3}$ to caudal base. Caudal (now damaged) emarginate. Pectoral short, upper rays longest, fin pointed, reaches about $\frac{2}{3}$ to ventral. Latter inserted about opposite dorsal origin and reaches vent. Vent close before anal, but immediately in front is the long ovipositor, and though shrunken considerably now evidently protruded as far posteriorly as the end of the caudal.

Color in alcohol largely dull brownish, becoming paler on sides and below, the latter with silvery reflections. Upper surface of head brownish, slightly dusky on snout and above eyes, and sides bright silvery-white. Muzzle more or less brownish, though mandible pale. Parallel with vertebral column a narrow diffuse dusky streak along trunk, and this most pronounced posteriorly or along side of caudal peduncle. Fins all plain pale brownish. Iris silvery-white.

Length (ends of caudal slightly damaged) $1\frac{3}{4}$ inches.

Type, No. 28, 580, A. N. S. P. Lake Biwa at Matsubara, in Omi, Japan. Jordan and Synder. From Stanford University.

The above is the only example I have, and was found among a number of small fishes received from Stanford University several years ago. It appears to differ from *Acheilognathus himantegus* (Günther) and *A. mesembrinum* Jordan and Evermann, both from Formosa, in the fewer anal rays. From *A. cyanostigma* Jordan and Fowler, it differs in coloration. Both *A. himantegus* and *A. longipinnis* (Regan), the latter from L. Biwa, differ in having barbels.

(*Brevis*, short; *analis*, anal; with reference to the short anal fin.)

Paracheilognathus peihoensis sp. nov. Fig. 3.

Acheilognathus imberbis J. F. Abbott, Proc. U. S. Nat. Mus., XXIII, 1901, p. 484, Pei Ho River, at Tien Tsin, China. (Part.)

Head $3\frac{4}{5}$; depth $2\frac{1}{8}$; D. iii, 12, I; A. ii, 10, I; P. I, 15; V. I, 7;

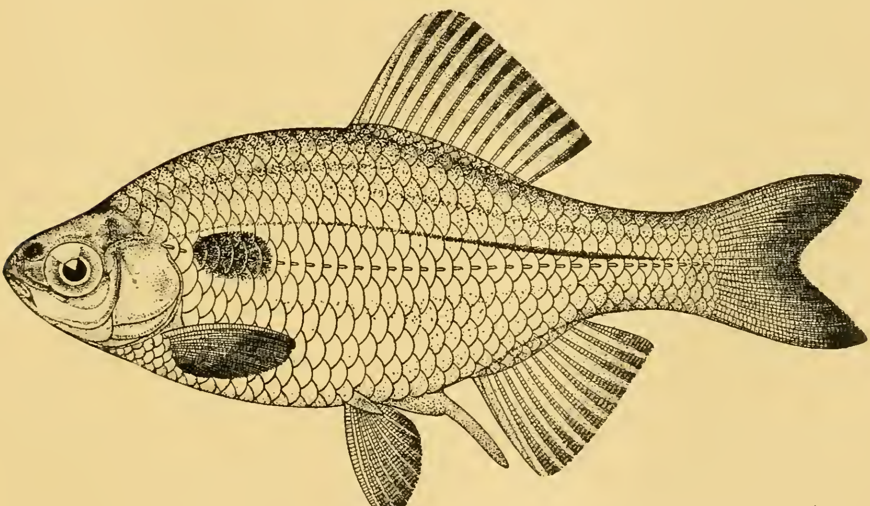

Fig. 3.—*Paracheilognathus peihoensis* Fowler. (Type.)

scales 34 in l. l. to caudal base, and 2 more on latter; 6 scales above l. l.; 5 scales below l. l.; 15 predorsal scales; head width $1\frac{4}{5}$ its length; head depth at occiput about $1\frac{1}{8}$; snout $3\frac{4}{5}$; eye 3; maxillary $3\frac{4}{5}$; interorbital $2\frac{1}{3}$; third dorsal spine $1\frac{1}{4}$; second anal spine $1\frac{2}{5}$; least depth caudal peduncle $1\frac{4}{5}$; pectoral $1\frac{1}{4}$; ventral $1\frac{3}{7}$.

Body rather deep, well compressed, contour ovoid with greatest depth anterior or about midway in preventral region, profiles similar, and edges apparently all evenly convex. Caudal peduncle compressed, least depth about equals its length.

Head deep, compressed, mostly flattened sides scarcely constricted below, and lower profile little more inclined than concave upper. Snout short, convex over surface, end rather obtuse, projecting beyond mandible, and length about $\frac{3}{4}$ its width. Eye large, circular, not high, and center near first third in head. Premaxillary protractile down and forward. Lips moderately thick, fleshy. Maxillary small, mostly concealed, to hind nostril. No barbel. Mandible depressed, small, included in upper jaw, and rami well elevated inside mouth. Tongue fleshy, little distinct, adnate. Jaw edges rather pliable, blunt. Nostrils large, together, anterior circular and with cutaneous posterior margin exposing posterior in narrow crescent. Interorbital broadly convex. Preorbital small, trapezoidal, length $1\frac{1}{2}$ in eye. Postorbital width about $\frac{1}{4}$ of eye, postero-infraorbital wider, and antero-infraorbital much narrower. Posterior margin of preopercle convex, inclined a little forward.

Gill-opening forward about last third in head, or about to hind preopercle margin. Rakers about 2 + 6? short weak fleshy points, much less than filaments, and latter about $\frac{2}{3}$ of eye. Pseudobranchiæ little less than filaments. Teeth 5–5, compressed, broad ends curved over in a slight hook, and with moderately broad grinding-surfaces, their edges crenulated.

Scales large, rather narrowly imbricated on sides of body, and exposed in series parallel with l. l. Scales on edges of body and breast a trifle smaller than others. Pointed axillary ventral scale with greater outer portion free, equals $\frac{1}{3}$ of fin. L. l. complete, straight, not decurved, and tubes simple, extending about first half of each exposed scale.

Dorsal origin about midway between snout tip and caudal base, first branched ray (damaged) evidently longest, depressed fin about $\frac{2}{3}$ to caudal base. First 3 anterior dorsal rays spinous, straight, robust. Anal inserted about opposite base of eighth branched dorsal ray, its first branched ray longest, depressed fin $\frac{4}{5}$ to caudal base. First 2 anterior anal rays spinous, straight, robust. Both dorsal and anal depressible in a scaly basal groove. Caudal forked, lobes pointed. Pectoral short, rounded or expanded distally, $\frac{3}{4}$ to ventral. Latter inserted a little before dorsal, and about to anal. Vent about midway in postventral region, and ensheathed behind base of the fleshy ovipositor, latter beginning just behind ventral bases and reaching back well beyond anal front.

Color in alcohol faded dull brownish almost entirely, with traces of slight silvery sheen, especially on opercle. Lower part of body scarcely paler. Back sprinkled with minute pale dusky dots. Iris grayish, evidently silvery. An elongated deep-brown blotch, a little longer than eye, about level with latter's upper edge just behind gill-opening. Behind this an indistinct pale streak, margined narrowly above from about opposite base of ventrals almost to caudal base with a narrow blackish line. Dorsal pale brownish with about 3 pale dusky blotches on each ray, forming as many longitudinal series of spots, though upper 2 rows closer together. Other fins all plain pale brown.

Length $2\frac{1}{2}$ inches.

Type, No. 29,468, A. N. S. P. Pei Ho River, at Tien Tsin, China. N. F. Drake. From Stanford University.

Also Nos. 29,469 to 29,471, paratypes, same data. Head $3\frac{3}{4}$ to 4; depth $2\frac{2}{5}$ to $2\frac{3}{4}$; D. iii, 14, I once, iii, 12, I, usually; A. ii, 10, I; scales 33 or 34 + 2; 6 scales above l. l.; 5 scales below l. l.; 15 or 16 predorsal scales; snout $3\frac{1}{2}$ to 4 in head; eye $2\frac{3}{4}$ to $3\frac{1}{10}$; maxillary $3\frac{1}{3}$ to 4; interorbital $2\frac{2}{5}$ to $2\frac{3}{4}$; teeth 5–5; length $2\frac{1}{8}$ to $3\frac{5}{6}$ inches.

Related to *Paracheilognathus imberbis* Bleeker, but differing chiefly in the presence of the dark shoulder blotch. Bleeker's description fails to note this character, and his figure[5] also does not indicate it. His example has been thought by Günther[6] to be different from the latter's *Achilognathus imberbis*[7], which is said to have both dorsal and anal radii 12. *Paracheilognathus rhombeus* (Schlegel) from Japan, differs from my species in having maxillary barbels and more scales below the l. l. *Acanthorhodeus dicæus* Rutter from Swatow,[8] agrees with this latter in having maxillary barbels, and is therefore not identical.

(Named for the Pei Ho River, in the Province of Pechili, China.)

HEMIGRAMMOCYPRIS gen. nov.

Type *Hemigrammocypris rasborella* sp. nov.

Body compressed, ellipsoid, moderately deep, postventral trenchant. Head moderate. Snout short. Eye moderate. Mouth moderate, well inclined. Premaxillaries protractile. Maxillary well inclined, not reaching eye. No barbels. Jaws firm, mandible slightly protruding. Interorbital broadly convex. Rakers small. Pseudobranchiæ well developed. Teeth 1, 3, 5–5, 3, 1, hooked, with slight grinding-surfaces. Scales large, about 30, narrowly imbricated.

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[5] *Verh. Kon. Ak. Wetensch.* (Mém. Cyprin. Chine), XII, 1871, p. 37, Pl. 4, fig. 1.
[6] *Zool. Record*, 1871, p. 107.
[7] *Cat. F. Brit. Mus.*, VII, 1868, p. 278.
[8] *Proc. Acad. Nat. Sci. Phila.*, 1897, p. 58.

L. l. incomplete, decurved, not extending beyond ventral base. Dorsal about midway between hind pupil margin and caudal base, rays all flexible, contains 8 branched. Anal inserted close behind dorsal base, rays all flexible, contains 8 branched. Caudal emarginate. Pectoral $\frac{3}{4}$ to ventral. Ventral inserted little before dorsal, about $\frac{3}{4}$ to anal. Vent close to anal. Size small.

This genus seems to be related to *Rasbora*, but differs in the incomplete l. l. From *Zacco* and *Opsariichthys* it also differs in the same character, besides others, such as the larger scales, etc.

(Ἡμι, half; γραμμή, line; κύπρις, *Cypris*.)

Hemigrammocypris rasborella sp. nov. Fig. 4.

Head $3\frac{1}{4}$; depth 3; D. iii, 7, I; A. iii, 8, I; P. I, 11; V. I, 6; scales in lateral series to caudal base 32 + 2; 12 scales transversely, between dorsal and anal origins; 13 predorsal scales; head width 2 in its length; head depth at occiput $1\frac{2}{5}$; first branched dorsal ray $1\frac{3}{7}$; first branched anal ray $1\frac{4}{5}$; least depth caudal peduncle $2\frac{1}{2}$; pectoral $1\frac{5}{7}$; ventral $1\frac{3}{4}$; snout 4 in head, measured from upper jaw tip; eye $3\frac{1}{2}$; maxillary 3; interorbital 3.

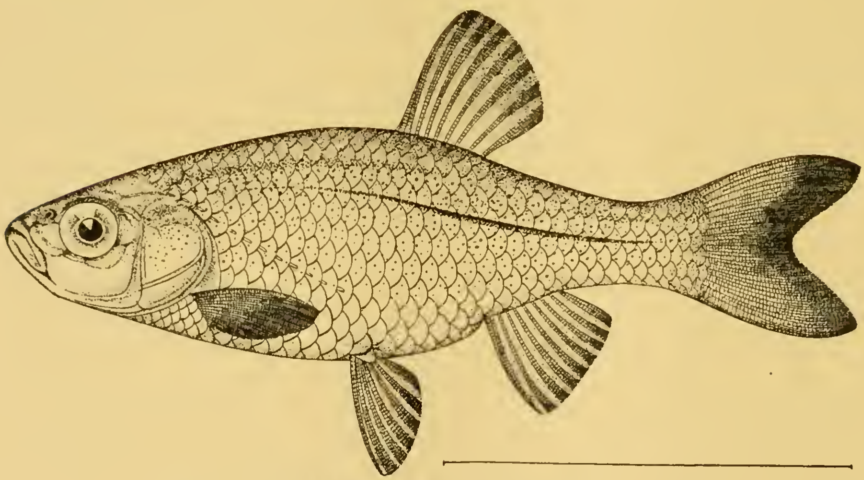


Fig. 4.—*Hemigrammocypris rasborella* Fowler. (Type.)

Body compressed, moderately deep, rather ellipsoid, greatest depth at dorsal origin, postventral trenchant and other edges convexly rounded. Caudal peduncle compressed, least depth $1\frac{1}{3}$ its length.

Head compressed, moderate, flattened sides slightly converging below, upper profile nearly straight and less inclined than lower, which forms an angle at mandibular articulation. Snout convex over surface, upper profile straight, and length about $\frac{3}{4}$ its width. Eye circular, moderate, a little high, and center near first third in head. Mouth moderate, well inclined. Premaxillaries protractile anteriorly down. Lips firm, scarcely distinct from jaws. Maxillary well inclined to hind nostril. Mandible prominent, depressed, protruding beyond snout tip, moderate, and rami a little elevated inside mouth. Tongue fleshy, not free. Jaw edges firm, scarcely trenchant and laterally on each side of upper a broad notch. Nostrils large, together, anterior circular with rather broad posterior cutaneous margin exposing posterior in narrow crescent. Interorbital broadly and evenly convex. Preorbital moderate, trapezoidal, length $1\frac{1}{3}$ in eye. Postorbital width $2\frac{1}{3}$ in eye, and infraorbitals scarcely more. Posterior preopercle margin vertical, or sloping but slightly backwards below.

Gill-opening forward nearly midway in head, not quite to hind eye margin. Rakers about 2 + 8? firm points, about 4 in filaments, and latter about $1\frac{2}{5}$ in eye. Pseudobranchiæ a little less than filaments. Teeth 1, 3, 5–5, 3, 1, ends hooked, and larger with slight smooth grinding-surfaces, edges also smooth.

Scales large, narrowly imbricated, on sides of body, disposed in even longitudinal series, and smaller on edges of body and breast. Axillary ventral scale short, little pointed, mostly adnate. L. l. decurved slightly below lowest third in greatest body depth, incomplete, and only extending opposite ventral base. Tubes short, each over about first $\frac{2}{3}$ of exposed scale, simple, and 12 in number.

Dorsal origin nearly midway between hind pupil margin and caudal base, first branched ray longest, depressed fin $1\frac{5}{6}$ to caudal base. Anal inserted just behind dorsal base, fin similar, depressed $1\frac{1}{2}$ to caudal base. Caudal emarginate, lobes equal, little pointed. Pectoral $\frac{3}{4}$ to ventral, upper rays longest. Ventral inserted a little before dorsal, nearly midway between tip of muzzle and caudal base. Vent simple, close before anal.

Color in alcohol generally dull brownish, a little paler below. Back and upper surface of head sprinkled with minute dusky dots, becoming a little more sparse and larger on opercle and longitudinally along middle of side, most pronounced superiorly. Concurrent with vertebral column a dusky streak, diffuse largely, and becoming more distinct and emphasized along caudal peduncle side, but fading out at pale caudal base. Fins all pale brownish, dorsal, caudal and upper pectoral rays all sprinkled with minute dull dusky dots. Snout pale dusky. Lips pale. Iris whitish.

Length $2\frac{1}{16}$ inches.

Type, No. 29,162, A. N. S. P. Lake Biwa at Matsubara in Omi, Japan. Jordan and Snyder. From Stanford University.

A large number of small examples, with the same data, were received with the other small cyprinoids some years ago.

(*Rasborella,* diminutive, from *Rasbora,* a related genus.)

A NEW HAITIAN OLIGOCENE HORIZON.

BY HENRY A. PILSBRY.

Messrs. W. W. Webster and Edmond Roumain, in the course of explorations in Haiti in 1905, located several beds of fossils, all apparently of Oligocene age.

The number of species obtained is not sufficient for any comparison with the Santo Domingo beds, yet the diversity of what were found may indicate a slightly different horizon. The following forms have been identified from a bed exposed in a stream on the road between Las Caobas and Hinche.

Potamides roumaini n. sp. Fig. 1.

The shell is conic, rapidly and regularly tapering, rather thick and solid. The summit is lost in adults, the breach closed by a strongly convex plug. $6\frac{1}{2}$ whorls remain, sculptured as follows: each whorl bears three strong spiral ridges, of which the upper one, forming a projecting ledge immediately below the suture, is strongest, the others equal, and nearly as wide as the intervals, which are marked with growth-lines. On the first two whorls the ridges are made nodose by rather close longitudinal waves, but on the last three whorls the ridges are smooth and even. The last whorl has about six smooth ridges below the subsutural ledge, and a few very weak ones on the base. The aperture is trapezoidal, channelled at both ends. Outer lip thick, expanded, protruding below. Columella short, thick.

Potamides roumaini.

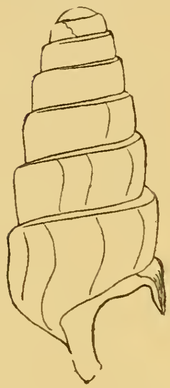
Length 24, diam. 13 mm.

Potamides hillsboroensis (Heilprin) has some resemblance to this species, but it is more nearly related to *P. suprasulcatus* (Gabb), from which *P. roumaini* differs as follows: it is a smaller and narrower shell; the subsutural cord is more prominent; the other spiral cords are stronger.

Potamides roumaini is named in honor of Mr. Edmond Roumain of Port-au-Prince. In a second specimen $7\frac{1}{2}$ whorls remain.

Potamides caobasensis n. sp. Fig. 2.

The shell is conic-turrite, rather solid, $6\frac{1}{2}$ whorls remaining, the summit truncate, closed by a convex plug. There is a prominent ridge forming a narrow, horizontal ledge below the suture. Below this ledge the surface is flat, smooth and vertical. The last whorl is rounded at periphery and base. The aperture is injured, but apparently formed much as in *P. roumaini.*



Potamides caobasensis.

Length of broken shell 23 mm.

A peculiar species, distinguished by its smooth whorls, prominent below the suture.

Natica rugosa Gmel.

A single specimen, found with the preceding.

Arca websteri n. sp.

Shell of moderate size, the alt. contained nearly $1\frac{1}{3}$ times in the length, inflated, thick and heavy, with strongly elevated prosogyrate beaks. Left valve with 32 strong, abruptly elevated ribs which are closely sculptured with transverse nodules, and are a little wider than their intervals. On the posterior slope the ribs lose the nodules, gradually decrease in elevation and are rounded, becoming quite weak near the hinge border. The basal margin converges posteriorly towards the hinge line, and is full and convex anteriorly; anterior end rounded, posterior end convex, obliquely subtruncate. Hinge bearing about 2,438 teeth, an irregular tooth or two near the middle, terminal teeth larger but straight or nearly so. Cardinal area short and wide, marked with several resiliary grooves forming 3 or 4 concentric lozenges. The terminal and basal margins of the valves are deeply fluted, and the interior conspicuously striated.

Length 42.5, alt. 34, diam. of left valve 17.3 mm.; length of hinge-line 28.5 mm.

This fine ark is closely related to the recent *A. chemnitzii* but differs by the greater number of radial ribs and the heavier, larger shell. *A. staminea* Say is also related. It is represented by numerous left valves and fragments, some of the latter indicating that it attains a larger size than the type specimen. The two valves are presumably alike in sculpture.

In several valves in the lot, the cardinal area is decidedly narrower than in the type. These may possibly represent another species. Type No. 1,312 A. N. S. P.

Arca sp. undet.

A single right valve was taken representing another species having more numerous ribs decidedly narrower than their intervals. As it is somewhat imperfect, description is deferred.

Ostrea sp.

Oysters occur in some quantity in a bed between Los Cahobas and Formonde. The species has not been determined. Another oyster bed was found in the mountains north of Lake Assuei.

DESCRIPTION OF NEW SERPULIDS FROM BERMUDA WITH NOTES ON KNOWN FORMS FROM ADJACENT REGIONS.

BY KATHARINE J. BUSH, PH.D.

The following descriptions of species of Serpulids are of forms (six of which are considered as new to science) collected at Bermuda by Professor A. E. Verrill and party, in 1898 and 1901; also at the Island of Dominica, W. I., by A. H. Verrill, in 1906.

A full description is given of the rediscovered species *Pomatostegus brachysoma* of Schmarda who failed to mention characters which, at the present time, are considered of great importance in determining genera and species. Notes are also given of some of McIntosh's species in which the genera is questionable; but the specimens are not sufficiently well preserved to reveal any additional facts, so that the exact genera must still remain undetermined.

Mention is made of most, if not all, of the species belonging to the group found in the southern waters, and figures are introduced of important features of known Mediterranean forms collected at Beirut, Syria, and thought to have been incorrectly determined.

SALMACINOPSIS gen. nov.

This genus resembles Claparede's genus *Salmacina*, 1869 and 1870, (type *S. incrustana* Clap.), in having few branchiæ, no operculum and 9 thoracic segments, but differs in having simple tapered setæ without fin-like basal expansion, in the collar fascicle and different shaped uncini, which are similar to those in the genus *Protula*, from which the 9 thoracic segments, absence of thoracic membrane and the peculiar branchiæ readily distinguish it. Type, the following species:

Salmacinopsis setosa sp. nov.

Numerous slender, rounded, rather fragile tubes attached their entire length were taken from a piece of dark green glass. They are of uniform diameter, more or less irregularly curved, without sculpture, roughened by irregular lines of growth.

Body rounded, of uniform size, with broadly rounded blunt posterior end. Anteriorly without distinct segmentation but posteriorly divided into well-rounded segments on one side. Thoracic region defined only by setæ and tori, there being 9 fascicles of setæ alternating with

8 tori in a straight series. No thoracic membrane along sides or posteriorly but an indistinctly four-lobed collar of moderate uniform depth, lapping along the median line, reaching but a short distance posteriorly with broadly rounded ends; lateral incisions or clefts the depth of collar forming three definite unequal parts, the middle one emarginate in the center appearing as an indistinct double lobe. Branchial lobes in the form of a rather deep collar-like membrane attached in a semicircle to the comparatively small stem-like cephalic lobe. The branchiæ, 4 on each side in the largest example, arise from this border and are peculiar in being but two sided, *i.e.*, broad, flattened, thin with a single row of rather stout long pinnæ in the middle of the inner surface, leaving a wide somewhat puckered margin or border on each side. They are equal in length, twisted about each other in retraction, and have elongated tapered naked tips. No operculum. Tori and uncini of uniform size throughout entire body. Small fascicles of setæ on abdomen. Setæ on thorax long, slender, tapered, simple blades with long capillary ends, a few without blades, and in the last three fascicles (7–9) a few with short blades and long, broadened, deeply serrate ends. Setæ on abdomen strongly bent at base of moderately wide, somewhat abruptly tapered, conspicuously serrate blades; additional long stiff hair-like ones along caudal region. Uncini resembling those of *Protula*, with numerous exceedingly fine appressed teeth and one very long fang-like end or terminal one.

Protula sp.

Two imperfect unattached tubes of good size, over 40 mm. long and 4 mm. in diameter, are slightly tapered and somewhat tortuous, the surface roughened by fine lines of growth. Only the branchial lobes of the animal were found and are of interest in being elongated into a spiral of about one and a half turns bearing numerous, between thirty and forty (30–40), long slender branchiæ having elongated tapered naked tips; they undoubtedly belong to a species of typical *Protula*.

Protula diomedæ Benedict, 1886, has similar branchial lobes but is a very much larger species, building tubes 4 or 5 inches long. The type was found off Cape Hatteras, N. C., in 43 fathoms. Other specimens are cited from the Gulf of Mexico in 111 fathoms, and further rather remarkable range is given as extending north from Chesapeake Bay to the Grand Banks in 65 to 1,290 fathoms. *Protula alba* Benedict, 1886, from shallow water at St. Thomas, W. I., has but twenty-five branchiæ.

Protula submedia Augener, 1906, from off the Windward Islands in

127 to 248 fathoms, has uncini very like those of *P. diomedæ*. *Protula antennata* Ehlers, 1887, found off Cuba in 292 fathoms, does not belong in the genus *Protula*. The uncini have the long terminal tooth, truncated and notched.

The *Protis simplex* Ehlers, 1887, has no operculum, but the collar setæ bring it into close relation to the genus *Salmacina*. The following species from Bermuda also has some affinity to the genus *Protis*.

From a mass of very much coiled and twisted eroded tubes partially covered with sponges, ascidians, and bryozoans, an exceedingly interesting deep crimson colored annelid with darker spots and markings was taken. The most perfect specimen is about 20 mm. long, with between 60 and 70 segments, with 7 on the thorax, the fascicles of setæ in very oblique series. Branchial lobes wanting. Collar apparently 4-lobed, reaching only to the 2d fascicle of setæ; no later or posterior free border on thorax. Collar setæ with stout shaft or manubrium with long, narrow, serrate, abruptly tapered end, bent and somewhat enlarged at the base and coarsely serrate, spreading out, resembling a fin. Other setæ very long, very slender, with very delicate deeply fringed blade with long lash-like end. Uncini small, very numerous; on the abdomen the tori reaching nearly around the body. They are somewhat triangular with few (5 or 6) curved pointed teeth above an unusually large base, somewhat protruding beneath the very large terminal tooth. Abdominal setæ flaring, asymmetrical, with serrate edge. The *Filigrana Huxleyi* Ehlers, 1887, from Tortugas, in 19 fathoms belongs to this group.

MEMBRANOPSIS gen. nov.

Membranopsis inconspicua sp. nov.

A small animal 6 mm. long is of special interest in the development of the thoracic membrane. As the branchial lobes are wanting its exact generic relation is indeterminable. The 9 thoracic segments bring it in close relation to *Salmacina*, while the form of the uncini and abdominal setæ show affinity to *Apomatus*; the development of the thoracic membrane separates it from *Salmacinopsis*.

It is of a brownish color in preservation, rounded, with but little taper to the blunt posterior end. There are 9 thoracic and about 25 abdominal segments. The collar is of moderate depth, apparently of four (4) lobes, two rolling rounded median ones and two small lateral ones, which extend backward around the 3d fascicle of setæ; from the 4th to the 8th fascicle, the free border is deeply incised on the side of each forming separate deep narrow scollops; that of the

9th fascicle continues as a wide, free, unbroken border across the body to the opposite fascicle; the fascicles forming a straight series. The setæ on the collar are badly injured; a few show simple tapered rather stiff blades similar to those on the following segments; in the 7th to 9th fascicles, there are a few curved setæ with short blades and broad, deeply serrate ends. On the abdomen the setæ are curved somewhat in cresent shape rather narrow and abruptly tapered toward the tip. Uncini similar to those of *Protula* and *Apomatus*.

SUBPROTULA gen. nov.

Branchial lobes small, not spiral, the branchiæ in a semicircle. No operculum. Collar three-lobed (3). Thoracic membrane a free margin to the fifth (5) segment, no posterior border. Thoracic segments seven (7). Setæ similar. Uncini irregularly trapesiform with a number of teeth, the last large and square cut. Type, the following species:

Subprotula longiseta sp. nov.

Nine good sized specimens (about 20 mm. long) taken from dead coral from Castle Harbor, have short rachis-like branchial lobes, not spiral, with the moderately long, rather stout branchiæ extending their entire length forming a kind of semicircle; the end of each abruptly contracted above the long pinnæ then expanding into a conspicuous club-shaped tip, the inner surface covered with minute papillæ; on one or two these appear to have become greatly enlarged, forming a closely crowded mass. On the sides of each rachis, which number fifteen (15) in each lobe, there are similar rounded or pear-shaped papillæ resembling uncolored occelli, close together at the base, becoming well separated distally. No operculum. Thoracic membrane very much developed, forming a deep rolling three (3)-lobed collar extending backward along the sides, gradually diminishing in width from the very large angular lateral flaps to the fifth (5th) fascicle of setæ. There is no free posterior border. In front of the large median lobe a triangular or tongue-shaped process protects the mouth. There are seven (7) fascicles of setæ on the thorax and six (6) tori; each of the latter situated on the posterior edge of a rectangular membrane successively increasing in size, often overlapping each other. Setæ numerous, all similar, very long, slender, with long capillary ends, the inferior ones the broader and more curved; on the collar a few capillary ones. Uncini with about sixteen (16) teeth on the largest, the terminal one very large and truncated, not at all like that of *Protula*. There are between fifty (50) and sixty (60) abdominal segments; the setæ three or four (3 or 4) in a fascicle rather stiff, very long, regularly tapered from an angular base with conspicuously serrate edge; along the caudal region replaced by long hair-like ones.

As far as Schmarda's description and figures of *Protula longiseta* from the coral reefs of Jamaica shows, this species agrees fairly well. The Bermuda form, however, cannot be placed in the genus *P. sygmobranchus*, in which Schmarda's species has been placed, as the type (*P. protensus* Gm.) as given by Claparede, 1870, has small branchial lobes with numerous branchiæ in a circle, seven (7) thoracic segments, but with the collar entire and the uncini very distinctive, somewhat resembling those of *Protula*. No genus is known that can include this Bermuda form, therefore the new name *Subprotula* is proposed with the specific name *longiseta*, avoiding multiplicity of names if it prove to be the same as Schmarda's species.

A fragment of a tube about 2.5 mm. in diameter is of especial interest in having a tough, horn-colored, semitransparent, chitinous lining; the calcareous covering is thick, its surface nearly smooth, without markings of any kind, even lines of growth. The animal, about 20 mm. in length, is destitute of an operculum, a very small protuberance on outside of the base of one of the branchial lobes showing point of attachment. The branchial lobes small, stem-like; the branchiæ (16 on each side) much curled and twisted in preservation are arranged in a semicircle. Thoracic membrane well developed, forms a deep rolling collar, apparently 3-lobed (mutilated), extends backward as a free lateral border to the 5th fascicle of setæ; no posterior border. Seven (7) fascicle of setæ and six (6) tori on thorax; the latter in separate rectangular membranous areas successively increasing in size. Setæ numerous, very long and slender, none showing broadened conspicuously serrate ends. Uncini much striated, approaching *Protula* in form, but with coarser teeth (about 16 in largest), the last moderately long and square-cut.

The conspicuously developed chitinous lining of this tube is remarkable. The character of the animal agree closely with *S. longiseta*, with the exception of the small protuberance noted on the base of one of the branchial lobes. This may possibly be an abnormality and not the point of attachment of a lost operculum.

———? **assimilis** (McIntosh, as *Placostegus*).

This species is recorded by McIntosh from off Bermuda, in 435 fathoms.

The tube is glassy, ornamented with a dorsal, or median, and two lateral ridges, which terminate at the aperture in tooth-like projections.

The characteristic operculum ought to be readily recognized. It is described, in the type, as concave, of a dull yellowish color with brown rim; a second specimen has an additional upper part, like an inverted cone.

The peculiarities of the collar described as made up of a number of unequal ribbon-like processes or lobes, are possibly due to injury. The rectangular form of the thoracic uncini, with numerous teeth above one long, sharp, terminal one, seems the only character showing any affinity to the genus *Placostegus* (type, *P. tridentatus*). The thoracic setæ are very slender and simple. The *Placostegus incomptus* Ehlers, 1887, from off Cuba, in 101 to 129 fathoms, has strong affinity to the genus *Plagostegopsis* Saint-Joseph, 1894.

Eucarphus serratus sp. nov.

Branchial lobes not free, the branchiæ arranged in a semicircle; there are twelve about equal ones in each, with long delicate ends and long pinnæ; a rudimentary operculum opposite the fully developed one, which has two chitinous cups one above the other, the lower with numerous radii and deeply pointed margin, very unlike the shallow broadly scalloped margin found in that of *Eucarphus lunulifera* Claparede, 1870, the upper one edged with thirteen stout, rather long, erect spines broadly rounded on the end, curved beneath on either side, forming a small angular lateral point; no outer, inner, nor basal processes or spinelets. Collar very deep and full. Setæ similar to those found in *Hydroides* and *Eupomatus*, with stout manubrium having two large tooth-like spines on exposed end at the base of the very delicate, abruptly tapered terminal portion, not broadened into a blade. Six fascicles of setæ and six tori on thorax. The setæ with long gracefully tapered ends; the uncini somewhat triangular in outline, the base much prolonged and tapered beneath the teeth, which number about seven, are of about equal size, rather long, pointed and appressed, in front view appearing broad and delicately serrate in a single series; on the abdomen becoming smaller and thicker with more numerous sharper teeth, eight or nine in the largest, the last broader than the others. Abdominal setæ flaring, with coarsely serrate edge, elongated on one side with a delicate (scarcely discernible) filamentose end; needle-like along caudal region.

Only one specimen in an irregular good sized tube roughened only by unequal irregular lines of growth.

This may prove to be the *Eucarphus dirampha* Mörch, 1863, from St. Thomas, W. I.

That is described as having from 13–16 spines on the operculum, which are figured as having bulbous bases not at all like the simple taper of the Bermuda species. The tube is given as slightly tortuous, loosely agglomerate, with unequal lines of growth; 3 mm. in diameter. Another related species (*E. benzoni* Mörch, 1863) is recorded from Bahia, Brazil. This builds left-handed, solitary, very solid, obsoletely nodulose spirorbiform tubes attached to *Purpura* and *Dolium*.

Hydroides bispinosa sp. nov.

Two specimens differ from typical *Hydroides* in having the edge of the lower cup of the operculum, with broad, shallow scallops, not deep narrow points; the upper cup has about 9 strongly curved, tapered spines somewhat angular on the outer side with a single small pointed process or spinelet on each side just below the angle and a long spike-like spinule on inner base. Rudimentary operculum in opposite lobe. Branchiæ eight on each side; long, rather stout, with very long terminal filament. Thoracic membrane but little (comparatively) developed, with moderately deep collar. Setæ in collar fascicle with two very prominent striated spines at base of abruptly tapered ends; in the following six fascicles long tapered blades. Uncini noticeable in being triangular, broad at base, with few, about equal, very sharply pointed, much curved, well separated, teeth, 5 or 6 on those of thorax and 3 or 4 on abdomen. Abdominal setæ in fascicles of seven, flaring without elongation, the edge coarsely dentate, one end tooth larger than the others and curved in hook-shape; similar to the setæ figured by Marenzeller as *Hydroides multispinosa;* additional long stiff hair-like ones along caudal region.

Tubes much roughened by irregular growth lines crossing two large dorsal carinæ, the shallow central area extending forward at the aperture in a broadly rounded projection; attached in irregular flat coils in masses or groups, often much eroded.

Hydroides parvus (Treadwell 1901, as *Eupomatus*).

Numerous rough tubes of good size, variously curved and often twisted over each other, are attached their entire length to the exposed surface of valves of *Placuanimia rudis*, the interior of the aperture of *Livona pica* and other hosts found at Bermuda.

They are rounded, of nearly uniform diameter, with two more or less clearly defined dorsal carinæ, with here and there a faintly indicated median thread; no transverse markings other than irregular ones of growth which roughen the entire surface.

The species was recorded by Treadwell from the shores of Porto Rico attached to Bryozoans. The Bermuda specimens are of larger size, agreeing well with Treadwell's description, with the exception of the form of the abdominal setæ. The long acicular ones described by him occur only on the caudal region; those of the characteristic *Hydroides* form with striated, flaring, conspicuously serrate ends are present on the other abdominal segments. The characteristic basket-like operculum readily distinguishes the species, in some instances two fully developed ones occur. It is formed of two chitinous light yellow cups, fitted one above the other, on a long, slender, rather stiff peduncle. The lower is edged with 25 or 30 deep points and the upper has nine strongly curved fang-like spines with three conspicuous outer processes (two pointed lateral and one blunt, more or less elongated, median) situated at the point of greatest curvature; a little above the middle; at the inner base of each fang is a short, erect, blunt process or spinule; in every instance these fangs have their points in contact forming a very pretty basket-like end to the operculum. There is great variability in the size of the blunt median process, which is sometimes low and broadly rounded and sometimes much elongated and truncated.

The animals are long (50 mm.) slender rounded, the branchiæ about 4 mm. The collar setæ, characteristic of the group, are horn-colored with stout shaft or manubrium with two, sometimes three, conspicuous tooth-like spines at the base of long tapered ends; other thoracic setæ long and narrow regularly tapered. Uncini much striated with a few (7) strongly curved pointed teeth in profile but showing irregular series when the rather broad exposed surface is in view. Abdominal setæ with flaring striated coarsely serrate ends; hair-like along caudal region.

Eupomatus elegantulus sp. nov.

The species is readily identified by its large operculum ($2\frac{1}{2}$ mm. in diameter). The lower cup edged with 30 or 40 deep narrow points, the upper with 13 very long, very slender, tapered, regularly curved, spreading, simple spines without outer, lateral, or inner spinelets except a long slender much curved spinule at the inner base of each, their points in contact forming a basket-like center. Entire length of body about 20 mm. Branchial lobes simple, short, the branchiæ in a semicircle (16 or 18 on each). Thoracic membrane badly mutilated but showing a well-developed collar and free lateral and posterior border. Seven (7) fascicles of setæ and six (6) tori in oblique series on thorax. The collar setæ with two (2) conspicuous spines at base of moderately long tapered end; other setæ long, very slender with capillary tips. Uncini triangular in outline, the base protruding forming a narrow end beneath the six (6) coarse teeth, which successively increase in size.

Tubes unattached, yellowish, of good size, gradually tapered, rounded, and somewhat contorted, the surface roughed by numerous conspicuous irregular growth lines crossed on one side by three well-separated rather delicate longitudinal often lamellar-like lines.

Three similar species have been recorded from the West Indian fauna. *Eupomatus sanctæ-crucis* Mörch, 1863 (as *Eucarphus*), from the Island of St. Croix is described and figured as having a minute spinelet on the outer (?) surface of each spine of the upper cup of the operculum at about the middle, thus if correct (they usually occur on the inner surface) representing a connecting link between typical *Hydroides* with two or more spinelets and typical *Eupomatus* destitute of them. *Eupomatus spongicolus* Benedict, 1886 (as *Hydroides*), from Gulf of Mexico in sponges from 26 fathoms, has numerous (14-18) simple long slender curved spines with long basal inner spinules on upper cup of the operculum and about 65 narrow deep points on edge of lower one. *Eupomatus Floridanus* nom. nov. for *E. uncinatus* Ehlers, 1887 (*non* Philippi, 1844), from 7 fathoms off Cape Dear Rio, Florida, has 11 very long, much curved spines with inner basal spinule on upper cup and about 30 deep points on edge of lower one. This does not agree with the operculum of *E. uncinatus* from the Mediterranean (a fact mentioned by Ehlers). From mass of 2 or 300 tubes in Yale Museum, a number of dried animals were taken showing the opercula and collar setæ in good condition. There are 9 or 10 spines on the upper cup which are stiff nearly straight, being curved only near the tip and so abruptly as to appear angulated on the outer surface, the inner basal spinule inconspicuous wart-like; they are very like the figure given by St.-Joseph, 1906. On the American coast the *Eupomatus dianthus* (Verrill) Bush as figured by Benedict, 1886 (as *Hydroides*), is a closely related species.

Pomatostegus brachysoma Schmarda.

One beautifully preserved animal has been received from the Island of Dominica, W. I., from Mr. A. H. Verrill. Entire length 45 mm.; operculum 15 mm. of which 5 mm. belongs to its horny end; thorax, about 5 mm.

The very large operculum arises abruptly without a peduncle from the base of one of the branchial lobes. It is cornucopia shaped with very oblique end and very conspicuous thin membranous side appendages, gradually increasing in width from the base to the free rounded end lobe. There are three semitransparent horn-colored somewhat saucer-shaped plates conspicuously serrate on edge and about equal in size, the lowest closely affixed to the end of the operculum. From this, a little to one side of center, a large rounded hollow column arises, made up of four parts or sections successively decreasing slightly in size, with concave sides and flaring top and bottom, each of which is encircled by a series of elongated spines, longest above; at the base of the lowest one no spines are developed. At the joining of the sections there are therefore two series of spines between which a large saucer-shape plate rests; in this specimen, the third joint is destitute of a plate and some of the spines at the apex have been torn away. Branchial lobes elongated, free, slightly spiral, plume-like, the slender tapered rachis, with a thick, broad or deep, striated, web-like membrane on each side, is strongly curved at the end causing the sides to be unequal. The moderately long, much curled, stout branchiæ (about 50) arise on the outer side only. Collar conspicuous, entire, varying in depth, a broad, shallow emargination on each side forming a comparatively narrow, deep, angular median marginal lobe having a noticeable seam-like median depression; the large lateral flaps end on a line with the first torus without forming any lateral nor posterior free border. The thorax, however, conspicuously defined, the seven fascicles of setæ in very oblique series; the tori reaching across body nearly in contact along the median line; each is situated in the posterior edge of a separate overlapping membrane which forms a free, broadly rounded, outer end with pointed fluke-like side lobes; only on the first do both of them show, and on the sixth or last the posterior one is elongated, extending across the body to the opposite side in a scarcely discernible free border. Collar fascicle small, the superior setæ very slender, geniculate and roughened by minute hair-like spines at base of narrow regularly tapered blade approaching the form characteristic of the genus *Spirobranchus;* inferior setæ capillary. Other thoracic fascicles large with numerous rather stiff setæ; the shortest, capillary; median with darker rounded elongated blades and short tips; the longest with short tapered ends. Uncini like *Spirobranchus* with curved pointed teeth (8 in largest abdominal one) above a more prominent truncated terminal tooth (not twisted). Abdominal setæ comparatively small, slender, tapered, often scarcely discernible, just pricking through the integument.

Pomatostegus stellata (Abildgaard, 1789) was carefully described by Ehlers, 1887, from a specimen from off Florida in 13 fathoms. It has a similar one-lobed collar but smaller operculum and a more elongated body of 140 segments. Benedict, 1886, also described and figured the same species from several specimens from Jamaica and Curaçao and Treadwell recorded it from Porto Rico. The *P. macrasoma* Schmarda, 1861, is distinguished by its 2-lobed collar (which possibly may have been mutilated) and more elongated form with comparatively small operculum. The *P. brachysoma* is relatively short of 100 segments with a very large operculum plashed with chocolate brown, the branchiæ and pinnæ banded with the same color.

Benedict, 1886, and Ehlers, 1887, record *Spirobranchus giganteus* (Pallas) Mörch, *S. tricornis* (Mörch) Ehlers, *S. pseudoincrassatus* Bush, 1905 (for *incrassatus* Benedict, 1886, *non* Kröyer), and *S. dendropoma* Mörch, 1863, from off Florida and the West Indies. Other serpulids recorded from this region and Bermuda are *Crucigera Websteri* Benedict, 1886, *Hyalopomatus Langerhansi* Ehlers, 1887 (which is not a true *Hyalopomatus*), *Cymospira* (?) *polycera* Schmarda, 1861, *Paravermilia annulata* (Schmarda, 1861) Bush, 1907, not *Vermilia annulata* Ehlers, 1887 = *Paravermilia Ehlersiana* n. n., *Paravermilia Bermudensis* Bush, 1905 and 1907, *P. amblia* Bush, 1907, *P. intermedia* Bush, 1907, *Pseudovermilia occidentalis* (McIntosh, 1885) Bush, 1907, *P. pileum* Bush, 1907, *Spirorbis formosus* Bush, 1905, *Spirorbis mutabilis* Bush, 1905, and *Rhodopsis pusillus* Bush, 1905.

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Explanation of Plate XXXVI.

Fig. 1.—*Paravermilia amblia* Bush. Side view of operculum; *a*, abdominal seta; *b*, thoracic seta.

Fig. 2.—*Pseudovermilia occidentalis* (McIntosh) Bush. Front and back views of operculum; *a*, collar seta; *b*, seta from 2d segment.

Fig. 3.—*Spirorbis mendosus* n. n. for *S. cornu-arietis* Marion and Bobretzki, 1875, *non* Philippi, 1844 + Caullery and Mesnil, 1897. Side view of calcareous plate of operculum.[1]

[1] Figures 3, 4, and 6 are from specimens described by the author in 1905, from Beirut, Syria, page 288.

Fig. 4.—*Spirorbis serratus* sp. nov. Two calcareous plates of operculum; upper one tilted to show posterior basal serrations; lower separate shield-shaped frontal plate.

Fig. 5.—*Spirorbis formosus* Bush. Side view of operculum with two complete calcareous cylinders.

Fig. 6.—*Spirirbis nudus* sp. nov. Side view of operculum.

Fig. 7.—*Spirorbis mutabilis* Bush. Side view of animal taken from tube and stained to show position of eggs (*e*), protozoans, etc., cover the operculum; *a*, back view of an operculum filled with eggs; *b*, front view of another operculum, the calcareous plate is dislodged; *c*, views of another operculum; *d*, back and side views of collar seta.

Fig. 8.—*Paravermilia bermudensis* Bush. Side view of operculum of type, the tip broken off; *a*, abdominal seta; *b*, edge of thoracic uncinus; *c*, collar seta.

Fig. 9.—*Paravermilia intermedia* Bush. Side view of operculum; *a*, abdominal seta; *b*, edge of thoracic uncinus; *c*, back view of seta from 2d segment.

All the figures are camera-lucida drawings by the author. A No. 3 objective was used for the opercula, with the exception of fig. 1, where an inch objective was used. No. 7 objective was used for the setæ.

LAND MOLLUSCA OF THE PANAMA CANAL ZONE.

BY H. A. PILSBRY.

The land shells listed below were collected by Dr. A. P. Brown during a visit to the Canal Zone in April of this year. Twenty-two species were taken, but this is probably not half of the fauna of the Zone, since other interests left but little time for collecting snails, and the condition—dense jungle with only small exposures of calcareous rock—made collecting rather slow work.

Notes on a few species from other sources are appended.

Prof. von Martens has reported 20 species of land shells from Panama, on the authority of various authors. The following species from his list are additional to those taken by Dr. Brown:

Aperostoma giganteum.
Helicina amœna.
Euglandina sowerbyana.
Drymœus bugabensis.
Drymœus alternans.
Drymœus panamensis.
Subulina octona.
Leptinaria interstriata.
"Melaniella" fimbriata.

HELICIDÆ.

Pleurodonte (Labyrinthus) otis orthorhinus Pils. Tabernillo.

Several other races of *P. otis*, and *P. uncigera* are found on the Isthmus. See below.

Thysanophora conspurcatella (Morel.). Las Cascades.

The specimens are somewhat larger than the typical form from Mexico. Some shells of practically typical *T. conspurcatella* are in the collection of the Academy under the name *Helix panamensis* Perez. So far as I can learn no description under this name has been published. They are from the Morelet collection.

Thysanophora canalis Pils. Las Cascades.

ACHATINIDÆ.

Leptinaria lamellata concentrica Reeve. Tabernillo.

Leptinaria filocostata (Strebel) (?). Tabernillo; Las Cascades.

Leptinaria sp. undet. Las Cascades.

Leptinaria panamensis Pils. Tabernillo.

Opeas beckianum (Pfr.). Tabernillo.

Opeas pumilum (Pfr.). *O. goodalli* Mill. not Fér. Las Cascades.

Opeas panamense Pils., collected at Panama by Prof. C. B. Adams, was probably taken near the city of that name, where Adams collected marine mollusks extensively.

BULIMULIDÆ.

Bulimulus unicolor (Sowb.). Las Cascades.

Drymæus semimaculatus Pils. Tabernillo.

Drymæus near **josephus** Ang. Tabernillo.

Some other species of *Drymæus* are known from the islands in the bay of Panama.

Oxystyla princeps (Brod.). Tabernillo.

Auris distorta panamensis Pils. Between Tabernillo and San Pablo.

OLEACINIDÆ.

Euglandina cumingi (Beck). Tabernillo.

Euglandina probably **striata** (Müll.) Tabernillo. Fragments.

Salasiella browni Pils. Tabernillo; Las Cascades.

SUCCINEIDÆ.

Succinea recisa Morel. (?). Las Cascades.

Also reported by other authors.

ZONITIDÆ.

Guppya gundlachi (Pfr.). Tabernillo.

Guppya browni Pils. Between Tabernillo and San Pablo.

Ammoniceras n. sp. near **guildingi** Bld. Tabernillo.

Imperfect shells only.

PUPILLIDÆ.

Bifidaria servilis (Gld.).

Some specimens of this species from the Morelet collection are in the museum of the Academy from Panama, collected by Paz, under the name "*P. pazensis* Perez." It is probably *Pupa pazi* Hidalgo Journ. de Conchyl., 1875, p. 129. Von Martens reports *P. pellucida* in which he includes *servilis*, from Panama.

HELICINIDÆ.

Helicina funcki Pfr. Tabernillo.

Helicina lirata Pfr. Tabernillo, abundant.

Notes on New or Imperfectly Known Species.

Pleurodonte (Labyrinthus) otis (Sol.). Pl. XXXVII, figs. 5, 6, 7.

Helix otis [Solander] in Skinner & Co.'s Catalogue of the Portland Museum, 1786, p. 38, lot No. 925, based solely on Favanne, La Conchyliologie, pl. 63, fig. 11.
Helix labyrinthus Chemnitz, Conchylien Cabinet, XI (1795), p. 271, pl. 208, fig. 2048 (copied from Favanne).

The typical form of this remarkable snail is figured. It is distinguished by the strongly recurved peripheral and axial ends of the peristome and the spatulate shape of the aperture. Alt. 21, diam. 51 mm.

Isthmus of Panama. No more exact locality is known, but the form will probably be found in or near the Canal Zone. Several more or less divergent races have been described from Panama and Colombia, the status of which remains to be determined. A synopsis of these forms follows.

P. o. subplanata (Petit).

Caracolla subplanata Petit de la Saussaie, Revue Zoologique, Aout, 1843, p. 238 (Nouvelle Grenade); Magazin de Zoologie, 1843, Mollusques, pl. 68.

Smaller than *P. otis*, alt. 14, diam. 40 mm., reddish brown. Aperture as in *otis*, the peristome retracted at both ends.

This Colombian form differs from typical *P. otis* by its diminished size, but is probably not separable from the small Panamic form called *sipunculata*.

P. o. sipunculata (Forbes).

Helix labyrinthus variety *sipunculata* Forbes, P. Z. S., 1850 (March 26), p. 53, pl. ix, figs. 4*a*, 4*b* (Panama).

Shell purple-brown, 35 mm. in diameter, decidedly smaller than *P. otis;* aperture as in typical *otis*, the columellar and peripheral angles of the peristome strongly recurved.

This shell does not seem to differ very materially from the earlier *subplanata* Petit. It is only provisionally admitted as a race. The figure shows the umbilicus somewhat smaller, and the aperture not exactly similar. It may, as Dr. Brown suggests to me, be a dwarfed form of *otis* owing to unfavorable station.

P. o. annulifera ('Pfr.' Reeve).

Helix annulifera Pfeiffer, P. Z. S., 1851 (December 7, 1853), p. 260 (Panama) Reeve, Conchologia Iconica, *Helix*, pl. 100, fig. 555 (May, 1852).

The shell is much smaller than *P. otis*, alt. 13, diam. 34 mm.; deep chestnut colored with *a broad white band* at the acute keel. The aperture is shaped as in *P. otis;* the peristome is retracted at both ends.

This race differs from *sipunculata* only in color, which may or may not be a constant racial character.

P. o. erecta (Mouss.).

Helix erecta Mousson, malak. Blätter, xxi, 1873, p. 3. Pfeiffer, Novit. Conch., III, p. 116, pl. 127, figs. 1–3 (Bogota).

Blackish-brown, identical with *subplanata* except for its smaller size and greater elevation, alt. 13, diam. 30 mm.

P. o. orthorhinus n subsp. Pl XXXVII, figs. 1, 2, 3, 4.

The shell is dark brown, often blackish at the keel, and differs from *L. otis* in having the inner end of the peristome less recurved into the umbilical cavity, and the outer end much less deeply channelled, scarcely or not recurved; the gutter above the keel and the upturned flange of the latter are less emphatic.

Alt. 19, diam. 42 mm.; 5 whorls.

Types No. 101,308, A. N. S. P., from a small clearing between Tabernillo and San Pablo, on the new line of the Panama R. R., collected by Dr. Amos P. Brown, April, 1910. The same form is in the collection of the Academy from Gorgona, also on the Panama R. R. One of the specimens from Gorgona has been figured in the *Manual of Conchology*, V, pl. 64, figs. 14–16.

A specimen somewhat abnormally elevated measures alt. 23.5, diam. 45 mm.

In connection with the preceding it may be well to consider the following South American species.

Pleurodonte (Labyrinthus) plicata (Born).

Helix plicata Born, Testacea musei Cæsarei Vindobonensis, 1780, p. 368 referring to Knorr, Vergnügen der Augen und des Gemüths, 1771, pt. V, pl. 26, fig. 5 (India occidentalis).

Caracolla hydiana Lea, Obs. Genus Unio, ii, 1838, p. 98, pl. 23, fig. 73. (Near Puerto Cabello [Venezuela].)

This species is well distinguished from *P. otis* by its more open aperture and smaller basal teeth, as pointed out in the *Manual of Conchology*. Some specimens in the series before me agree closely with the figure referred to by Born, others with Lea's figure. It is apparently an abundant snail around Puerto Cabello, Venezuela, found also at Chorini and Caraccas, and one specimen received from Deshayes is labelled Carthagena, N. G. There is no trustworthy record of *plicata* from Panama. I cannot agree with Prof. von Martens that *plicata* and *hydiana* (*hydeana* Martens) are distinct species. A careful study of numerous specimens shows that they are identical.

A very small race, alt. 11.5, diam. 31 mm., from Marmato, Colombia, has been figured in the *Manual of Conchology* V, p. 164, pl. 63, figs. 6, 7, 8. It may be called *Pleurodonte plicata marmatensis*.

Pleurodonte (Labyrinthus) uncigera (Petit.). Fig. 1.

Caracolla uncigera Petit, Mag. de Zool., 1838, pl. 113.

Pleurodonte (Labyrinthus) tenaculum Dall, Smiths. Misc. Coll., Vol. 52, part 3, p. 361, pl. 37, figs. 5, 6, 10, 11.

This species is well distinguished by the hook within the basal lip, projecting between two basal plicæ, though really arising from the inner part of the outer plica. Petit's very good figure of this structure is copied in my fig. 1. A whitish band revolves above, another below the peripheral keel, which is dark. Diam. 27–30 mm.

Isthmus of Panama (Pavagean, type of *uncigera*); near the Atrato River, Sierra Darien (Heighway, type of *tenaculum*).

Fig. 1.—*P. uncigera* (after Petit).

Fig. 2.—*P. u. chiriquensis*.

Pleurodonte (Labyrinthus) uncigera chiriquensis n. subsp. Fig. 2.

Helix uncigera Pilsbry, Manual of Conchology, V, p. 164, pl. 42, figs. 23, 25, 25, 26. Not of Petit.

The shell resembles *uncigera* in shape and color, and in the form of the aperture. There are two teeth within the basal lip, the inner one small, tubercular, sometimes nearly obsolete; outer tooth entering pliciform, double, consisting of an inner fold terminating in a hook or vertical lamina, and an outer fold *superposed upon the other*, not reaching so far forward.

Alt. 12, diam. 27.5 mm.
" 12, " 28 "
" 12, " 30 "

Chiriqui, Isthmus of Panama (McNeil exped.). Type No. 5612, A. N. S. P. Also taken by Dr. W. Newcomb on the Isthmus, exact place not stated.

In this form the hook does not stand free from the entering lamina, as it does in *uncigera*. The lamina overrides the fold bearing the hook, and does not continue to or upon the peristome. In several specimens the hook is not free but united by a thin lamina with the lip. This is the form which I described and figured as *uncigera* in the *Manual of Conchology,* Vol. V.

Thysanophora canalis n. sp. Fig. 3.

The shell is umbilicate the width of umbilicus contained 4½ times in the diameter of the shell, which is somewhat depressed with conic spire and obtuse summit; thin; dull brown. Surface lusterless, finely striate, bearing rather closely spaced retractive delicate cuticular laminæ, much more oblique than the growth-lines, usually in large part lost or wholly wanting by wear. Whorls 4¾, strongly convex, separated by deep sutures, the last rounded peripherally and beneath. Aperture much larger than the umbilicus, oblique, rotund-lunar. Peristome simple, forming about three-fourths of a circle.

Alt. 3.8, diam. 4.6 mm.

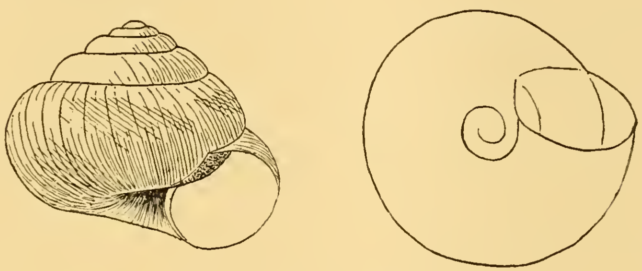

Fig. 3.—*Thysanophora canalis.*

Las Cascades, on the Panama Railroad, Canal Zone. Types No. 101,329, A. N. S. P., collected by Dr. A. P. Brown, April, 1910. This species differs from *P. conspurcatella* by its much more elevated spire and smaller umbilicus. The same species is in the collection of the Academy from Cariaca, Venezuela, collected by F. R. Cocking. These specimens are of a pale yellowish color and slightly smaller size.

Auris distorta panamensis n. sp. Pl. XXXVII, Figs. 8, 9.

This snail is closely related to *A. d. bisuturalis* Pils. from San José de Cucuta, Colombia, with which it agrees in size and general fusiform shape, in having a distinct narrow margin below the suture on the last whorl, and in style of markings. The shell, in the freshest examples, is reddish with rather widely separated, longitudinal, protractive dark streaks. It differs from *A. d. bisuturalis* by having the last whorl more compressed and tapering basally, with several short spiral furrows behind the lip, above the basal ridge; the aperture is narrower and distinctly retracted at the base, the outer lip, in profile, curving backward there, while in *bisuturalis* it is nearly straight.

Length	41	, diam.	18.5,	length aperture		22.5 mm.			
"	43.5,	"	18 ,	"	"	25	"	whorls	5¾.
"	41.5,	"	18 ,	"	"	23.6	"	"	5¾.
"	42.5,	"	18 ,	"	"	23.3	"	"	5½.

Between Tabernillo and San Pablo. Types No. 101,314, A. N. S. P., collected by Dr. A. P. Brown.

This is further northwest than any *Auris* has been found hitherto.

Leptinaria panamensis n. sp. Fig. 4.

The shell is narrowly perforate, turrite-conic, thin, corneous, translucent, glossy, and smooth except for very faint growth-lines. Whorls 6½, moderately convex. Aperture ovate, subvertical, its length contained 2⅔ times in that of the shell. Outer lip thin, arching forward somewhat above the middle. Columellar margin reflexed, tapering downward, armed below the middle with a strong oblique lamella.

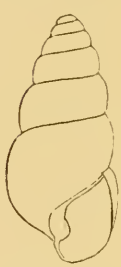

Fig. 4.—*L. panamensis.*

Length 8, diam. 3.3, length of aperture 3 mm.

Between San Pablo and Tabernillo, on the new line of the Panama Railroad. Types No. 101,320, A. N. S. P.

This species is closely related to *L. mexicana* Pfr., but differs by its smooth surface.

Salasiella browni n. sp. Fig. 5.

The shell is subcylindric, the upper third tapering, thin, pale yellowish, polished, irregularly sculptured with very strongly arcuate growth wrinkles. The spire tapers slightly to the obtuse apex. Whorls 5½, strongly convex, joined by a deep suture. Aperture very narrow in the upper half. Outer lip thin, arching very strongly forward in the middle. Columella slightly concave, truncate as usual.

Length 10.2, diam. 4, length of aperture 6 mm.

Las Cascades. Types No. 101,325, A. N. S. P. Also taken between Tabernillo and San Pablo.

The largest shell, a dead one from the last locality, measures: Length 12, diam. 4.5, aperture 7.2 mm.; whorls 5½. Named for Dr. Amos Brown, who collected the specimens.

Fig. 5.—*S. browni.*

Guppya browni n. sp. Fig. 6.

The shell is perforate, trochiform, distinctly angular at the periphery, thin, yellowish-corneous, glossy, lightly marked with growth-lines. The outlines of the spire are nearly straight. Whorls $6\frac{1}{2}$, moderately convex, the last convex beneath, impressed around the perforation, which is half covered by the expanded columellar lip. Aperture somewhat lunate; peristome simple.

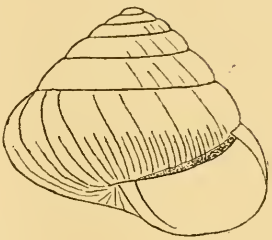

Fig. 6.—*G. browni.*

Alt. 5.3, diam. 6.5 mm.

Between Tabernillo and San Pablo, on the new line of the Panama Railway. Type No. 101,319, A. N. S. P.

This species is related to *G. selenkai* Pfr. but differs by being much larger, less glossy, with the base less convex and the peripheral angle far weaker. It is larger than any of the trochiform species known to me.

Explanation of Plate XXXVII.

Figs. 1–4.—*Pleurodonte otis orthorhinus* n. subsp.
Figs. 5–7.—*Pleurodonte otis* (Solander). Typical form.
Figs. 8, 9.—*Aûris sinuata panamensis* n. subsp.

THE MOLLUSCA OF MANDEVILLE, JAMAICA, AND ITS ENVIRONS.

BY HENRY A. PILSBRY AND AMOS P. BROWN.

The mollusks enumerated below were collected by one of us (Dr. Brown) during two visits to Jamaica, in February–March and May of this year; on the former occasion with assistance from Mr. Stewardson Brown. The material has been studied by both authors.

While the non-marine molluscan fauna of Jamaica might be considered well known, since most of the species have been described, yet it is really most imperfectly known. Very few forms have been examined anatomically; almost nothing has been observed of the relations of the many specialized forms to their environments; a large proportion of the species has not been figured, and many are scarcely recognizably described. Finally, our knowledge of the distribution of species is extremely imperfect. The Mandeville list may therefore prove useful, both as the most nearly complete fauna published for any Jamaican locality, and because definite localities are supplied for a large number of species hitherto known from no more exact habitat than "Jamaica."

The "Contributions to Conchology" of Professor C. B. Adams was for the time a work of distinguished excellence; but it has a very serious defect in the omission of localities. Almost all of the species of Pfeiffer, Gray and Sowerby were also described as from Jamaica, without nearer localization. A list published by C. P. Gloyne[1] supplies localities for some species, but often only the Parish is mentioned. Mr. J. B. Henderson, Jr.,[2] has given a more extended list (248 species) in which the localities are carefully noted. Out of 55 species listed by him from "Mandeville," 17 were not found in our material.[3] Adding

[1] *Journal de Conchyliologie*, XX, 1872, p. 26; XXIII, p. 115.

[2] *Nautilus*, VIII, 1894, pp. 1, 19, 31. See also C. T. Simpson, *Proc. U. S. Nat. Mus.* XVII, 1894, pp. 423–440, where several new forms are described. Other new species of *Urocoptidæ*, *Achatinidæ* and *Oleacinidæ* from Mr. Henderson's collection have been described in the *Manual of Conchology*.

[3] These Mandeville species which we did not obtain are: *Varicella ligata*, *Sagda cookiana*, *S. epistylioides*, *S. arboreoides*, *Pleurodonte jamaicensis cornea*, *Cepolis subconica*, *Urocoptis inornata*, *Geomelania fortis*, *Aperostoma subrugosum*, *A. rupisfontis*, *A. crassum*, *Tudora proxima*, *Colobostylus tectilabris*, *C. banksianus*, *Helicina jamaicensis*. Probably Messrs. Henderson and Simpson listed all species collected within a radius of some miles as from Mandeville.

them to the 110 species enumerated below gives a total of 127 species of land snails for Mandeville and its environs. To this number, considerable additions may yet be made, chiefly among the very small species.

The tertiary limestones underly the region about Mandeville, exposed in nearly every roadside cut and in many small borrow-pits along the post-roads, and generally cropping out on every hill-top. On the slopes of the steeper hills the limestone often stands up in bold cliffs, especially on the higher hills of the northwest and west of the town,

Fig. 1.—Sketch map of Mandeville and environs.

in the ridges towards the western border of the Parish of Manchester. The elevations run from about 1000 feet above sea level at Williamsfield to 2060 at Mandeville and 2700 on the ridge overlooking the valley of St. Elizabeth Parish and Black River. The entire country was evidently once covered with jungle or "bush" throughout, but in the more cultivated parts the ground has been cleared of woods except on the tops of the stony hills.

There are no streams or other surface water in this part of Manchester except what is collected in the cattle pools and drinking water cisterns, but the washing of the surface by torrential rains has had its effect in shaping the topography. The rain water, however, soon passes underground, and these underground waters have honeycombed the limestones, forming numerous caves and pipes in the limestone and resulting in sinks and "cockpits," so that the entire surface is covered with cup-shaped valleys, more or less surrounded by hills, and is very uneven, a few acres of level ground being rarely found. The hills are generally steep, in many places limestone cliffs of 20 to 50 feet high rising abruptly on their slopes; the hill-tops very frequently show base rock in places. On this account the hill-tops have often been left covered by jungle except where the wood was needed for fire-wood, etc.; but even these are often cleared, especially on the lower ground towards Williamsfield and Porus, and to a less degree along the roads towards Kendal, so that only fruit trees or occasional shade trees remain.

Along the Williamsfield road, at Wesley Mount Church, and on the parish roads to the south in the direction of Porus to Sterridge's Place and beyond, as well as along the Newport road running out of Mandeville to the south, most of the hills have been cleared of trees and large patches of woods are not common, but a few bits of the original forest remain. Such are the woods at Benmore and at the King Edward Hotel and the woods opposite Cedar Hill. The species obtained at Wesley Mount Church were from the roadside on the limestone sand and rock and at the base of the limestone walls. These limestone walls are a feature of the region; they line the roads everywhere. They are built from the stone gathered in the adjoining field, without plaster, and as the limestone weathers soon become the home of numerous species of snails. Much of the roadside collecting is from the walls, especially after a rain, when the animals crawl out on the surface of the walls and may be gathered in quantities. At Sturridge's the country has been completely denuded of trees and the small collection made there came entirely from the walls. At Cedar Hill there are no trees, the collection was taken from a low limestone cut about ten feet high along the roadside. The Bloomfield colony lives on a similar cut, and a steep hillside rising above it, where some trees shade the road. These conditions continue for about one-third of a mile. Garrett's woods is a hill top covered with almost untouched virgin forest, but is only some five or six acres in extent. The specimens from the Lower Santa Cruz road are from small roadside cuts, some in limestone and some in the red residual clay from its weathering, with occasional collections from the damp shady borrow pit holes and caves along the road. Many specimens were gathered from the stone walls along this road. There are not many places beyond Garrett's woods along this road "2 to 4 miles from Mandeville" where the woods touch the road, but a few were explored, generally caves and borrow pits; the ground rises in this direction to perhaps 2500 feet above sea level at four miles from Mandeville.

To the west and northwest of Mandeville there is more of the original forest remaining uncleared, and at Somerset there is considerably more forest than cleared land. The ridge near Lincoln, the most western point explored in this region, rises to some 2,700 feet above sea level, and lies to the north of the road. It overlooks the valley of the Black River and St. Elizabeth Parish, and from it may be seen the Santa Cruz mountains in the distance. The hill-top is rocky with the honeycombed limestone in place, and rising in many chimneys and spires, forming a very favorable habitat for the species found, but the woods has been somewhat disturbed by cutting of firewood, though evidently never cleared. Out the Kendal road, to the north of Mandeville, the ground is thoroughly cultivated and again few patches of original forest come down to the road. The specimens were mostly obtained from stone walls and low roadside cuts in the limestone down to about 1,500 feet above sea level. In a few places the forest touched the road and collections were made along the cuts at these places, but the woods were not explored.

The colony on the Somerset road, near the 2 mile post from Mandeville (about three miles from the town), was a patch of woods and a small quarry or borrow pit, on the north slope of a hill overlooking the valley of Williamsfield and Kendal, and was at about the elevation of Mandeville. From this point onward the parish road to Somerset is shaded by the trees of the portions of the original forest that are here quite extensive. The hills are more abrupt and the cliffs rise in many places 50 to 100 feet or more. At Somerset, about six miles from Mandeville, the woods are so nearly continuous that there is no bar to the free migration of the species from one to another, but still it is evident that there are a number of distinct colonies. Collections were made from the roadside cuts and walls, in the stony pastures and woods, from the cliffs and from a dissected cave and a sink hole. The woods and cliffs were principally explored, and under stones and in rock piles many specimens were taken alive. The limestone in places wears into cylindrial more or less vertical holes of all sizes up to ten feet in diameter, and in these many dead shells are found. At the bottom of a fissure in the limestone or under a cliff at the base is generally found a grave-yard of these shells, often several bushels in the space of a few feet. Fresh shells are more uncommon. As the woods are here all connected more or less, no attempt was made to keep the colonies separate, but from a study of these dead shells it would probably be easy to distinguish a number. About twenty different hills were explored from the base to the top, besides the caves and sink noted above, and many specimens were taken from small exposures and stone piles in the cleared ground. The elevation of the road at Somerset is about 2,200 feet above sea level, and the hills rise for 200 or 300 feet more in some cases.

HELICIDÆ.

Cepolis (Dialeuca) nemoraloides (C. B. Ad.).

Woods opp. Cedar Hill; Lower Santa Cruz road, about 3 miles southwest of Mandeville.

Cepolis (Dialeuca) conspersula (C. B. Ad.).

Somerset.

Cepolis (Hemitrochus) graminicola (C. B. Ad.).

Benmore, Mandeville; roadsides about 3 miles north and east of Mandeville; Cedar Hill; Santa Cruz road, common all along the road; Somerset road; Somerset.

Pleurodonte bainbridgei (Pfr.).

Cedar Hill, woods near King Edward's Hotel, Garrett's woods, ridge near Lincoln, and at Somerset. The pale variety *pretiosa* was not found.

Pleurodonte acuta goniasmos ('A. D. Brown' Pils.).

Kendal road, 3–3½ miles northwest of Mandeville; near Bloomfield; woods at Benmore Hotel and King Edward's Hotel, Mandeville; Cedar Hill; Garrett's woods; Santa Cruz road, 2–4 miles out; Somerset road, 2 miles out; ridge near Lincoln; Somerset.

The form from Somerset is rather large, resembling figures 60, 62, 63, 64 of plate 26, *Manual of Conchology,* V, though neither of those figures is wholly like the prevalent type.[4]

The form from other localities mentioned is smaller and higher. It has not been illustrated, though abundant and well known, but plate 26, fig. 59 of the *Manual,* Vol. V, somewhat resembles it. *Helix*

[4] Figures 59, 63, 64 of plate 26 of the *Manual,* Vol V, do not represent *P. nobilis* C. B. Ad., which Pilsbry had not correctly identified at the time that volume was written. Figures 5, 59, 60, 62, 63, 64 of that plate are all forms of *goniasmos,* of which *nannodonta* A. D. B. is merely a form.

abnormis Pfr. was apparently based on a pathologic individual of this small race. The forms of *P. acuta* from this region will be considered in a later paper by one of us.

Pleurodonte acuta acuta (of which *lamarckii* Fér. and *acutissima* Lam. are absolute synonyms) is found near the coast, at Swift River, and in a less typical form around to Bowden.

Pleurodonte sinuata (Müller).

Kendal road, 3½ miles north of, and Benmore and Bloomfield in Mandeville; woods at King Edward's Hotel and opposite Cedar Hill, Garrett's woods, Santa Cruz road, 2–4 miles southwest of Mandeville; ridge near Lincoln; Somerset. Found everywhere, in some abundance, living under stones and leaves, in the woods.

Pleurodonte anomala (Pfr.).

Found with *P. sinuata*, probably everywhere, but not taken at Bloomfield or Cedar Hill woods.

Pleurodonte picturata (C. B. Ad.).

Kendal road, about 3½ miles northwest of Mandeville. Only three bleached specimens of the small form, diam. 22 mm.

Pleurodonte cara (C. B. Ad.).

Somerset.

Pleurodonte peracutissima (C. B. Ad.)

Bloomfield and Benmore, Mandeville; wood near King Edward's Hotel; Kendal road about 2 miles north of Mandeville, in stone walls; woods opposite Cedar Hill; Garrett's woods, Santa Cruz road, 2–4 miles southwest of Mandeville; ridge near Lincoln; Somerset road; Somerset, abundant.

Pleurodonte (Dendrocochlis[5]) aspera (Fér.).

Found at all the localities visited; very abundant everywhere even in the town. Arboreal.

Pleurodonte (Eurycratera) jamaicensis (Gmel.).

Found at all the localities, but larger and more abundant westward of Mandeville, towards Somerset and Lincoln. Terrestrial, living in holes in the rocks.

Zaphysema macmurrayi (C. B. Ad.).

Bloomfield, Mandeville; Garrett's woods; ridge near Lincoln; Somerset.

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[5] *Dendrocochlis* n. subg. for *aspera* and *cognata*, the former type of the subgenus

Zaphysema tunicata (C. B. Ad.).

Woods opposite Cedar Hill, near Mandeville; Kendal road; ridge near Lincoln; Somerset.

This is *Helix tumida* Pfr. not Gmelin.

Zaphysema tenerrima (C. B. Ad.).

Woods opposite Cedar Hill; Somerset.

Proserpinula margaritella n. sp.

Wesley Mount Church, near Williamsfield.

Proserpinula infortunata (Bland).

Helix infortunata Bld., Annals and Lyc. Nat. Hist. of N. Y., VI, 1854, p. 78; 1855, p. 149.

Woods opposite Cedar Hill, and at King Edward's Hotel; Somerset.

Bland in 1854 transferred this species from *Proserpina* to *Helix* on the ground that in it the internal partitions are not absorbed, as they are in the *Proserpinidæ*. In 1855 he stated, on the authority of the Hon. Edward Chitty, that the animal "is the same as of *Helix*." Albers (*Die Heliceen*, 1860, p. 77) instituted the new group *Proserpinula* which he ranks as a subgenus of *Sagda*, placing in it the species *discoidea* C. B. Ad. and *opalina* C. B. Ad. (= *infortunata* Bld.). Tryon in Vol. II of the *Manual of Conchology*, p. 201, considers *Proserpinula* a section of *Zonites*.

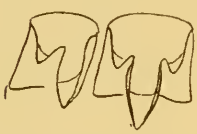

Fig. 2.—Central and lateral teeth of *P. infortunata*.

The radula of a decayed specimen we have examined was imperfect, only the central and lateral teeth being preserved. These are of the type found in *Thysanophora*, *Sagda* and *Zaphysema*. The central has a short, wide basal-plate, the mesocone projecting well beyond it, side cusps well developed. The laterals (at least 11 on each side) are similar but asymmetrical by suppression of the entocone (Fig. 2).

P. infortunata is oviparous, the egg-capsules rather large, with calcareous shell.

Thysanophora turbiniformis (Pfr.).

Sterridge's place, 3 miles southeast of Mandeville; Lower Santa Cruz road; Somerset.

Thysanophora subpyramidalis (C. B. Ad.).

Woods opposite Cedar Hill; Lower Santa Cruz road; ridge near Lincoln, Somerset.

Thysanophora depressa (C. B. Ad.).

Benmore, Mandeville; Cedar Hill; Lower Santa Cruz road; Somerset road.

Thysanophora boothiana (Pfr.) ?.

Kendal road, 1 mile north of Mandeville; Cedar Hill; Sterridge's place; Lower Santa Cruz road; Somerset road; Somerset. The identity of this shell with the Cuban *T. boothiana* is doubtful, but it is apparently what Adams so identified.

Thysanophora anthoniana (C. B. Ad.).

Somerset.

Thysanophora epistyliulum (C. B. Ad.).

Woods at Benmore, Mandeville; woods opposite Cedar Hill; Somerset.

Thysanophora inconspicua (C. B. Ad.).

Near Mandeville.

Thysanophora diminuta (C. B. Ad.).

Near Mandeville; ridge near Lincoln.

Thysanophora dioscoricola (C. B. Ad.).

Near Mandeville.

Sagda jayana (C. B. Ad.).

Kendal road, 3½ miles north of Mandeville. Benmore and Bloomfield, Mandeville; woods at King Edward's Hotel; woods opposite Cedar Hill; Garrett's woods; Santa Cruz road, 2–4 miles southwest of Mandeville; ridge near Lincoln; Somerset.

The young shells at a certain stage are perforate. The two internal lamellæ were found constant in a large number opened. It is an extremely abundant species.

Sagda grandis n. sp.

Somerset.

Sagda connectens (C. B. Ad.).

Somerset.

Sagda alveare (C. B. Ad.).

Somerset and along roadsides near Mandeville.

Sagda foremaniana (C. B. Ad.).

Somerset; ridge near Lincoln.

Sagda simplex n. sp.

Somerset.

Sagda hollandi (C. B. Ad.).

Somerset.

BULIMULIDÆ.

Drymæus immaculatus (C. B. Ad.).

Garrett's woods; Somerset.

Oxystyla undata (Brug.).

Benmore, Mandeville, from trees in the garden, two large specimens, probably imported from Trinidad. It is not the well-known Jamaican form of *Oxystyla*.

ACHATINIDÆ.

Opeas micra (Orb.).

Wesley Mount Church near Williamsfield; Benmore, Mandeville.

Subulina octona (Brug.).

Benmore, Mandeville; Cedar Hill.

Leptinaria lamellata (P. and M.).

Benmore, Mandeville.

Leptinaria striosa abdita (Poey).

Benmore, Mandeville; Sterridge's place; Lower Santa Cruz road; Somerset road, 2 miles from Mandeville; Somerset.

Leptinaria robertsi Pils.

Cedar Hill; near Mandeville. No exact locality was hitherto known.

UROCOPTIDÆ.

Urocoptis ambigua (C. B. Ad.).

Wesley Mount Church, near Williamsfield; Kendal road, 3 miles north of Mandeville; Benmore, Mandeville; King Edward's Hotel, woods opposite Cedar Hill, Garrett's woods, Lower Santa Cruz road, near Mandeville; ridge near Lincoln; Somerset. Abundant throughout the region, on stone walls and stone piles in open woods, etc.

Urocoptis rosea (Pfr.).

Benmore, Mandeville.

Brachypodella gracilis (Wood).

Abundant around Mandeville, north and west, on walls along the roadsides; Kendal road, 3½ miles north of Mandeville; ridge near Lincoln; Somerset, on cliffs.

Spirostemma dunkeri (Pfr.).

Ridge near Lincoln, on rocks.

Spirostemma tenera (C. B. Ad.).

Near Mandeville.

Spirostemma mandevillensis n. sp.

Somerset road, 2 miles from Mandeville.

Anoma splendens ('Mke.' Pfr.).

Bloomfield, Mandeville; Somerset.

Anoma splendens citrina (C. B. Ad.).

Williamsfield road, 2 miles south of Williamsfield; Garrett's woods; near Mandeville; Somerset road; Somerset.

Anoma alboanfractus paivana (Pfr.).

Somerset.

Microceramus gossei (Pfr.).

Wesley Mount Church, 1 mile south of Williamsfield; Benmore, Mandeville; Sterridge's place, 3 miles southeast of Mandeville; Santa Cruz road; Somerset. Everywhere abundant along roadsides and walls.

OLEACINIDÆ.

Varicella philippiana elegans (C. B. Ad.).

Garrett's woods, near Mandeville; ridge near Lincoln; Somerset.

Varicella venusta (Pfr.).

Somerset.

Varicella procera (C. B. Ad.).

Ridge near Lincoln; Somerset.

Varicella mandevillensis Pils.

Somerset road, 2 miles northwest of Mandeville; Sterridge's place, about 3 miles southeast of Mandeville; also from roadsides north and east of Mandeville.

Varicella blandiana (C. B. Ad.).

Benmore, Mandeville; woods at King Edward's Hotel; Santa Cruz road, about 3 miles southwest of Mandeville; Somerset.

Varicella proxima (C. B. Ad.).

Woods opposite Cedar Hill.

Varicella dissimilis Pils.

Somerset.

Varicella near **clappi** Pils.

Bloomfield, Mandeville. A single imperfect specimen.

Varicella cochlidium Pils.

Wesley Mount Church, near Williamsfield, and along the road toward Mandeville.

Varicella rapax n. sp.

Somerset.

Varicella similaris sloaneana Pils.

Kendal road, 3 miles north of Mandeville.

Spiraxis mirabilis C. B. Ad.

Somerset.

Spiraxis procerus (C. B. Ad.).

Benmore, Mandeville.

Spiraxis parallelus Pils.

Somerset; woods at King Edward's Hotel, near Mandeville.

Spiraxis læviusculus C. B. Ad.

Near Mandeville.

Spiraxis perplexus C. B. Ad.

Near Mandeville; Somerset.

Spiraxis terebella C. B. Ad.

Near Mandeville.

Pseudosubulina problematica Pils.

Near Mandeville.

ZONITIDÆ.

Guppya gundlachi (Pfr.).

Near Mandeville. The generic synonyms are as follows:

Guppya Mörch, Journ. de Conchyl, XV, 1867, p. 256, for *Conulus vaccus* [*vacans*] Guppy.
Habroconus Fischer et Crosse, Miss. Sci. Mex., Moll. (1878), I, pp. 154, 171. Type *Helix selenkai* Pfr.
Ernstia Jousseaume, Mém. Soc. Zool. France, II, 1889, p. 250, for *Ernstia ernsti* Jouss.

LIMACIDÆ.

Agriolimax sp. undet.

A single shell not unlike *A. agrestis* was picked out of dirt collected near Mandeville.

SUCCINEIDÆ.

Succinea latior C. B. Ad.

Kendal road 3 miles from Mandeville; Wesley Mount Church; Benmore, Mandeville; Cedar Hill; Sterridge's place; Lower Santa Cruz road; Somerset. It is found sparsely almost everywhere in the grass.

PUPILLIDÆ.

Bifidaria pellucida (Pfr.).

Near Mandeville.

Bifidaria servilis (Gld.).

Garrett's woods and elsewhere near Mandeville. A form with the teeth weak, the upper palatal plica very minute, basal plica absent or excessively weak.

Bifidaria rhoadsi Pils.

Near Mandeville. New to Jamaica. The specimens are smaller than the types from Miami, Florida, measuring, length 1.5, diam. .85 mm.

Vertigo (Bothriopupa) tenuidens C. B. Ad.

Around Mandeville and at Somerset. This species differs from *V. variolosa* of Florida by its rather more robust contour and strong upper palatal plica. Probably *Bothriopupa* will be removed from *Vertigo* on account of its long, entering parietal lamella; yet it does not seem to belong to *Bifidaria*.

VERONICELLIDÆ.

A species of *Veronicella* about 25 or 30 mm. long was seen under stones, but none were collected.

TRUNCATELLIDÆ.

Geomelania minor C. B. Ad.

Wesley Mount Church, near Williamsfield; Benmore, Mandeville; Somerset road and Somerset.

Geomelania gracilis (C. B. Ad.).

Wesley Mount Church, near Williamsfield; Bloomfield and Benmore, Mandeville; Somerset.

Geomelania elegans C. B. Ad.

Near Mandeville.

Geomelania (Scalatella) pygmæa (C. B. Ad.).

Neighborhood of Mandeville.

Geomelania (Scalatella) microglypta n. sp.

Near Mandeville.

CYCLOPHORIDÆ.

Aperostoma (Ptychocochlis) jamaicense (Sowerby).

Benmore, Mandeville; King Edward's Hotel, woods opposite Cedar Hill; Garrett's woods; Santa Cruz road, 2–4 miles southwest of Mandeville; two miles out the Somerset road; ridge near Lincoln; Somerset. Found everywhere.

Aperostoma (Ptychocochlis) varians (C. B. Ad.).

King Edward's Hotel, woods opposite Cedar Hill, Garrett's woods, Santa Cruz road, 2–4 miles west of Mandeville; 2 miles out the Somerset road; ridge near Lincoln; Somerset.

A single depressed, more widely umbilicate *Ptychocochlis* was found on the ridge near Lincoln. It probably represents another species.

ERICIIDÆ (CYCLOSTOMATIDÆ).

The Jamaican Cyclostomas differ from *Ericia elegans* of Europe by the form of the muzzle, which is deeply bifid at the end, not flattened and disk-like distally, as Fischer figures that of *E. elegans*. In creeping the muzzle takes no part, and is not applied to the ground except occasionally for the purpose of feeling. The foot is divided lengthwise by a median sulcus, only the two outer edges being in contact with the earth in crawling, which is effected by the passage of high narrow folds or waves from the tail forward alternately on the two sides, only one at a time on a side. The wave lifts free from the support, as shown in fig. 3, so that there is no sliding motion of the sole against the ground. Viewed from in front or behind the snail has an absurd appearance of striding along on stumpy legs. These observations were made on *Colobostylus jayanus rufilabris* (Ad.) and *Tudora armata* (Ad.)[5].

Fig. 3.—*Colobostylus jayanus rufilabris* (Ad.). Fig. 4.—Head of same, from above.

Colobostylus jayanus (C. B. Ad.).

Roadside north of Mandeville; ridge near Lincoln; Somerset.

Colobostylus jayanus rufilabris C. B. Ad. Figs. 3, 4.

Kendal road, 2 miles north of Mandeville, on stone walls; Benmore, Mandeville; woods at King Edward's Hotel; Somerset road, 2 miles northwest of Mandeville.

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[5] It may be of interest in this connection to quote Dr. Jousseaume's account of the walking of *Ericia elegans*. The foot is divided by a median line or raphe. "Pour avancer, l'animal glisse en avant l'une des moitiés artificielles de son pied et lorsqu'elle a dépassé l'autre du quart, plus au moins, de son longueur, elle s'arrête, pendant que l'autre moitié sort de son immobilité et s'avance à son tour, dépasse sa congénère que se remet alors en mouvement. Cette progression alternative se fait sans interruption; elle est continue comme dans les autres modes. Qu'on suppose un homme, les deux pieds dans un sac, avançant en glissant le pied droit, puis le pied gauche et ainsi de suite successivement et l'on aura une idée exacte de la progression d'un Cyclostome" (Bull. Soc. Zool. France, Vol. 34, 1909, p. 113).

Lives in rather open places, as in the crevices of stone walls, and in the edges of woods.

The foot is bluish-gray, tentacles, rostrum and eyes black.

Colobostylus banksianus (Sowb.).

Somerset road, 2 miles west of Mandeville; Somerset.

Annularia fimbriatula (Sowb.).

Bloomfield and Bennore, Mandeville; King Edward's woods, woods opposite Cedar Hill and Garrett's woods near Mandeville; Santa Cruz road, 2–4 miles from Mandeville.

The living snail is very handsome. The foot is flesh-pink, paler in front, shading to bright red behind in the region of the operculum; the whole flecked with opaque white; dorsal surface (neck) and front edge almost white. The tentacles are deep carmine, the rostrum grayish-fleshy with black spots and flecks, closer on the sides.

Adamsiella variabilis (C. B. Ad.).

Somerset.

Adamsiella ignilabris (C. B. Ad.).

Near Mandeville; Somerset; ridge near Lincoln.

Tudora fecunda (C. B. Ad.).

Somerset.

Chondropoma mordax (C. B. Ad.).

Roadsides near Mandeville.

Lives in the woods. It is very common near Mandeville but was not seen around Somerset.

Rhytidopoma fraterminor n. sp.

Wesley Mount Church, 1 mile south of Williamsfield.

HELICINIDÆ.

Helicina neritella Lam.

Roadsides about 3 miles northeast of Mandeville; woods opposite Cedar Hill and Santa Cruz road near Mandeville; Somerset. Abundant, living in the open.

Helicina jamaicensis Sowb.

Bloomfield, Santa Cruz road, and Somerset road, near Mandeville; Somerset. Abundant.

Stoastoma pisum (C. B. Ad.).

Fig. 5.—*S. pisum*.

Benmore and Bloomfield, Mandeville; Garrett's woods, crawling on stones; Lower Santa Cruz road, 3 miles from Mandeville;

The dentition of *S. pisum* (fig. 5) confirms the position of this genus in the *Helicinidæ*. The marginal teeth are simply hook-shaped and very numerous. The outer tooth of the middle field has no cusp. Other characters are sufficiently shown by the figure.

Stoastoma gouldianum C. B. Ad.

Near Mandeville.

Stoastoma (Fadyenia) grayanum (Chitty).

Near Mandeville.

Stoastoma (Petiti) cumingianum (C. B. Ad.).

Woods a\ King Edward's Hotel, 1 mile from Mandeville; Garrett's woods; Somerset.

Stoastoma (Petitia) fortuneanum (Chitty).

Near Mandeville.

Stoastoma (Metcalfia) chittyanum C. B. Ad.

Near Mandeville.

Alcadia major Gray.

Somerset, very abundant.

Alcadia palliata (C. B. Ad.).

Benmore, Mandeville; roadsides north and east of Mandeville; 2 or 3 miles out; Santa Cruz road, 2–4 miles southwest of Mandeville; Somerset road, 2 miles out; also at Somerset, very abundant.

Alcadia albolabris (C. B. Ad.).

Roadsides, 3 miles north of Mandeville, towards Williamsfield; Cedar Hill, 1 mile south of Mandeville; Somerset. Not common.

Alcadia hollandi (C. B. Ad).

Garrett's woods near Mandeville; ridge near Lincoln; Somerset road, 2 miles west of Mandeville; Somerset. Abundant.

Alcadia pusilla (C. B. Ad.).

Somerset road, 2 miles out from Mandeville; Somerset.

Eutrochatella pulchella (Gray).

Williamsfield road about 3 miles from Mandeville; woods at King Edward's Hotel; woods opposite Cedar Hill, and Garrett's woods, near Mandeville; ridge near Lincoln; Somerset. Found crawling on rocks in the woods, not found copiously, but generally distributed around Mandeville.

Eutrochatella pulchella is transparent whitish, the rostrum and sides of foot maculated and dotted with black, tentacles clear whitish, eyes at their outer bases. It glides with the distal disk of the short muzzle in contact with the ground. When travelling on a dry table it sometimes raised the forward part of the foot.

The name *Trochatella* being preoccupied by Lesson, Fischer in 1885 proposed to substitute *Eutrochatella*, type *T. pulchella.*

The Cuban group of large species has been called *Hapata* by Wagner in his monograph in the *Conchylien Cabinet* now appearing, but it should bear the name *Viana* (type *Helicina regina* Morelet), the references being as follows:

Viana H. and A. Adams, *Genera of Recent Mollusca* II, p. 305, March 1856, for *regina* and *sagra.*

Hapata Gray, *Annals and Magazine of Natural History* (2 Ser.), XVIII, November 1856, p. 414. Monotype *Helicina regina* Morel.

Rhynchocheila Shuttleworth, *Notitiæ Malacologicæ* II, 1878, p. 15. Monotype *H. regina* Morel.

Lucidella aureola (Fér.).

Mt. Wesley Church near Williamfield; Bloomfield and other places within a mile of Mandeville; Santa Cruz road; Somerset, on shady stone walls.

Lucidella undulata Pfr.

Roadsides a mile north of Mandeville; Benmore and Bloomfield, Mandeville; Sterridge's place, about 3 miles southeast of Mandeville; Cedar Hill; Santa Cruz road, 2–4 miles southwest of Mandeville; ridge near Lincoln; Somerset road 2 miles west of Mandeville; Somerset.

Very variable in sculpture, often found in mossy places on stone walls; larger in shaded places.

Lucidella adamsiana Pfr.

Benmore and Bloomfield, Mandeville; King Edward's Hotel, and Somerset road, near Mandeville; Somerset.

Lucidella lineata (C. B. Ad.) (*L. nana* Pfr.).

Benmore and King Edward's Hotel, Mandeville.

PROSERPINIDÆ.

Proserpina nitida Gray.

Benmore, Mandeville; King Edward's woods, woods opposite

Cedar Hill, Garrett's woods and Lower Santa Cruz road, near Mandeville; ridge near Lincoln; Somerset.

Descriptions of New Species.

Zaphysema buddiana avus n. subsp.

The shell has the sub-globular, somewhat depressed shape of *Z. buddiana*, but is very much larger with about the same number of whorls. The spire is low and very obtuse. The surface, where unworn, shows delicate and rather close punctation, as in the typical form.

Alt. 24, diam. $30\frac{1}{2}$ mm.; whorls $4\frac{1}{3}$.
" 25, " 30 " " $4\frac{1}{2}$.

Westmoreland. Types No. 795, A. N. S. P., collected by W. J. Holland, and received with the A. D. Brown collection.

Proserpinula margaritella n. sp. Fig. 6.

The shell is subdiscoidal, biconvex; thin, polished, very faintly marked with minute growth-lines. Spire low, convex. Whorls 4,

Fig. 6.—*Proserpinula margaritella.*

moderately convex, joined by a distinctly impressed suture, the last rounded peripherally, the base depressed, deeply sunken at the axis, though there is no true umbilicus. The aperture is slightly oblique, of a broad, depressed lunate shape. Peristome simple, the outer lip evenly arcuate; basal margin straightened, columellar margin very short and arcuate; not thickened. Central callus very small and extremely thin. There is no perceptible internal callus and no teeth or lamellæ. Alt. 1.75, diam. 3.8 mm.

Wesley Mount Church, one mile south of Williamsfield. Types No. 101,430, A. N. S. P., collected by Dr. A. P. Brown, 1910. Other specimens were taken in the neighborhood of Mandeville, exact locality not noted.

This species is related to *P. discoidea* (C. B. Ad.), but it differs by the comparatively wider spire and much narrower last whorl (as seen in a dorsal view), and the smaller size, a specimen of *T. discoidea* with $3\frac{1}{2}$ whorls measuring 6 mm. in diameter.

Sagda grandis n. sp. Figs. 7, 8.

The shell is large, solid and high, the diameter not much exceeding the height; white under a very thin pale yellow cuticle. The spire is dome-shaped above; whorls about $9\frac{1}{2}$, somewhat convex, the first $1\frac{3}{4}$ nearly smooth, several following whorls densely and regularly sculptured with fine, close, slightly curved, retractive striæ, but on the last two whorls they become almost obsolete; on the later whorls, especially the last two, a secondary sculpture of extremely minute vertical and slowly ascending spiral threads appears. On the base this is wanting; and denuded shells show traces of it like an extremely fine fabric pressed into plastic clay. The last whorl in front view is double the width of the preceding, is rounded peripherally, rather convex on the base, and rather deeply excavated around the axis. Aperture of the usual lunate shape. The basal lamina varies from

Figs. 7, 8.—*Sagda grandis*. Fig. 9.—*Sagda spei*.

$\frac{1}{2}$ to one whorl long and is very high. It revolves at or barely within the greatest convexity of the base. The columellar lamella is either entirely wanting or low, blunt and weak, high on the axis.

Alt. $26\frac{1}{2}$, diam. $28\frac{1}{2}$ mm.
" 26 , " 29 "

Somerset, Manchester. Types No. 100,883, A. N. S. P., collected by Dr. A. P. Brown, May, 1910.

This fine *Sagda* is one of the largest of the genus. It occurs with *S. jayana* (C. B. Ad.) from which it differs by (1) the weakness or absence of a columellar lamella (2) the position of the basal lamella, which revolves decidedly nearer the center than in *S. jayana*. (3) the apical whorls, which are distinctly larger in *grandis* than in *jayana*

(4) the secondary microscopic sculpture of *S. grandis,* resembling a woven fabric.

This may be the form which C. B. Adams mentions (*Contrib. to Conch.*, p. 173) as a large form of *Helix epistylium,* but it is not the species so named by Müller. Thirty specimens were taken.

Probably C. B. Adams' *Helix epistylium* var. *minor* from Westmoreland (*Contrib. to Conch.*, p. 173) will prove to be a distinct species which will be called *Sagda minor* (C. B. Ad.).

The var. *delaminata* of the same author (t. c., p. 174) from Easington in the district of St. Davids is perhaps another distinct species, but it has been very inadequately described.

Sagda spei n. sp. Fig. 9.

The shell is of moderate size, solid, elevated, the height about 85 per cent. of the diameter, white under a thin pale brown-tinted cuticle; quite glossy. The spire is broadly dome-shaped above. Whorls about 8, moderately convex, the first 1½ nearly smooth, the rest sculptured with fine, slightly curved, retractive striæ, which in large specimens are usually weaker on the last whorl. Under a strong lens very feeble traces of granulation are barely perceptible in places between the striæ on the last whorl. The last whorl in a front view is more than twice the height of the preceding whorl. It is convex beneath and moderately excaved in the center. The aperture is lunate. The basal lamella is about a half whorl long, well developed, and revolves at the point of greatest convexity of the base. The columellar lamella though distinct is very small.

Alt. 18, diam. 21.3 mm.; whorls 8.
" 16, " 19.5 " " 7½.

Hope River region, the types from Hall's Delight, St. Andrew, No. 88,715, A. N. S. P.

This is a rather common snail eastward from Kingston. It differs from *S. jayana* (C. B. Ad.) by the rudimentary columellar lamella and by having the basal lamella situated further inward from the periphery. In the structure of the lamellæ it resembles *S. grandis* P. and B., from which it differs by the greater height of the last whorl, the totally distinct secondary sculpture, and the smaller apical whorl. *S. connectens* has the basal lamella more peripherally situated, and the spire is much lower. *S. alveare* (Pfr.) has a more conic spire and lower last whorl, but in the collection of the Academy numerous lots of this species were so labelled.

Sagda epistyloides Fér. is, according to the original figures, a shell of about the size of *S. spei*; but it is represented as far more coarsely sculptured. We have seen no *Sagda* agreeing with Férussac's figures.

One of us found many long-dead shells of *S. spei* in a thicket on the western slope of Long Mountain at Rockfort. The shells are small and low but otherwise agree with the types. Two apparently adult examples measure:

Alt. 13, diam. 17.5 mm.; whorls $7\frac{1}{2}$.
" 12, " 16 " " 7.

Sagda anodon n. sp.

The shell is imperforate, rather thin, the height usually about three-fourths the diameter; white under a thin smooth pale yellow cuticle. Spire convexly low conic, the apex projecting slightly. Whorls about $6\frac{1}{3}$, slightly convex very slowly increasing, irregularly, rather weakly striate. The periphery is broadly rounded. Base convex, excavated in the center. Aperture lunate, without internal lamellæ.

Alt. 9.8, diam. 13.8 mm.
" 9.5, " 13 "
" 8.5, " 13.3 "

Rockfort, near Kingston. Types No. 101,137, A. N. S. P., collected by Dr. A. P. Brown, May, 1910.

The type lot consists of "dead" shells. A fresh one, not quite mature, collected at Rockfort by Mr. Wm. J. Fox, supplied the item of color. It is possible that this shell is the *Helix epistylium* var. *delaminata*, very inadequately described by Professor C. B. Adams, from Easington, St. Davids, a place some distance east from Rockfort.

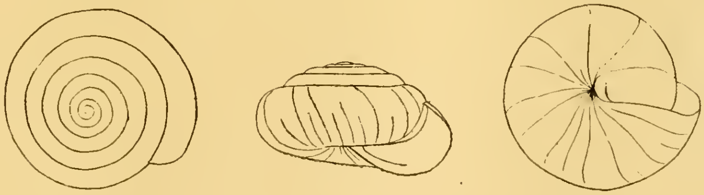


Fig. 10.—*Sagda simplex.*

Sagda simplex n. sp. Fig. 10.

The shell is imperforate, much depressed, the height slightly over half the diameter (56 to 57 per cent.); thin, white under a very thin, glossy pale yellowish cuticle. Spire convex, whorls $6\frac{1}{2}$ to $6\frac{3}{4}$, slightly convex, very slowly increasing, with weak sculpture of irregular growth-wrinkles. The last whorl is rounded peripherally, convex beneath, rather broadly but not deeply excavated around the axis. The aperture is lunate, the columellar margin thickened near and at its insertion in the center. There are no internal lamellæ.

Alt. 7.3, diam. 13 mm.
" 6.9, " 12 "
" 6.9, " 12.3 "

Somerset, Manchester. Types No. 101,140, A. N. S. P., collected by Dr. A. P. Brown, May, 1910.

This form is apparently what Professor C. B. Adams described as *Helix osculum* var. *delaminata;* but if so this name is barred by the prior *H. epistylium* var. *delaminata* C. B. Ad., which is probably a valid species. While the shell under consideration resembles *Sagda osculans* closely in form, it differs constantly, in a very large series collected in the Mandeville region, by the total absence of internal laminæ. The laminate *S. osculans* was not taken in this region. We have no evidence whatever that the two forms intergrade, and are decidedly of the opinion that both are distinct and valid species.

Spirostemma mandevillensis n. sp. Fig. 11.

The shell is pillar-shaped, the diameter contained 6 to 6½ times in the length, widest near the middle, tapering very slowly and slightly towards both ends; brown, rather dark when living; widely truncate above, the breach closed by a strongly convex plug. Whorls remaining are nearly flat, the last one shortly free in front, very strongly keeled, at the base, concave just above and below the keel. The sculpture is of fine, regular, extremely oblique retractive striæ, which are about as wide as their intervals. The aperture is small, its greatest length contained 6½ to 7½ times in the length of the shell, very oblique, obovate, being angular below, broadly rounded above. Peristome pale, continuous, narrowly expanded throughout. The internal axis is very slender, nearly straight in the upper whorls. It begins to be sinuous in the seventh, becoming progressively more broadly spiral from there to the last. In an obliquely basal view in the mouth a large false umbilicus is seen, about one-third as wide as the last whorl.

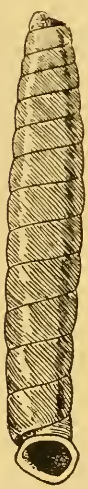


Fig. 11.

Length 14.3, diam. 2.2, length of aperture with peristome 1.9 mm.; whorls 12¾.

Length 13.3, diam. 2.25, length of aperture with peristome 2 mm.; whorls 12½.

Somerset Road, about two miles from Mandeville. Types No. 101,172, A. N. S. P., collected by Dr. A. P. Brown, 1910.

This species stands between *S. tenella* and *S. elatior* (C. B. Ad.). *S. tenella* is a paler, smaller and more delicate species, with the aperture less or not at all protracted. *S. elatior* is larger, more finely striate shell, with the axis gyrate in a greater number of whorls.

Varicella (Varicellula) rapax n. sp. Fig. 12.

The shell is lanceolate, slender, the length about $3\frac{1}{2}$ times the diameter, thin, corneous, glossy. The outlines of the spire are very slightly convex, nearly straight; apex obtuse. Whorls $6\frac{1}{2}$, moderately convex. The first $1\frac{1}{2}$ whorls are smooth; then narrow vertical impressed lines appear, faint and widely spaced at first, soon becoming deeper, the last four whorls sculptured with nearly regular vertical grooves parted by much wider convex intervals (or wide, very low, convex riblets parted by narrow grooves). On the face of the last whorl there are about 3 such riblets in one millimeter; they are a little more crowded on the last part of the whorl. They extend undiminished to the base. There are also a few very ill-defined slightly deeper varix grooves, two on the last, three on the penultimate whorl. The suture is margined by transparence. The aperture is lanceolate, quite narrow in the upper third, 40% the length of the shell. The outer lip arches well forward in the middle, retracting above and below. The columella is quite short, vertical, very obliquely truncate at its base. In basal view no "false umbilicus" is visible. Length 10.5, diam. 3, length of aperture 4.6 mm.

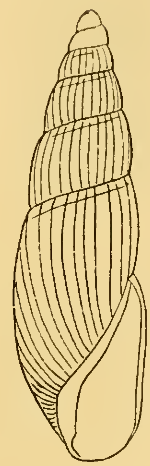


Fig. 12.

Somerset, Manchester. Type No. 101,421, A. N. S. P., collected by Dr. A. P. Brown, 1910.

This species resembles *V. puella* (C. B. Ad.) in form of the shell and columella, but differs from it by the very much coarser sculpture. *V. tenera* (C. B. Ad.) is a much more slender species, which approaches the new form in sculpture. *V. rapax* certainly differs from all of the numerous Varicellas described by C. B. Adams, the types of which have been redescribed and figured by one of us. Fresher specimens of *V. rapax* may perhaps show brown streaks along the indistinct varix-grooves.

Geomelania (Scalatella) microglypta n. sp. Fig. 13.

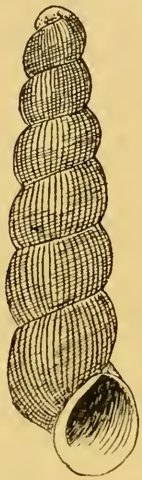


Fig. 13.

The shell is minutely rimate, slender, columnar, tapering very slowly to the obtuse (truncated) summit, grayish-white. $6\frac{1}{2}$ whorls remaining are very convex, the suture deeply impressed. Sculpture of longitudinal ribs somewhat wider than the intervals, and about .055 mm. from crest to crest, on the last two whorls; over the ribs and intervals run many fine spiral threads, of which there are about 36 on the penultimate whorl. The aperture is ovate, outer lip obtuse, expanded; in profile straight or slightly concave above the periphery, regularly arching forward at the lower outer portion. Length 4.1, diam. 1.1, length of aperture 1 mm.

Near Mandeville. Types No. 101,345, A. N. S. P., collected by A. P. and S. Brown, 1910.

In figure and size this species hardly differs from *G. pygmæa* C. B. Ad., but the sculpture is very much finer and closer.

Rhytidopoma fraterminor n. sp. Fig. 14.

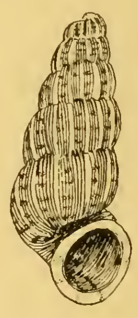


Fig. 14.

The shell is perforate, turrite, rather slender, thin, variable in color: dark reddish-brown, the striæ lighter, or pale yellow with vertical series of brown spots formed by the interruption of spiral bands, of which there are six on the last whorl, the next to the lowest one nearly continuous; or it may be uniform pale yellowish. In individuals retaining the spire the latter tapers regularly to the obtuse apex; but the early whorls are usually lost, leaving 5 to $5\frac{1}{2}$ in adult shells. Whorls $7\frac{1}{2}$, strongly convex, the last fourth of the last whorl descends, running free from the preceding whorl, separated from it at the aperture by a distance about equal to the width of the outer lip. The embryonic shell consists of 2 whorls, the first $1\frac{1}{2}$ smooth, the next half whorl minutely striate. After that sharp strongly raised, narrow striæ appear, arranged in groups of 3 or 4 on the third whorl, mostly by pairs on the next two whorls; after which the striæ are in groups of 4 or 5, the first one largest, the rest gradually diminishing. The groups are separated by plain spaces. On the last 3 or 4 whorls two or three larger striæ of each group become higher and lamellar near the suture above, where they project strongly.

Aperture oval, the inner outline less curved than the outer. Peristome thin, flatly reflexed, whitish with several brown spots, sometimes indistinct, wider on the outer and basal margins, and having a barely projecting inner rim.

Length 9.5, diam. 4 mm., width of outer lip .3 mm., 5½ whorls remaining.

Length 10, diam. 4.2 mm., apex entire.

Length 7, diam. 3.2 mm., 4½ whorls remaining.

Wesley Mount Church, near Williamsfield. Types No. 101,503, A. N. S. P., collected by Dr. A. P. Brown, 1910.

This species is closely related to *R. campbelli* (C. B. Ad.), but it is very much slenderer, less robust, with a much more slowly tapering spire and without the strong spiral cords in the umbilical region characteristic of *R. campbelli*. Seven specimens were taken, one having the spire entire.

The striæ are undulated in the darkest specimens, but not noticeable in the light ones.

CYCLOPHORIDÆ.

This family is represented by a single genus in Jamaica. There has been a good deal of uncertainty about the proper generic name for the group among the several following:

Aperostoma Troschel, Zeitschrift für Malakozoologie, IV, 1847, p. 44; *cf.* Pfeiffer, *t. c.*, pp. 44 and 104. Fischer, Manual de Conchyliologie, p. 744; and von Martens, Biologia Centrali Americana, Mollusca, p. 300 [type *C. blanchetianus*].

Crocidopoma Shuttleworth, Journal de Conchyl., V, 1857, p. 271 (for *C. floccosum* and *C. suturale*) [type *C. suturale*].

Playstoma Mörch, Malak. Blätter, VII, 1869, p. 66. Not *Playstoma* Meigen, 1803.

Neocyclotus Fischer et Crosse, Mission Sci. au Mexique, Moll., II, p. 148 [type *C. dysoni* Pfr.].

Ptychocochlis Simpson, Proc. U. S. National Museum, XVII, 1895, p. 431, type *Neocyclotus jamaicensis*.

Plectocyclotus Kobelt und Moellendorff, Cat. gegenw, Pneumonopomen, p. 138 (34) [type *C. jamaicense* Sowb.].

Aperostoma was proposed, as Fischer and Crosse have pointed out, for three very diverse species, belonging to as many genera; but Pfeiffer, in the same year commented upon this fact, and restricted the group to American Cycloti, giving a list of the species. This restriction was accepted by Fischer (1885) and by von Martens (1890). The genus *Neocyclotus* was therefore superfluous. *Crocidopoma* seems to us to be only a subgenus of *Aperostoma*, not a separate genus.

For the group of corrugated Jamaican species the subgeneric term *Ptychocochlis* Simpson should be used. *Plectocyclotus* Kob. et Mlldff. s an absolute synonym.

Ptychocochlis is a somewhat difficult group in the present condition of the literature. Chitty's monograph is not all that could be desired; yet his major grouping of the species by characters of the operculum is doubtless sound.

The species long known as "*jamaicensis* Chemnitz" is certainly not the Chemnitzian form, which was really *portlandensis* of Chitty. As Chemnitz was not binomial, this use of the name was of no effect. "*Cyclostoma jamaicensis*" next figured in the supplement of Wood's *Index Testaceologicus*, but the figure given defies identification, and may or may not represent the *jamaicensis* of Sowerby's *Thesaurus Conchyliorum*, where the first recognizable, though not very good, figures are given. We would therefore call the species *Aperostoma jamaicense* (Sowerby).

Aperostoma (Ptychocochlis) lacteofluviale n. sp.

The shell is umbilicate, the umbilicus contained $5\frac{1}{2}$ times in the diameter; rather depressed, the height two-thirds the diameter; solid, covered with a chestnut cuticle. The spire is low and small; whorls $4\frac{1}{3}$, very convex, very finely striate radially, the first $1\frac{3}{4}$ nearly smooth. Small waves then appear, at first radial in direction, but after $2\frac{1}{2}$ whorls they become strong, regular, protractive, not reaching either suture. After the first third of the last whorl the waves weaken and are replaced by ill-defined depressions longer in the spiral direction. At the periphery and base there are a few inconspicuous, coarse spirals. The basal keel is low, defined by a depression within, and sometimes with a few pits outside. The aperture is oblique, rotund, angular above, reddish-brown within, the lip whitish, outer and inner margins about equally curved. Alt. 10.5, diam. 16 mm.

The operculum is rather strongly concave outside, and bears a spiral lamella which makes 7 turns and terminates in a central pit as usual. At the outer whorls, the edge of this lamina is reflexed outwardly and flattened, almost meeting across the interval. Inside it is yellow and slightly convex. Diameter 5 mm.

Round Hill, Milk River, Clarendon, the types No. 101,193, A. N. S. P., received from Mr. George H. Clapp.

This is a species of Chitty's group 1, somewhat related to *A. notatum* Chitty, but distinct in sculpture, etc.

Aperostoma (Ptychocochlis) tryonianum n. sp.

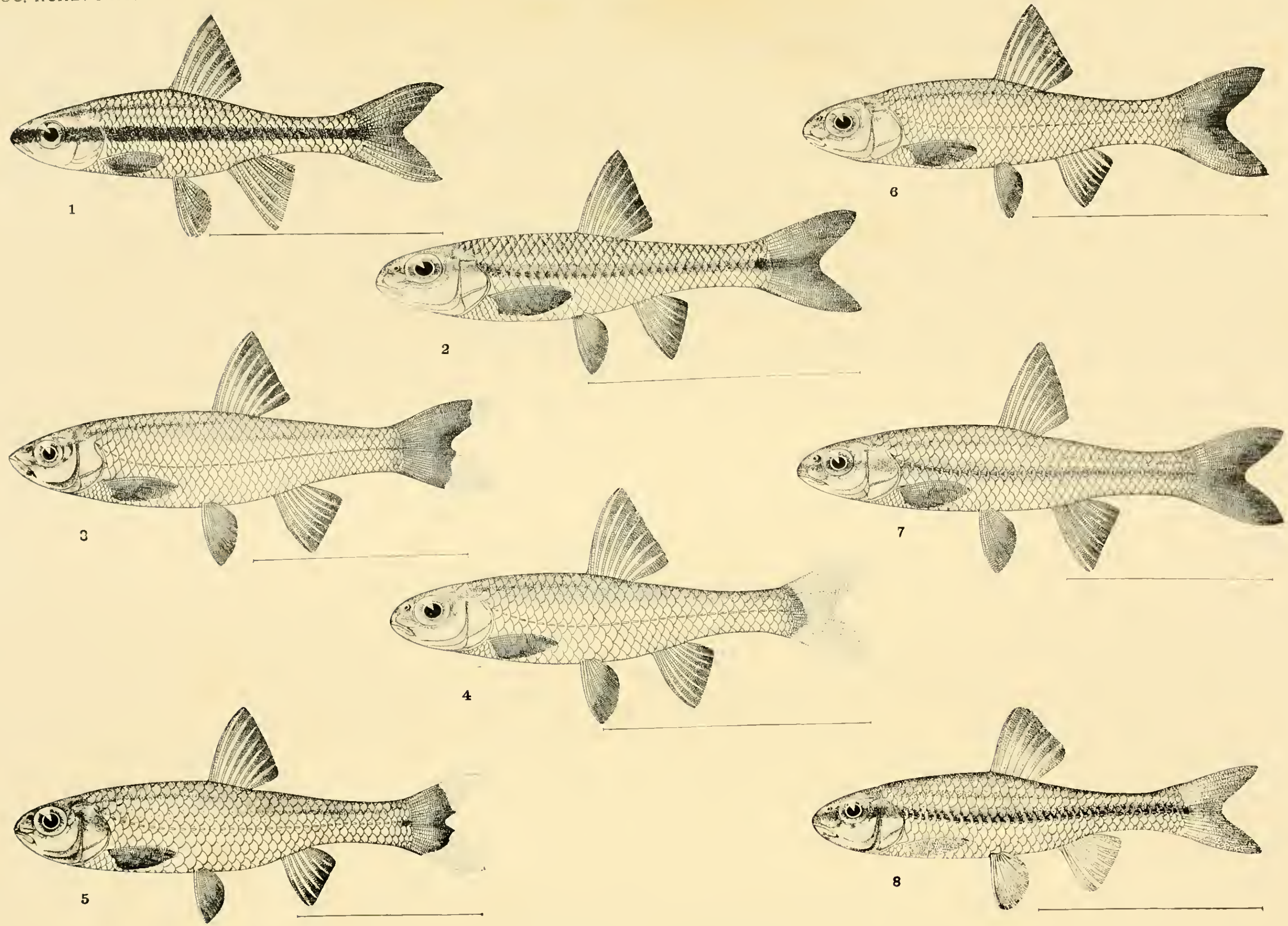
The shell is rather openly umbilicate, the diameter of the umbilicus half the width of the aperture; height about 70 per cent. of the diameter; white under a thin yellow cuticle which has a tendency to be deciduous in several narrow bands on the last whorl. Spire low-conic, the apex rather acute. Whorls $4\frac{1}{2}$, tubular, the first $1\frac{1}{2}$ nearly smooth, the rest having a sculpture of fine, close, thread-like radial striæ, closer and less regular on the last whorl. There is no trace of corrugation. The last whorl is rounded, with no trace of a keel or ridge on the base. Aperture nearly circular, not angular above, slightly oblique, the thin peristome in contact with the preceding whorl for a very short distance only.

Alt. 10, diam. 14 mm.

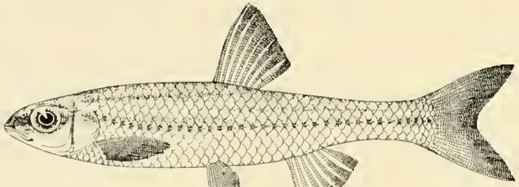
Operculum evenly and moderately concave outside, bearing a spiral lamina of fully 7 whorls outside of the central depression. This lamina flares broadly outward, leaving but a narrow space between the turns; and its outer end is not concrescent with the preceding turn. The inside is convex in the middle. Diameter 5 mm.

Jamaica. Type No. 101,141, A. N. S. P., from the G. W. Tryon collection.

A species of Chitty's group No. 1, apparently related to the small variety of *A. notatus,* but with no trace of a basal keel or corrugation.



FOWLER: NOTROPIS.



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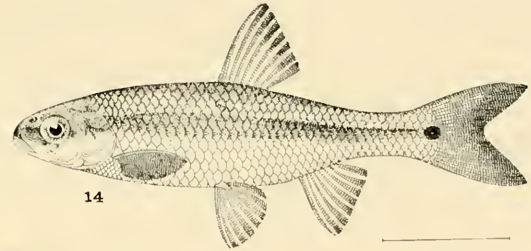

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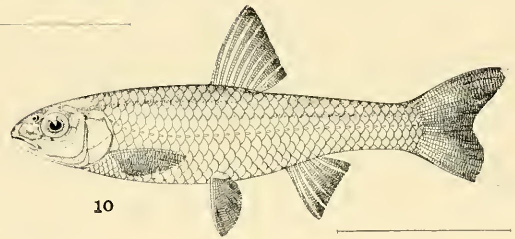

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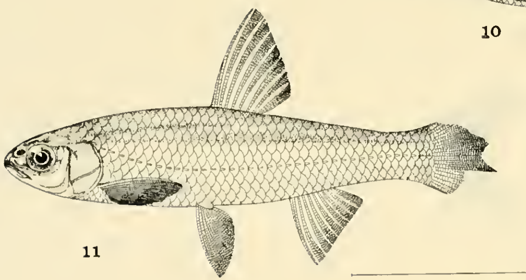

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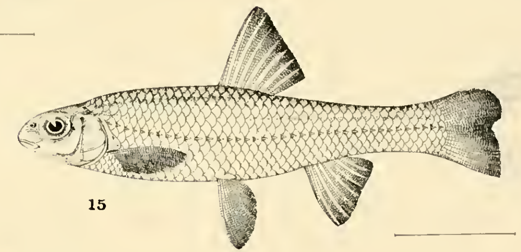

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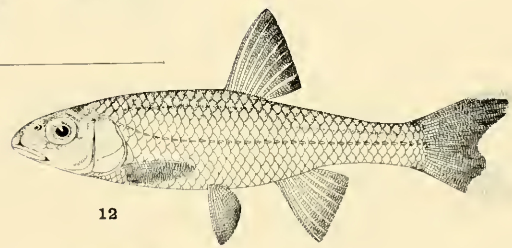

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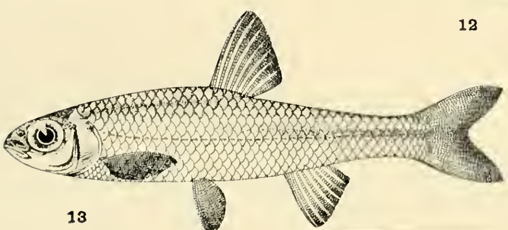

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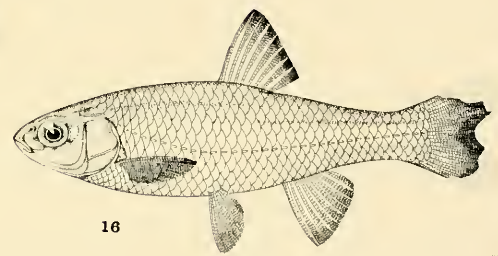

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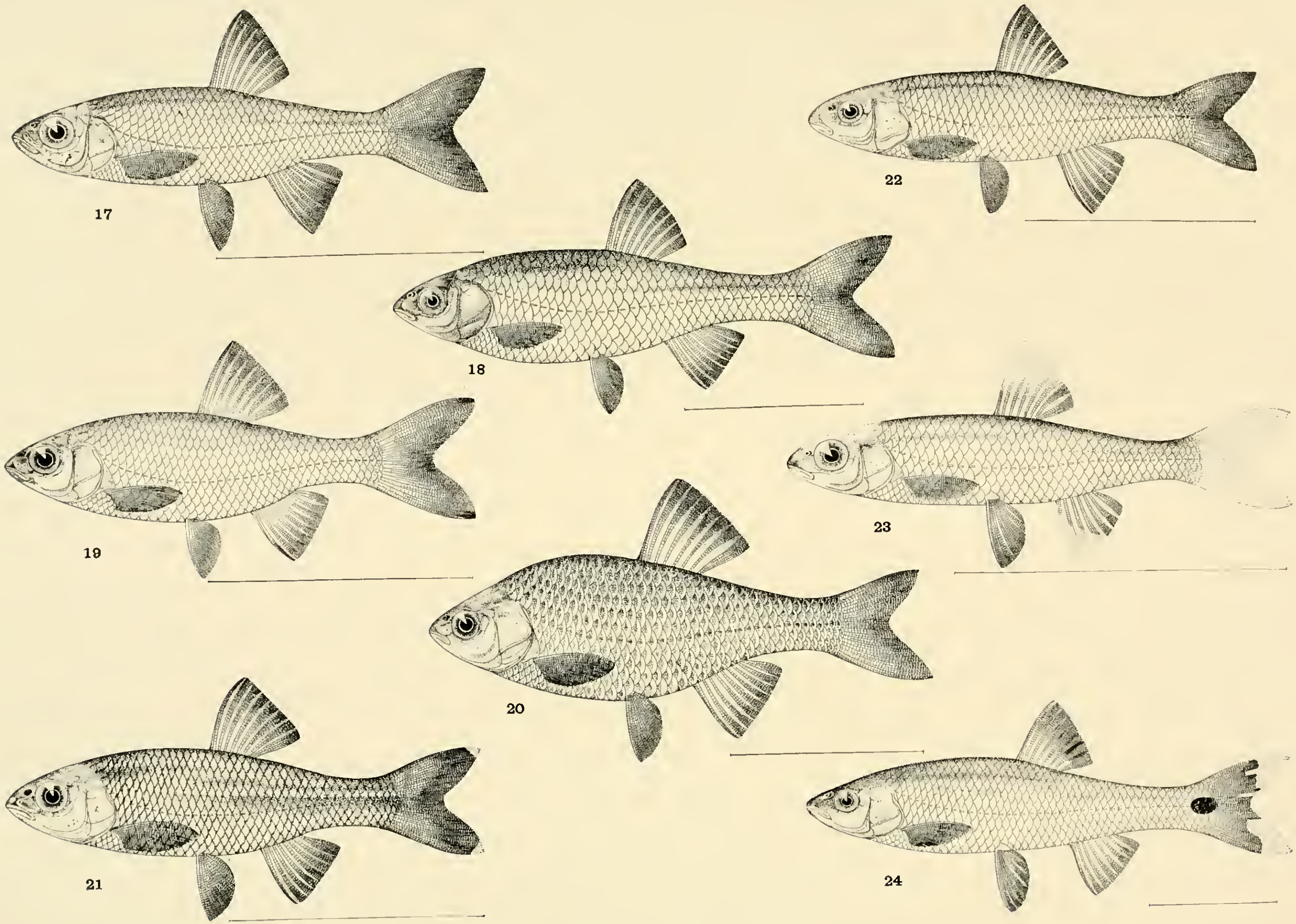

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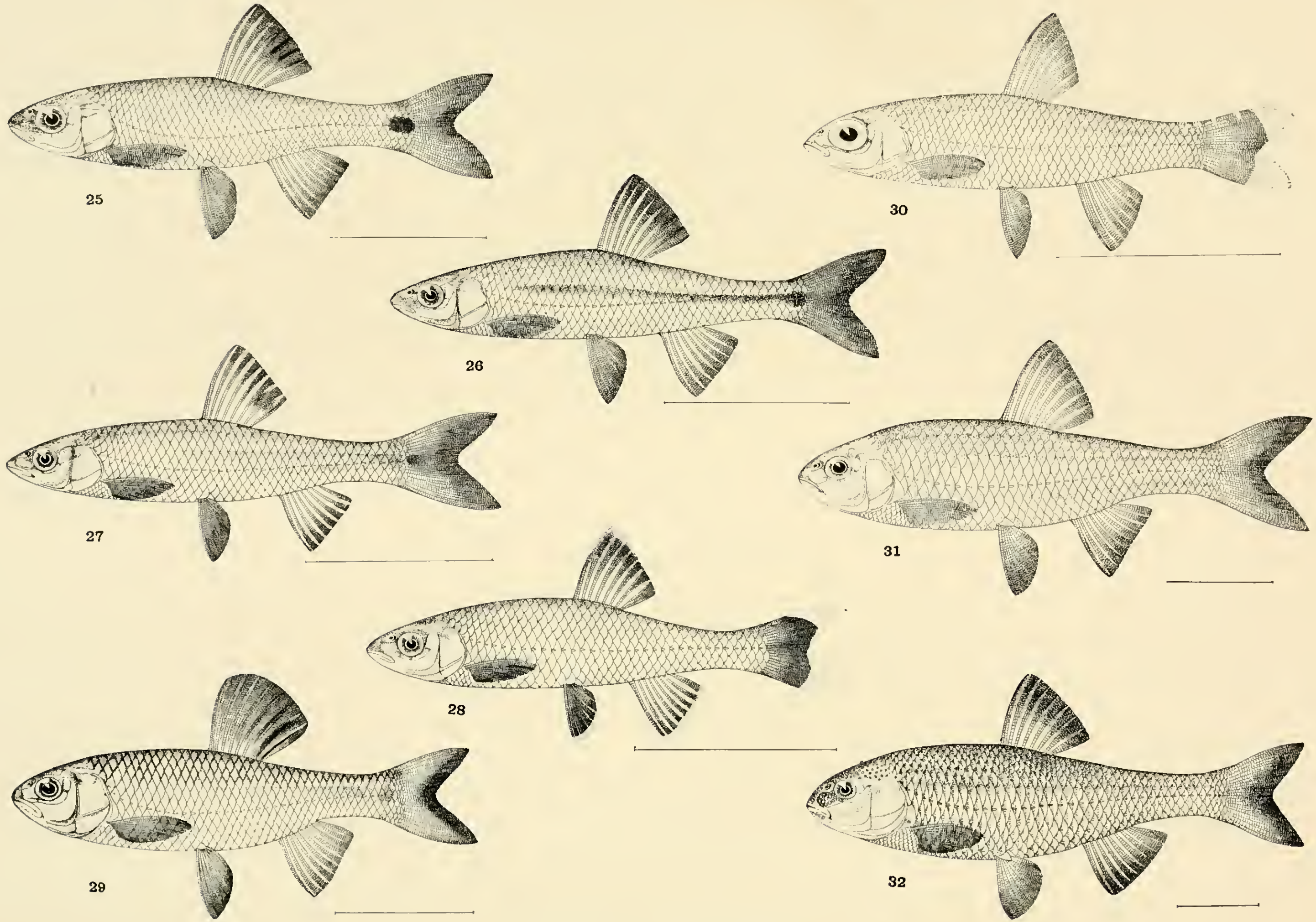

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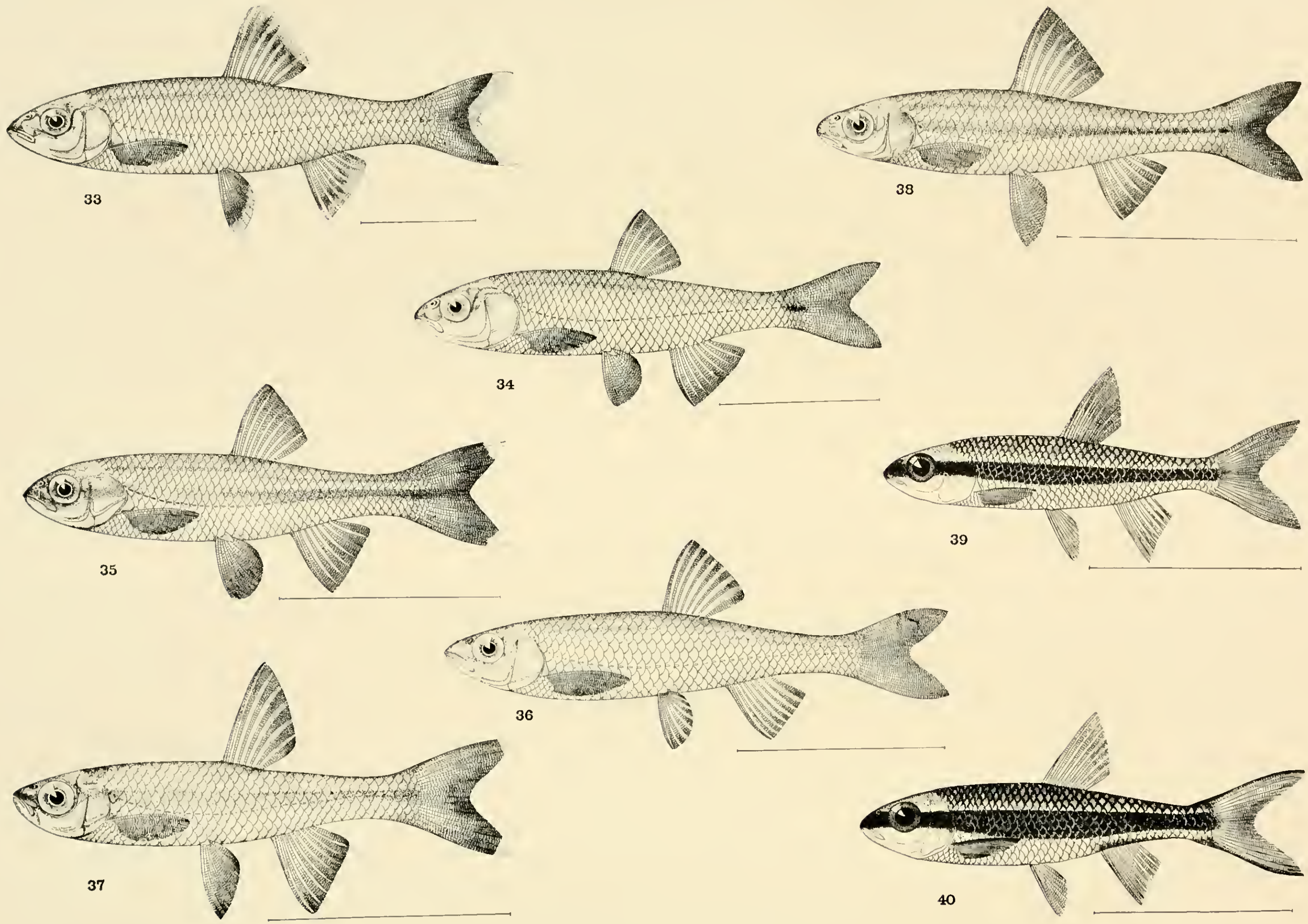

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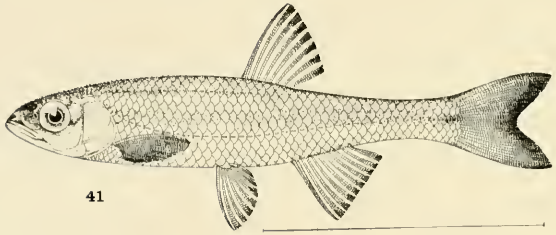

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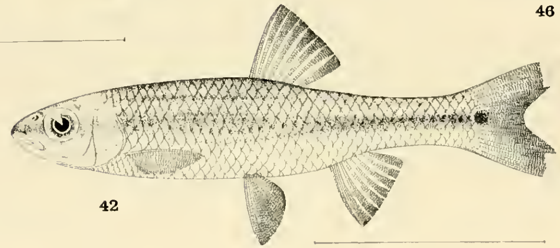

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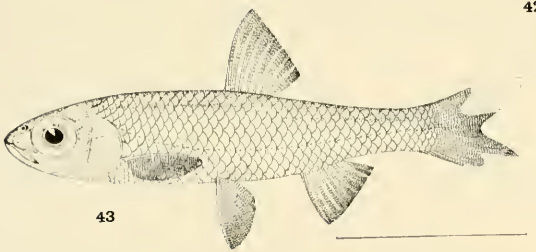

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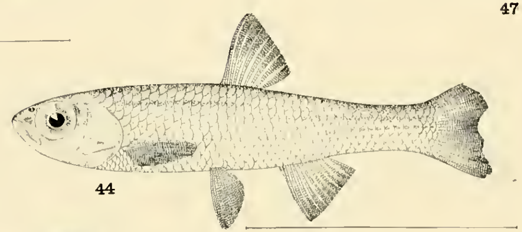

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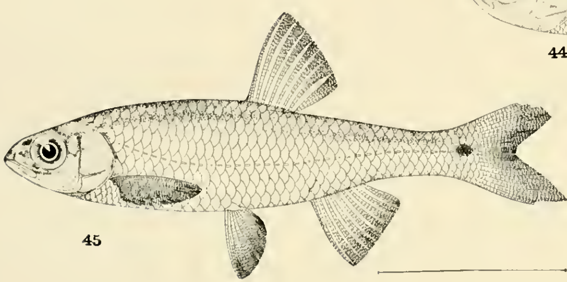

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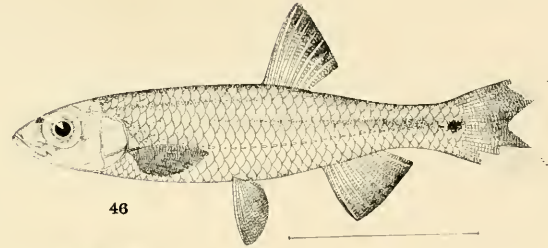

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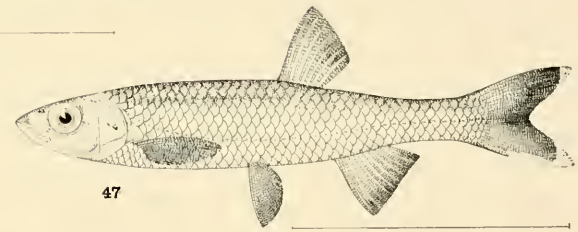

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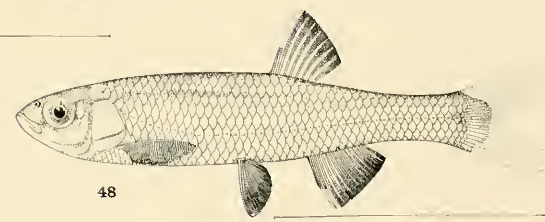

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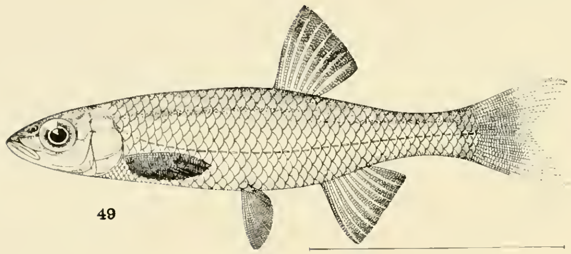
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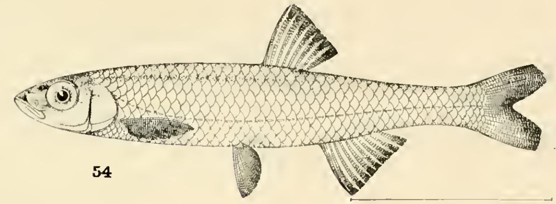
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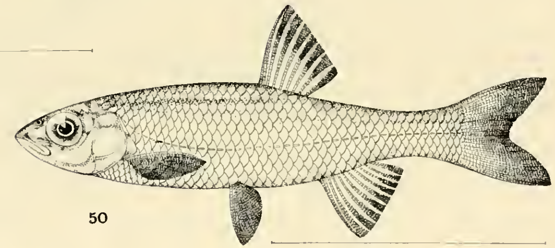
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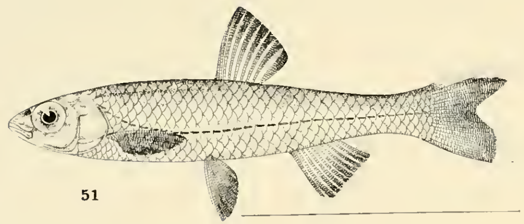
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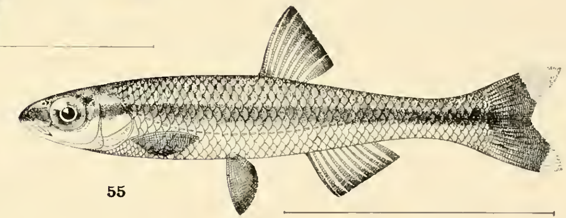
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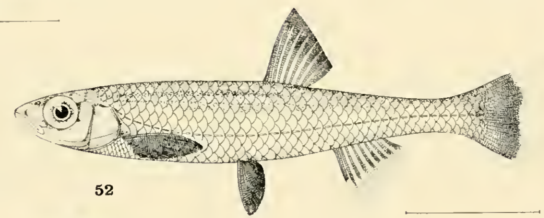
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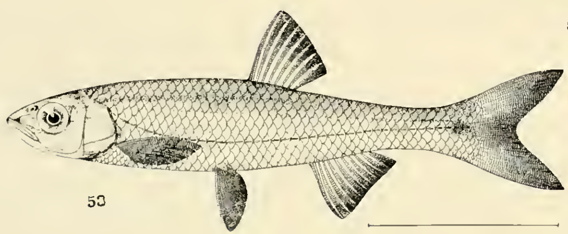
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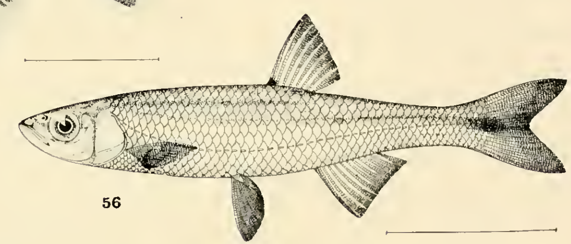
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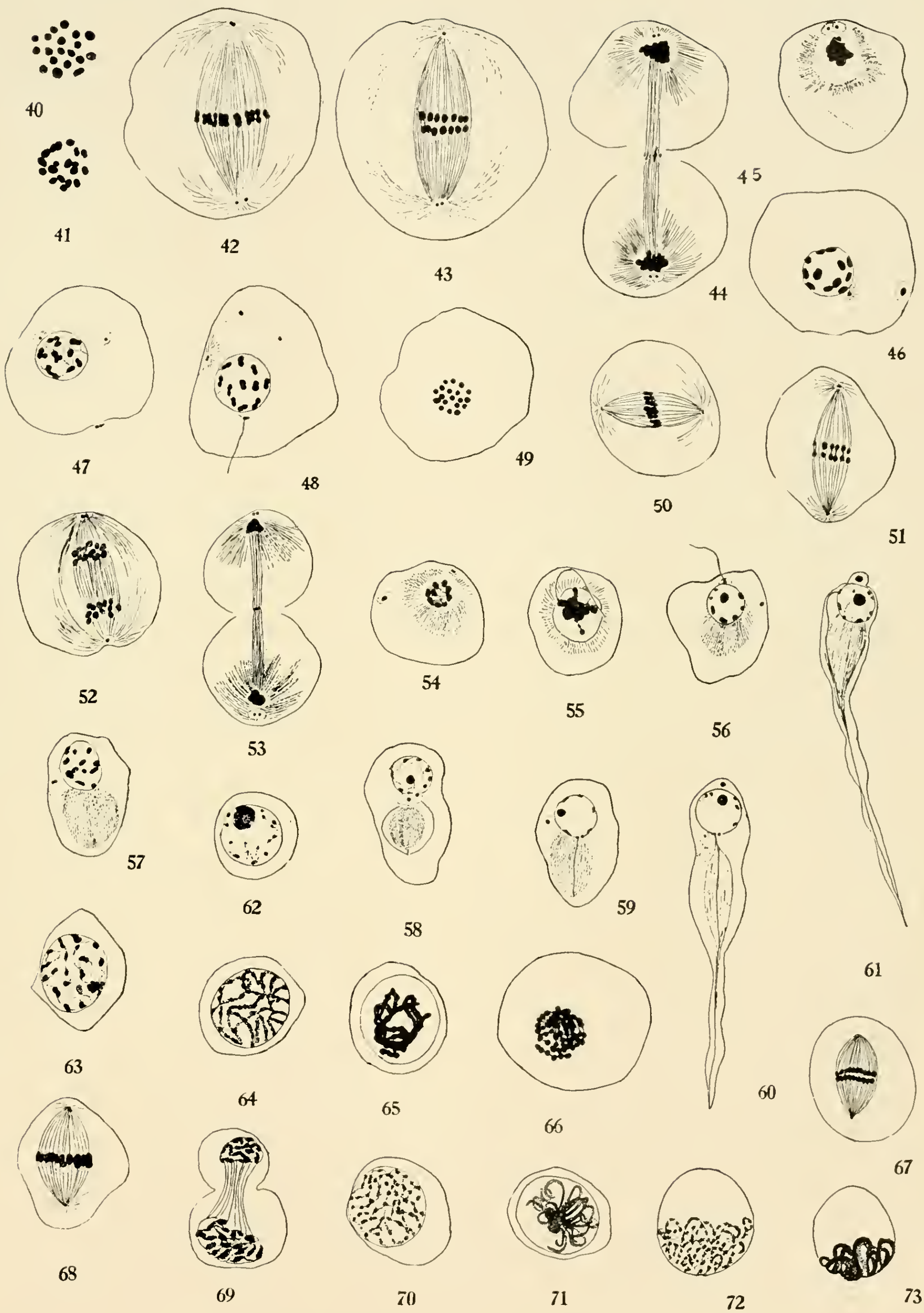
FOWLER: NOTROPIS.

COOK: SPERMATOGENESIS IN LEPIDOPTERA.



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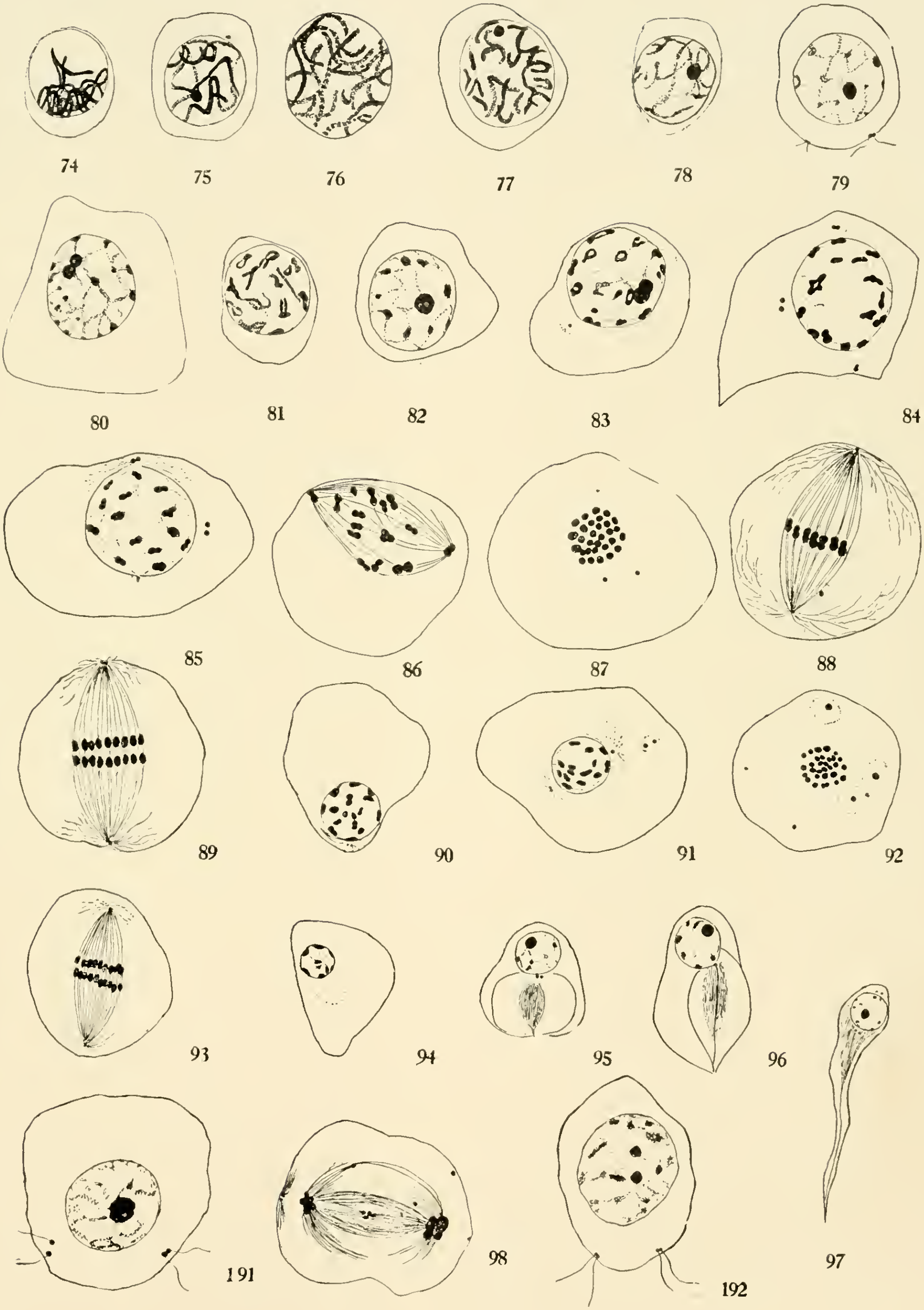

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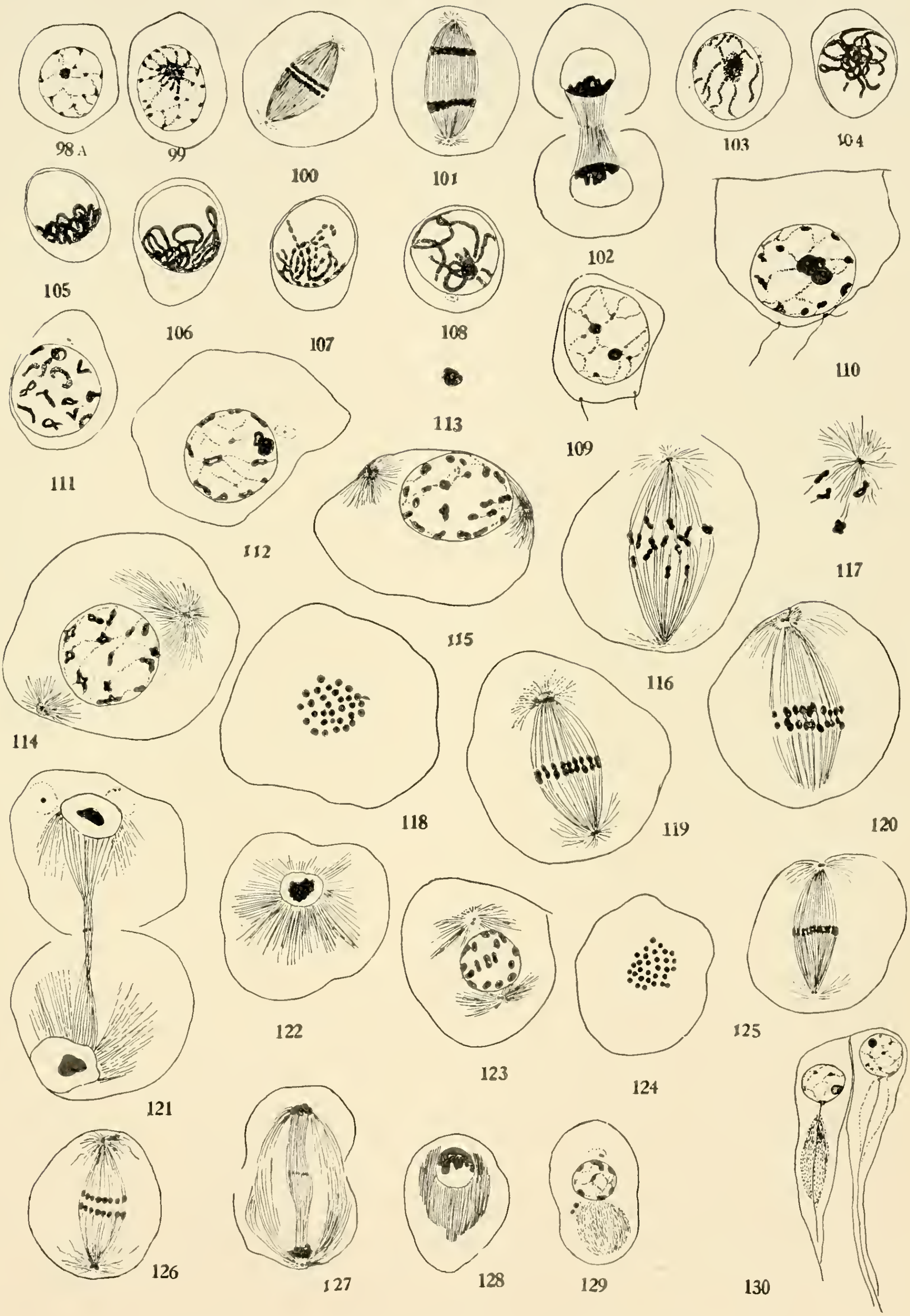

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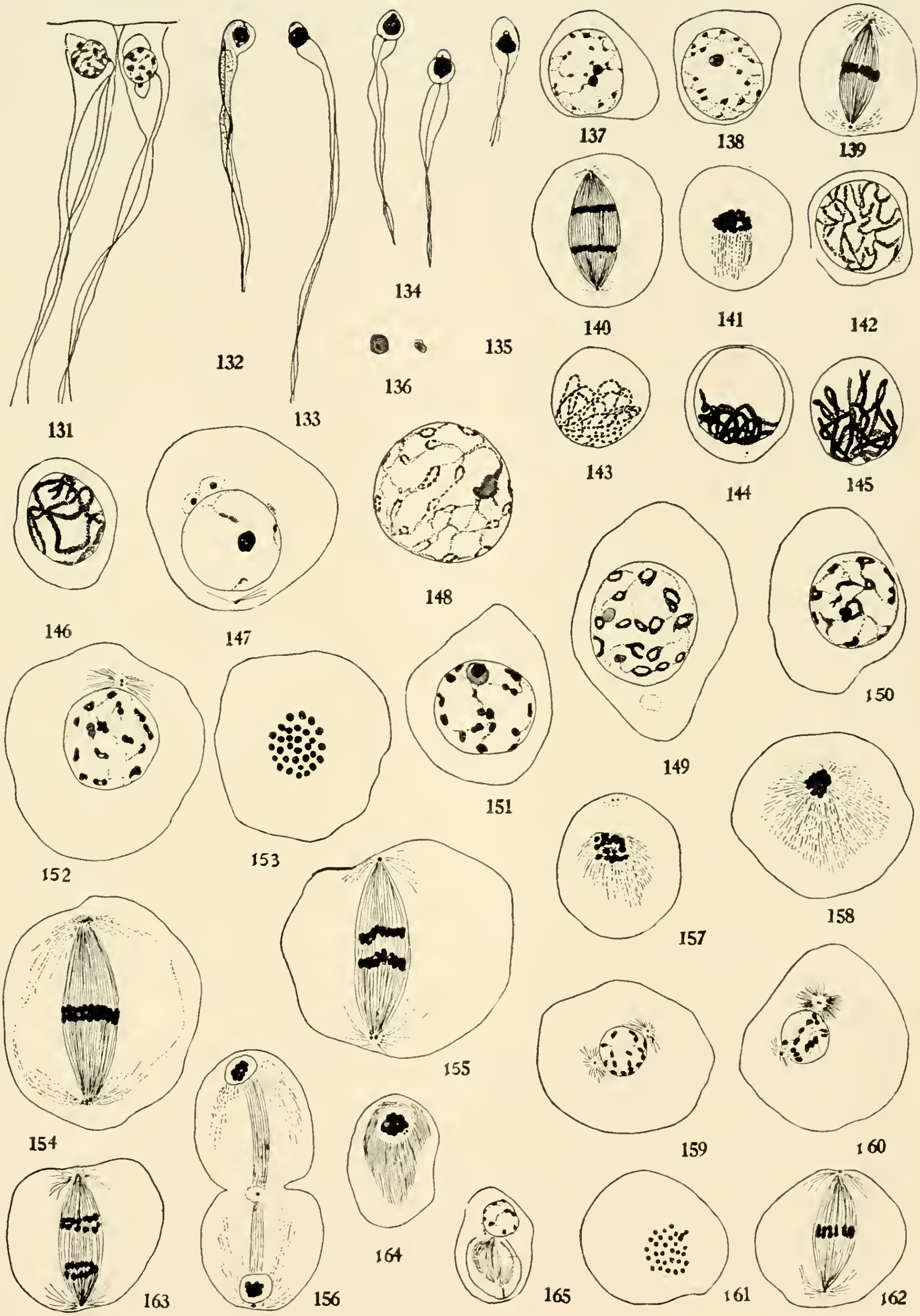

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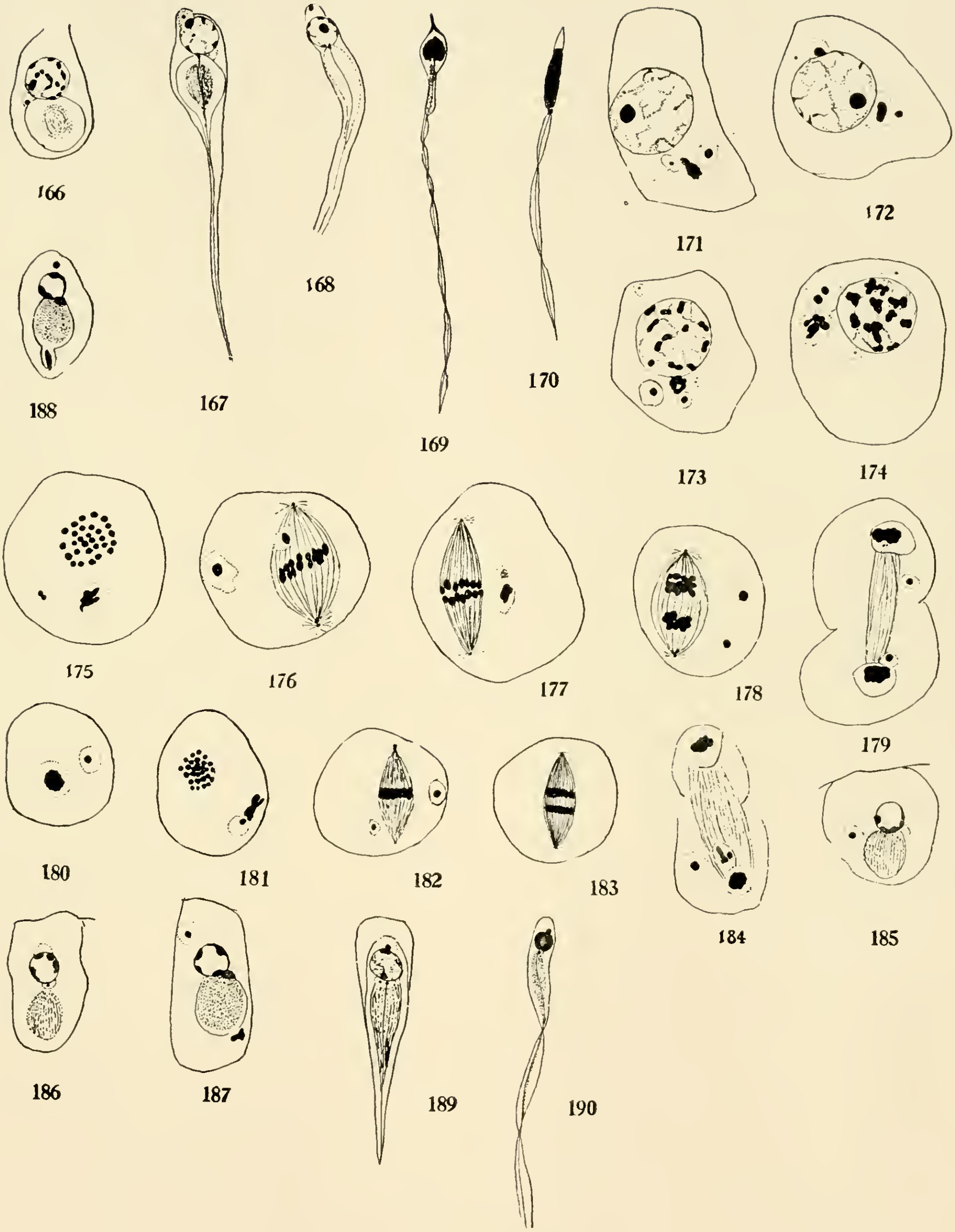

COOK: SPERMATOGENESIS IN LEPIDOPTERA.

MOORE: POLYCHÆTOUS ANNELIDS.

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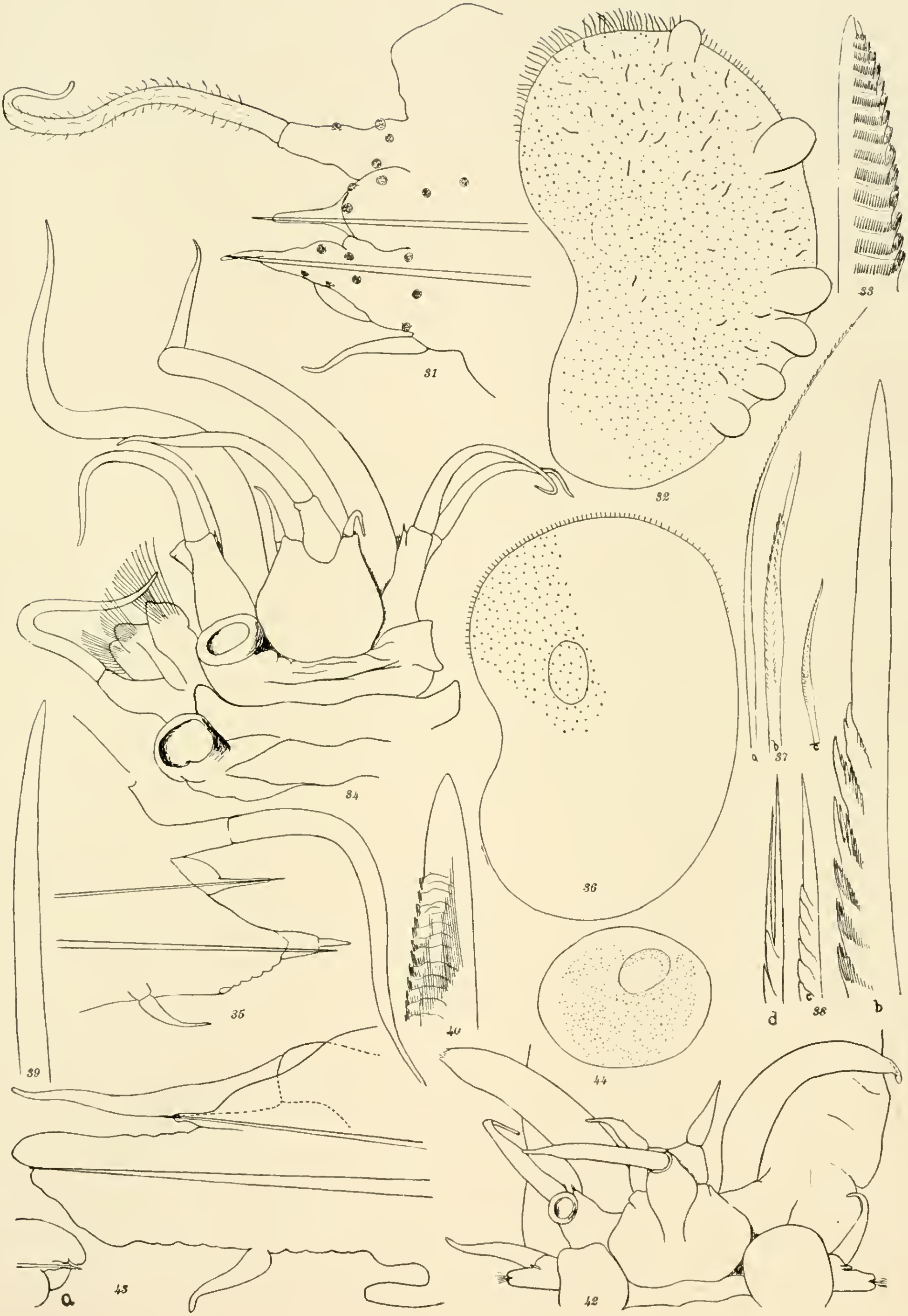

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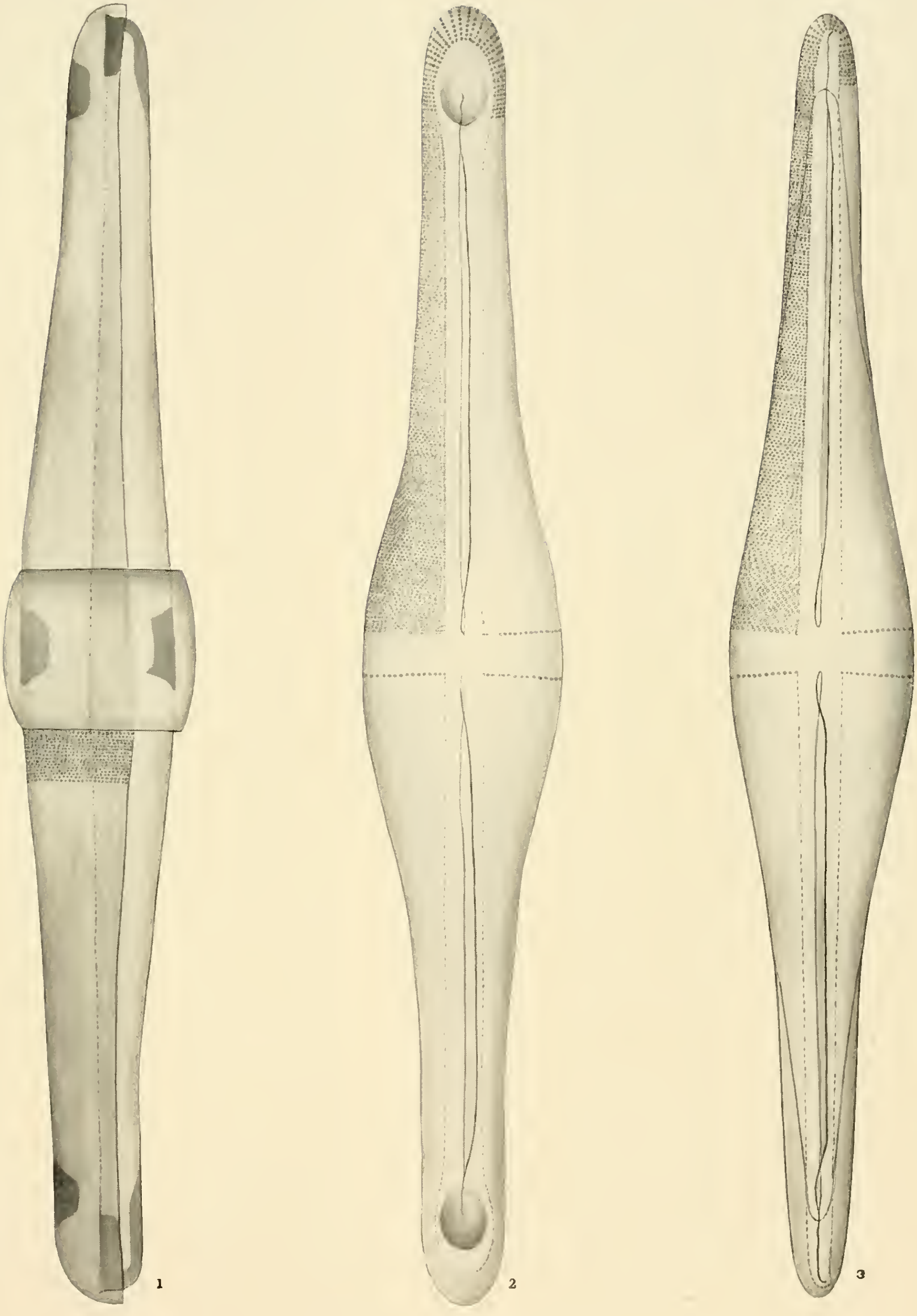
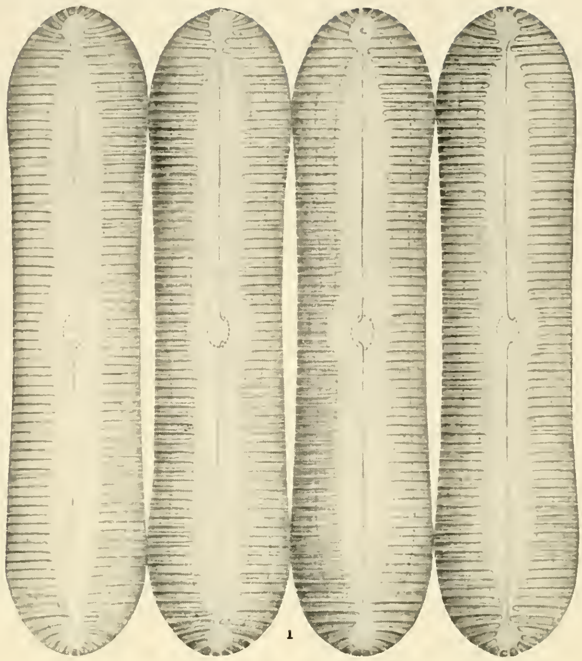


PALMER: STAURONEIS



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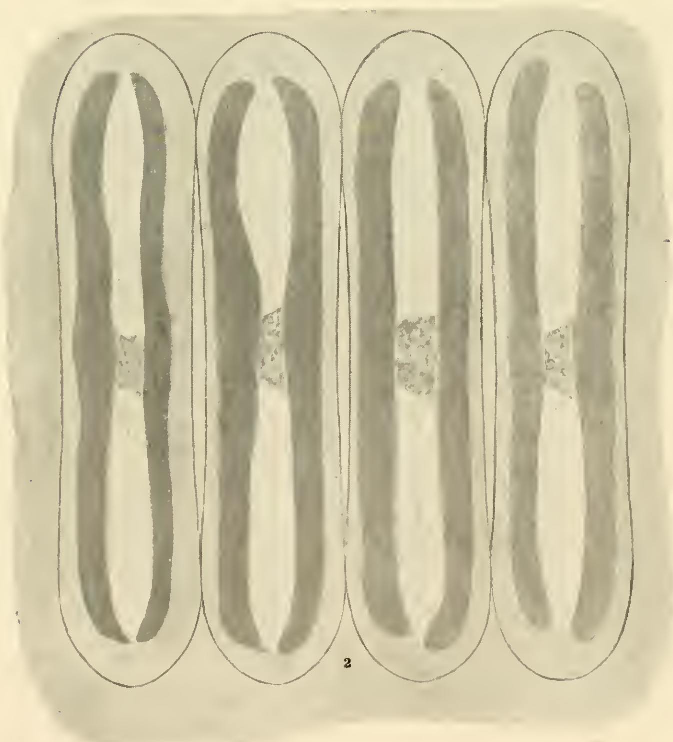

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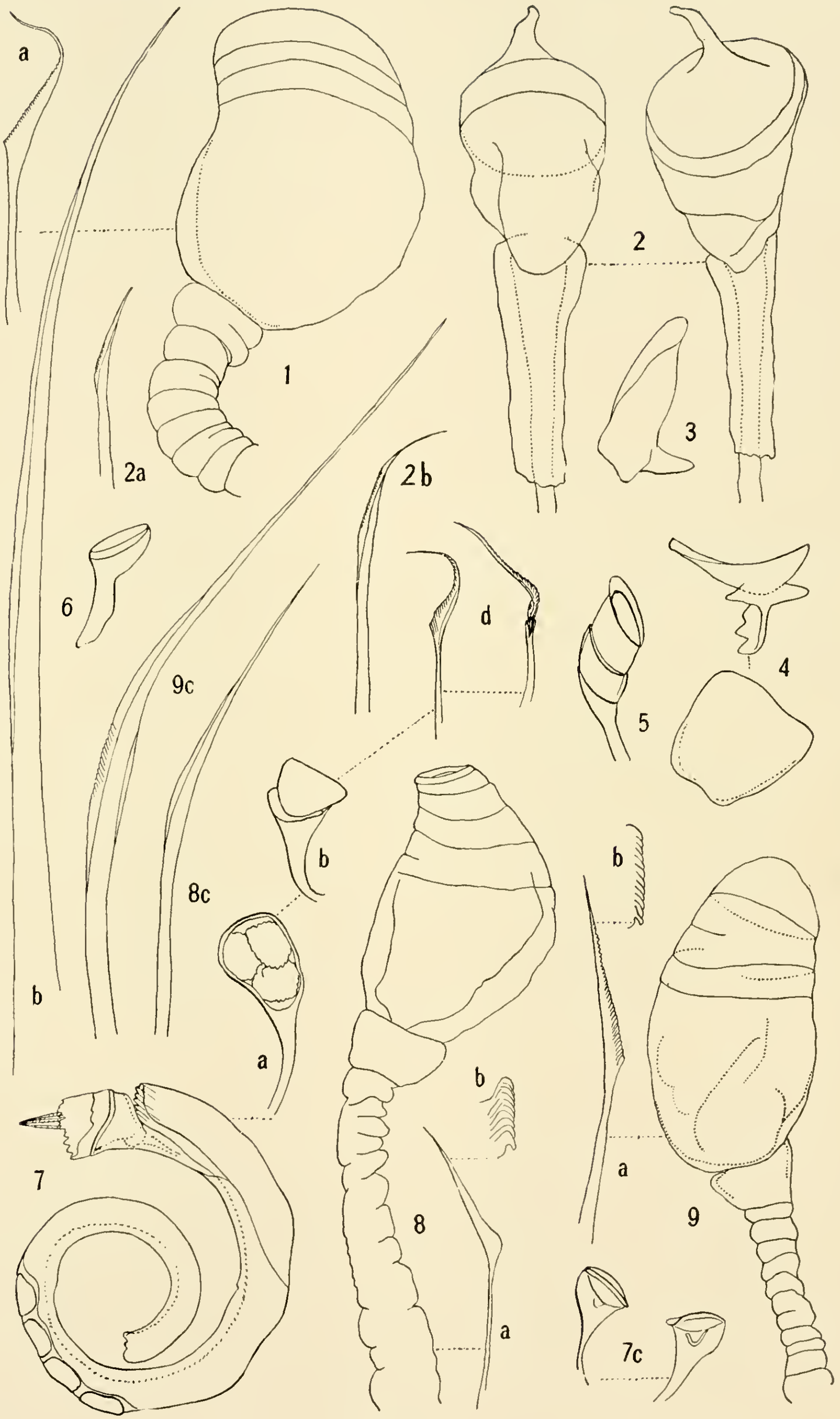
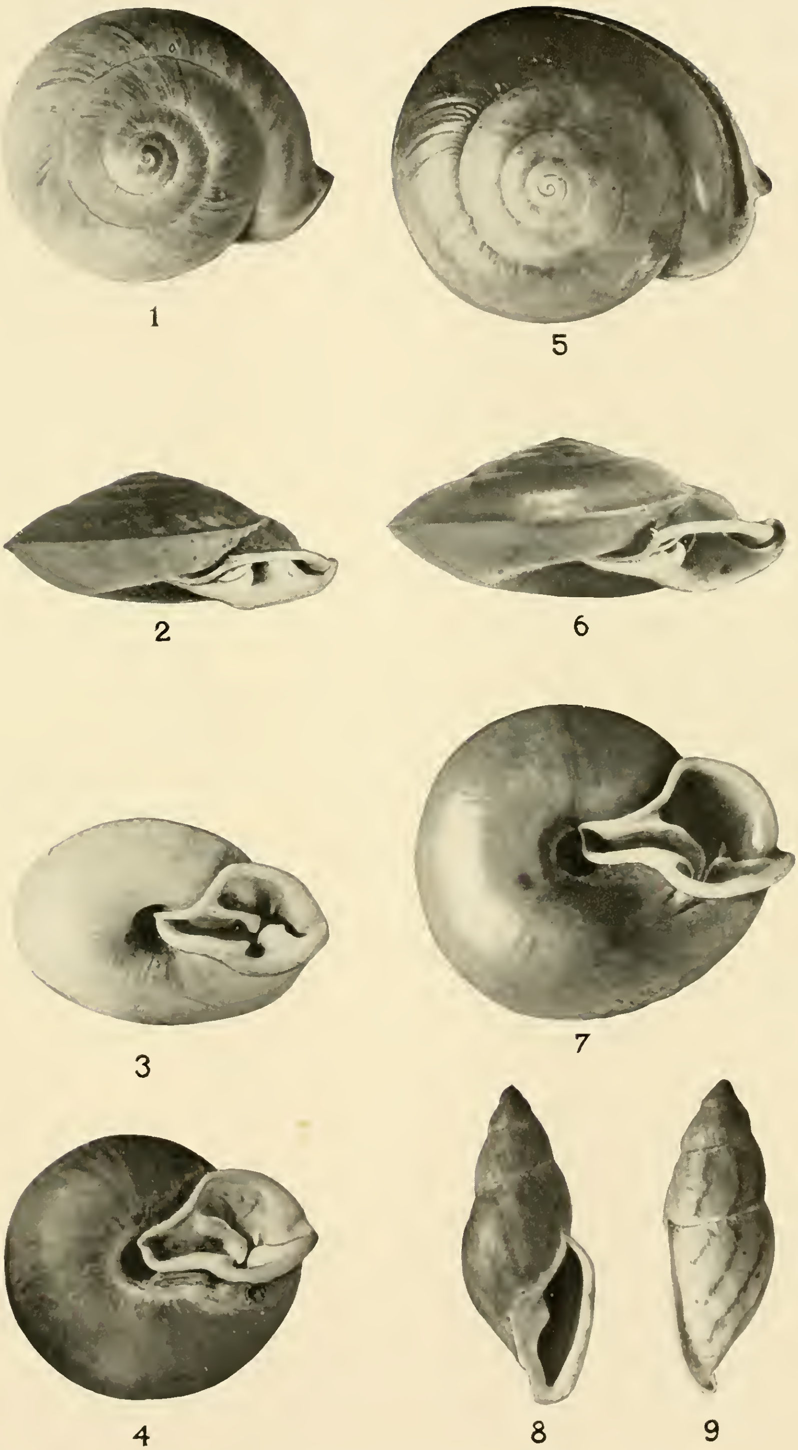
PALMER: NAVICULA SOCIALIS



BUSH: BERMUDA ANNELIDS.



PILSBRY · LAND MOLLUSCA OF PANAMA.

deciduous in several narrow bands on the last whorl. Spire low-conic, the apex rather acute. Whorls $4\frac{1}{2}$, tubular, the first $1\frac{1}{2}$ nearly smooth, the rest having a sculpture of fine, close, thread-like radial striæ, closer and less regular on the last whorl. There is no trace of corrugation. The last whorl is rounded, with no trace of a keel or ridge on the base. Aperture nearly circular, not angular above, slightly oblique, the thin peristome in contact with the preceding whorl for a very short distance only.

Alt. 10, diam. 14 mm.

Operculum evenly and moderately concave outside, bearing a spiral lamina of fully 7 whorls outside of the central depression. This lamina flares broadly outward, leaving but a narrow space between the turns; and its outer end is not concrescent with the preceding turn. The inside is convex in the middle. Diameter 5 mm.

Jamaica. Type No. 101,141, A. N. S. P., from the G. W. Tryon collection.

A species of Chitty's group No. 1, apparently related to the small variety of *A. notatus*, but with no trace of a basal keel or corrugation.

OCTOBER 4.

HENRY SKINNER, M.D., in the Chair.

Fourteen persons present.

The Secretaries, the Librarian and the Curators reported on the work accomplished during the summer.

The Publication Committee reported that papers under the following titles had been presented for publication since the meeting held May 17:

"A New Haitian Oligocene Horizon," by Henry A. Pilsbry (June 6).

"Descriptions of new Serpulids from Bermuda with Notes on known forms from Adjacent Regions," by Katherine J. Bush, Ph.D. (June 21).

"Flora of the Conowingo Barrens of Southeastern Pennsylvania," by Francis W. Pennell (June 28).

"Preliminary Studies of North Carolina Orthoptera," by James A. G. Rehn and Morgan Hebard (July 1).

"Records of Georgia and Florida Orthoptera with the Descriptions of one New Species and one New Subspecies," by James A. G. Rehn and Morgan Hebard (July 1).

"Antiquities of the St. Francis, White and Black Rivers," by Clarence B. Moore (July 7).

"Land Mollusca of the Panama Canal Zone," by H. A. Pilsbry (July 20).

"The Mollusca of Mandeville, Jamaica, and its Environs," by Henry A. Pilsbry and Amos P. Brown (July 21).

"Some Berks County Minerals," by Edgar F. Smith (September 13).

"Notes on Chimæroid and Ganoid Fishes," by Henry W. Fowler (September 27).

"Little Known New Jersey Fishes," by Henry W. Fowler (September 27, 1910).

The deaths of the following members were announced: Francis R. Cope, November 6, 1909; Oliver Bradin, May 8, 1910; Charles S. Whelen, June 10, 1910; John M. Hartman, September 4, 1910; Theodore de Thodorovitch, September 23, 1910.

OCTOBER 18.

ARTHUR ERWIN BROWN, Sc.D., Vice-President, in the Chair.

Twenty-four persons present.

A paper entitled "A New Albuloid Fish from San Domingo," by Henry W. Fowler, was presented for publication.

The paper entitled "Antiquities of the St. Francis, White and Black Rivers," by Clarence B. Moore, presented July 7, was accepted for publication in the JOURNAL of the Academy.

MR. WITMER STONE made a communication on further studies of the life-zones of southern New Jersey in continuation of a paper published by him in the PROCEEDINGS of the Academy for 1907. (No abstract.)

The subject was discussed by Messrs. A. E. Brown, Philip P. Calvert, Samuel Rhoads and John W. Harshberger.

The following were ordered to be printed:

SOME BERKS COUNTY MINERALS.

BY EDGAR F. SMITH.

Ten years ago, the late Ex-Congressman D. B. Brunner and Dr. Schoenfeld, of Reading, Pa., placed in my hands a number of minerals which they gathered from a railroad cut east of Reading. Considerable blasting had been done and a great deal of rock material had been removed. It was upon pieces of this rock and in its crevices that they obtained the minerals which I was to examine at my leisure and analyze if I cared so to do. At intervals these minerals have been submitted for study in the laboratory of the University of Pennsylvania, with results that have been more or less interesting.

Laumontite.—The color was chalky-white and the lustre vitreous and pearly. Before the blow-pipe it fused quite readily to a white enamel. It was gelatinized when digested with hydrochloric acid. The specific gravity of the sample taken for analysis was found to be 2,253. As a result of analysis it showed 14.12 per cent. loss upon ignition; 11.89 per cent. CaO; 22.2 per cent. Al_2O_3, and 52.12 per cent. SiO_2.

Apophyllite.—The crystals of the specimen examined were colorless to white, with a vitreous lustre and basal cleavage. When heated in a closed tube it exfoliated, became milk-white in color, and gave forth much water and showed a slight acid reaction. Before a blowpipe it fused to a plebby glass. It was decomposed by hydrochloric acid with the separation of silica, but it was not distinctly gelatinized. Its specific gravity was found to be 2,399. On analysis it showed:

SiO_2	52.03	per cent.
Al_2O_3	0.28	"
Fe_2O_3	Trace	
CaO	25.11	"
Na_2O	0.71	"
K_2O	5.13	"
Ign	17.43	"

Another specimen of crystals distributed over prehnite gave a specific gravity of 2.37, and on analysis showed:

SiO_2	51.95	per cent.
$Al_2O_3 + Fe_2O_3$	2.94	"
CaO	23.68	"
K_2O	4.47	"
Na_2O	0.34	"
MgO	0.36	"
Ign	15.81	"

Several samples of stilbite were found as thin radiating layers of crystals upon the face of the rock. These crystals readily broke into flat pearly plates. They gave much water when heated in a closed tube and were decomposed by hydrochloric acid without the formation of a jelly. Before the blow-pipe they fused with swelling and intumescence to a white enamel. The specific gravity was found to be 2.12. Upon analysis there were found:

SiO_2	54.27	per cent.
Al_2O_3	17.24	"
CaO	7.81	"
Na_2O	1.81	"
Ign	19.56	"

Garnets, varying in color from black to green, brown to gray, transparent in thin sections with a greenish to brownish tint, were observed distributed through the rocks. The specimen analyzed showed a specific gravity of 3.6, and upon analysis gave:

SiO_2	34.98	per cent.
Fe_2O_3	26.82	"
FeO	0.37	"
Al_2O_3	5.82	"
MnO	0.08	"
CaO	31.23	"
MgO	0.57	"

Pyroxene.—This appeared in light green colored crystals with a violet lustre. It fused quietly but with difficulty to a brown glass. It was insoluble in hydrochloric acid. The crystals showed the outward form of the hexagonal system. The specific gravity of the specimen analyzed was found to be 3,187. Its analysis showed:

SiO_2	52.23	per cent.
Al_2O_3	3.58	"
FeO	2.45	"
MnO	1.55	"
CaO	20.00	"
MgO	18.31	"
Ign	1.79	"

Chabazite.—The crystals were colorless or white. When heated in a closed tube they gave out much water. They were decomposed by hydrochloric acid without the formation of a jelly. They fused before the blow-pipe to a plebby glass. The specific gravity was found to be 2,053. The analysis showed:

SiO_2	48.59	per cent.
Al_2O_3	18.49	"
CaO	8.78	"
MgO	0.05	"
Na_2O	1.41	"
K_2O	0.69	"
Ign	22.01	"

Scolecite.—The specimen analyzed consisted of a mass of radiating needles in which were mixed small, but distinct, crystals of calcite, particularly at the base of the tufts of needles. The crystals showed a silky lustre. They gave out much water when heated in a closed tube and curled up like a worm. They were readily gelatinized by means of hydrochloric acid. The specific gravity was found to be 2.27. The analysis showed:

SiO_2	47.04	per cent.
Al_2O_3	25.42	"
CaO	9.86	"
Na_2O	4.77	"
Ign	13.60	"

So far as the writer is aware, this represents the first notice of the occurrence of this particular mineral in the State of Pennsylvania. All the others have been obtained at various points in Berks County, which has proved to be a most fruitful field for many mineral varieties.

FLORA OF THE CONOWINGO BARRENS OF SOUTHEASTERN PENNSYLVANIA

BY FRANCIS W. PENNELL.

During the summers of 1908 and 1909 the writer was enabled to spend considerable time in the study of the flora of the Conowingo or Serpentine Barrens lying in Chester and Delaware Counties, Pennsylvania. Nearly all the areas in these counties were visited, in most cases repeatedly, and full collections made. The writer has also been able to examine the material in the herbaria of the Academy of Natural Sciences of Philadelphia, the Philadelphia Botanical Club, and the University of Pennsylvania.

The object of this paper is to present accurate data as to the species composing the flora of the barrens. Effort has been made to make the list of species accurate and complete, while less attention for the present has been paid to the ecological grouping and adaptations of the flora. The general conditions of the environment—climate, physiography and soil—will, however, be considered, and a sketch of the flora and its affinities presented.

In the prosecution of this study the writer acknowledges the courtesy of the custodians of the herbaria named, and especially that of S. S. Van Pelt and Witmer Stone, to whose interest he is indebted for much aid in the determination of species. Also to Agnes Chase, of the United States Department of Agriculture, is he indebted for determinations in the genus *Panicum*.

CLIMATE.

The climate of this district, as taken from the reports of the Weather Bureau stations at West Chester and Kennett Square, shows the general condition prevailing throughout the Middle Atlantic States. The average temperature for January is 30° F.; for July 74° F.; the average first killing frost of autumn is on October 19, the last of spring on April 16; the precipitation is relatively even and well diffused throughout the year, reaching a total average annual rainfall of 50 inches. Thus it may be seen that the growing season is of considerable length, warm and well supplied with moisture. The xerophytic character of the Conowingo flora is not the result of the climate.

Physiography and Soil.

The Conowingo, or Serpentine, Barrens occur as small isolated areas, stretching in a much broken chain near the coastward edge of the Piedmont Plateau from New England to North Carolina. In Pennsylvania they lie in a hilly, much eroded country, and, owing to the chemical stability of serpentine rock, occur usually on crests and as low ridges.

Their geologic structure is striking and has been frequently described.[1] Their soil has been lately described in several publications of the Division of Soils of the U. S. Department of Agriculture.[2] In these the name Conowingo Barrens is consistently applied, which has led to its adoption in the present paper.

Two types of soil are derived from the weathering of the Serpentine—itself a soft, green, altered igneous rock: the Conowingo Barrens and the Conowingo clay. Of these the latter represents a much decomposed soil of considerable depth and forms a transition between the Conowingo Barrens and the normal mellow soils of the district. The Conowingo Barrens are alone considered here.

"The soil (of the Conowingo Barrens) generally is a light yellow or whitish-looking loam, but in places it is almost black. The top soil occasionally has a depth of 8 or 10 inches, and it is underlain by a yellowish-brown subsoil to a depth of 36 inches. The soil is generally much shallower, and in the case of the barren hills of this formation the rocks are devoid of any trace of soil covering except that caught in the pockets and crevices of the rocks. Frequently even on level or lightly rolling areas the soil may not exceed a few inches in depth. These soils, as seen from the mechanical analyses of samples collected, are not essentially different from many of the productive upland soils, but they are unproductive, and in extreme cases will not produce anything in a natural state except a stunted growth of small pines and knotty oak trees. At the best they are stubborn and unproductive, and although many reasons have been assigned for their sterility none seem altogether satisfactory. Professor Merrill (*Rocks, Rock-weathering, and Soils,* 1897) in speaking of the Chester County Barrens says that these soils are derived from the slow decomposition of peridotites, rocks rich in iron-magnesium silicates, but almost wholly

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[1] See (*a*) *Maryland Geol. Survey,* Cecil Co. Report; (*b*) *Penna. 2d Geol. Surv.,* Chester Co. Report; (*c*) *Philadelphia Geol. Folio,* 1909.

[2] See (*a*) *Maryland Geol. Survey,* Cecil Co. Report; (*b*) Harford Co. Report (*c*) *U. S. Div. of Soils,* Chester Co., Penna., Report.

lacking in lime, potash or other desirable constituents. Hence the soils derived from such rocks are naturally devoid of nutrient matter and can support only a scanty growth of grass and stunted shrubs. The main reason which may be assigned for their unproductiveness is the large amount of magnesia which they contain and their slight depth. The analyses of these soils show that they contain very minute quantities of lime and phosphoric acid."[3]

The Conowingo Barrens are rarely, if ever, cultivated; even for pasturage or for timber they are of little practical value. They have thus remained very nearly in their original condition. On all sides, however, they shade into the more tractable clay formation, which is frequently cleared and cultivated.

In Delaware and Chester Counties, as may be seen on the maps, the Barrens lie in two main divisions: to the northeast they are small and scattered (Chester Group), to the southwest they form essentially one long continuous area (State-line Barrens). In the former are some 10 or 12 well-marked exposures, ranging from less than one-half acre (*e.g.*, Sconnelltown) to such as the Serpentine Ridge, three to four miles long. These areas lie near together in extreme southern Montgomery, Delaware, southeastern Chester Counties, Pennsylvania, and northwestern Newcastle County, Delaware. They are separated some twenty miles from the nearest point of the State-line Barrens. The latter extends as one ridge, some thirty-five miles long, with a width of one to three miles, trending west-southwest from Little Elk Creek, Chester County, Pennsylvania, through northern Cecil County, Maryland, and over the Susquehanna River into Harford County, Maryland. With this area are allied smaller side areas in southern Lancaster County, Pennsylvania, near the Conowingo Creek.

Most of the field-work of this study is concerned with the Chester group of Barrens, practically every area of which in Delaware and Chester Counties has been visited. The State-line Barrens have been but twice visited, on both occasions in August, and the route traversed from Nottingham Station to Goat Hill near Octoraro Creek. As the barrens in this section are known as the Nottingham Barrens, this more local name will be used in reporting specimens.

The areas from which specimens have been examined are:

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[3] C. W. Dorsey and J. A. Bonsteel, in *Maryland Geol. Surv.*, Cecil Co. Report, p. 237.

CHESTER GROUP:

Delaware County—

1. Fawkes Run (Newtown).
2. Preston Run.
3. Bear Hill.
4. Blue Hill.
5. Middletown Township (Mineral Hill, Barrens of Middletown, Williamson, Lenni, Wawa).

Chester County—

6. Sugartown Barrens and Serpentine Ridge.
7. Cedar Barrens.
8. West Chester Barrens (Fern Hill).
9. Sconnelltown and Strode's Mill.
10. Brinton's Quarry.
11. Marshallton (specimens noted collected by B. Long).
12. Unionville.

STATE-LINE GROUP:

13. Nottingham Barrens (Nottingham Station to Goat Hill).
14. A few other specimens, mainly collected by J. J. Carter, are cited from points in southern Lancaster County.

COMPOSITION OF FLORA.

Throughout these areas, and doubtless far beyond on either side, the flora of the Conowingo Barrens is strikingly uniform, yet strikingly in contrast with that of the surrounding district. The latter originally was everywhere mesophytic woodland, on the Barrens the change is made to a xerophytic woodland, and over considerable areas to no woodland at all. Though other xerophytic areas, as notably the South Valley and North Valley Hills to the north or the dry sandy barrens of New Jersey across the Delaware River to the south and east, lie not far away, the flora of the Conowingo Barrens is quite distinct.

Yet the flora of these barrens is not uniform. Situated like islets in the midst of the surrounding vegetation, probably never interconnected, it is interesting to note that species will occur and be quite prevalent or even predominant on one, yet be quite scarce or not present at all on another. This local variation is most pronounced between the floras of the Chester and State-line groups.

In the general sketch now presented only the features common or nearly common to all the main exposures will be given. Local differences and geographic notes on the component features will be considered later .

The upland barrens are mostly covered by a sparse growth of timber of markedly xerophytic type. *Quercus stellata* is abundant on all barrens, *Quercus marylandica* on most, while with these on the State-line Barrens *Pinus rigida* becomes a predominant tree. Associated with these may occur *Sassafras sassafras*, *Acer rubrum* and *Prunus serotina* (the latter two usually in a stunted condition). The round bushy growth of the thick-leaved oaks, with open park-like spaces between, is the characteristic feature of this woodland.

It is but a step from this type of woodland to that where the open predominates, then to where on the barest ridges there is but scant covering above the rock for any growth whatever. In such exceedingly shallow soil, usually a greenish sand with fine portions of Serpentine and talc rock interspersed, there is a scattered growth of thin grasses, *Aristida dichotoma*, *A. gracilis*, and *Sporobolus vaginæflorus*, with the nearly equally delicate *Polygonum tenue* and *Aster parviceps pusillus*. It is here, locally, that *Talinum teretifolium* is found.

In slightly deeper soil, or on rock-ledges, *Arabis lyrata*, *Asclepias verticillata*, *Juncus secundus* and *Panicum philadelphicum* become predominant plants. Here *Arenaria stricta* is noteworthy as a local plant.

In all these the xerophytic habit is marked, mostly taking the form of reduced, narrow or involute leaves, in *Talinum teretifolium* of succulency; in *Arabis lyrata* the entire growth is made in the relatively moist spring season.

Scarcely less xerophytic is the herbaceous growth in the numerous park-like openings mentioned. Grasses and sedges form the bulk of the vegetation. *Andropogon scoparius* (both brown and purplish forms), *Panicum philadelphicum*, *P. sphærocarpon*, *Aristida dichotoma*, *A. gracilis*, and *Scleria pauciflora* are abundant, while constant, but individually less numerous, are *Sorghastrum nutans*, *Paspalum pubescens*, *Syntherisma filiformis*, *Panicum annulum*, *P. huachucæ silvicola*, *P. scribnerianum*, *Aristida purpurascens*, *Sporobolus vaginæflorus*, *Danthonia spicata*, *Eragrostis pectinacea*, *Cyperus filiculmis macilentus*, *Carex triceps hirsuta* and *Carex glaucodea*.

Other constant herbs of the dry open barrens are *Juncus secundus*, *Sisyrinchium mucronatum*, *Comandra umbellata*, *Polygonum tenue*, *Cerastium oblongifolium*, *Arabis lyrata*, *Saxifraga virginiensis*, *Potentilla pumila*, *Hypericum punctatum*, *Helianthemum majus*, *Viola* *fimbriatula* (S). (Serpentine form), *Angelica villosa, Sabbatia angularis, Asclepias verticillata, Kœllia flexuosa, Houstonia cærulea, Lobelia spicata. Eupatorium aromaticum, Solidago nemoralis, Aster ericoides, A. parviceps pusillus, A. lateriflorus, Antennaria neglecta, A. plantaginifolia*, and *Senecio balsamitæ*.

Where the trees are somewhat closer together and over much of the intervening area there is a shrubby growth forming dry upland thicket. *Salix tristis, Corylus americana, Rhus glabra, Ceanothus americana, Gaylussacia baccata, Vaccinium vacillans* are predominant, while frequent with these are *Quercus ilicifolia, Q. prinoides, Rosa humilis, Rhus copallina, Xolisma ligustrina* and *Polycodium stamineum*.

Large areas of the open, and especially about depressions, are covered with an abundant growth of greenbrier, mainly *Smilax rotundifolia*, though accompanied by *S. glauca. Juniperus virginiana* is the main tree of such depressions, and the densest growth of Smilax usually occurs beneath it. *Acer rubrum* here becomes a tree of considerable size.

In the dry upland thicket and open woodland, and about the edge of these cedar-greenbrier thickets, the vegetation is decidedly more mesophytic, most of the species here being common to the surrounding district. In the woodland occur *Phegopteris hexagonoptera, Panicum dichotomum, P. boscii, Linum virginianum, Dasystoma flava, Gerardia tenuifolia, Hieracium venosum, Nabalus serpentarius, Solidago bicolor* and *Sericocarpus asteroides*. Many other species of the surrounding flora are more or less casual here.

In the greenbrier thicket and about its edge grow many herbs, of which *Andropogon furcatus, Scirpus atrovirens, Silene stellata, Vernonia noveboracensis, Eupatorium perfoliatum, Solidago rugosa, Helianthus giganteus* and *Cirsium muticum* may be mentioned as constant and frequent. Beneath the dense shade of the cedars and greenbrier and on banks of small streamlets *Polystichum acrostichoides. Asplenium platyneuron, Homalocenchrus virginicus, Agrostis perennans, Arabis lyrata, Saxifraga virginiensis* occur with other species of the open dry barrens in ranker growth.

Where depressions exist free from the covering of thicket or trees, especially where, though not wet in summer, complete desiccation seldom occurs, where the soil is largely a greenish sand, but not dry or arid, a peculiar vegetation exists. *Deschampsia cæspitosa* and *Fimbristylis laxa* occur here, with locally *Cassia chamæcrista, Cyperus aristatus*, and *Gerardia purpurea parvula*.

Between the upland xerophytic woodland and the surrounding mesophytic forest the change, sometimes abrupt, is usually gradual. Of the trees *Quercus stellata*, *Q. marylandica* and *Pinus rigida* do not pass beyond the limits of the Serpentine, and over any extended view may be taken to indicate its position. But *Sassafras sassafras*, *Acer rubrum* and *Nyssa sylvatica* pass beyond, *Quercus alba*, *Castanea dentata* and *Quercus velutina* come successively into prominence, though not till the barrens are left does *Liriodendron tulipifera* become a predominant forest tree.

The flora of one other plant-association was noted, though only partially. In the rich swamps at the base of the hills, derived mainly from the washing of the barren soil, there is a varied and abundant vegetation. Mostly this is the normal swamp-flora of the surrounding district, but a few species seem constantly present here which are much less frequently seen elsewhere. Such are *Osmunda spectabilis*, *Spiræa latifolia*, *Sanguisorba canadensis* and *Heliopsis helianthoides*.

The local variations of this flora are considerable. The isolation of the different areas, the meagre size of some, the nearness of some to one or another barren of a different type, all tend to modify the flora. Yet the above characteristic species remain remarkably constant.

Because of its large continuous area the State-line Barrens probably better illustrate the complete flora of the type than any other. *Pinus rigida*, *Sporobolus heterolepis*, *Ascyrum hypericoides*, *Pieris mariana*, *Galium boreale*, and *Eupatorium pubescens* were found here only, while *Quercus marylandica*, *Cassia chamæcrista*, and *Acerates viridiflora* present here are very local in the Chester group.

The distance separating the two groups of barrens makes the distinction between them the most important variation in the flora. It is impossible from the meagre information as to the Nottingham flora to speak with certainty of what plants present in the Chester Group are absent in the State-line group. The following species of the former have not been noted in the latter, *Atheropogon curtipendulus*, *Deschampsia cæspitosa*, *Cyperus aristatus*, *Carex bicknellii* and *Scutellaria parvula ambigua*.

In the Chester Group the variation is mostly in accessory non-characteristic species. The only general division which can be made is between the relatively deeper-soiled barrens of Delaware County and the bare rocky ridges frequent in southeastern Chester County. On the latter only occur *Atheropogon curtipendulus*, *Talinum teretifolium* and *Arenaria stricta*, on the former *Quercus marylandica* and likely *Lilium philadelphicum*.

Many other notable species occur irregularly or in but one or two areas. Of commoner species *Phlox subulata* is a conspicuous instance. Of scarcer species may be mentioned *Pinus virginiana*, *Aristida oligantha*, *Sphenopholis obtusata pubescens*, *Aletris farinosa*, *Meibomia rigida*, *Sarothra gentianoides*, *Viola pedata lineariloba*, *Gentiana crinita*, *Phlox pilosa*, *Scutellaria parvula ambigua*, *Gerardia purpurea parvula*, *Castilleia coccinea*, *Lonicera sempervirens*, *Lacinaria spicata*, *Aster patens* and *Antennaria neodioica*.

Geographical Affinities of the Flora.

The following list shows 217 species composing the characteristic flora of the Conowingo Barrens, while some 77 others were collected occasionally. Of the characteristic species 17 in this section of the Piedmont area are quite or nearly confined to these barrens, while 48 others occur mainly here. The remaining species belong to the normal flora of the district, and their distribution will be less considered.

Many of the species occurring mainly on the Conowingo Barrens occur also on other barren (xerophytic) formations of the district, as the South Valley Hill (shale) and the North Valley Hill (quartzite and sandstone). Among such may be mentioned *Panicum philadelphicum*, *P. depauperatum*, *P. scribnerianum*, *P. sphærocarpon*, *Aristida gracilis*, *Juncus secundus*, *Smilax glauca*, *S. rotundifolia*, *Sisyrinchium mucronatum*, *Quercus ilicifolia*, *Q. stellata*, *Q. prinoides*, *Comandra umbellata*, *Polygonum tenue*, *Lespedeza capitata*, *L. virginica*, *Angelica villosa*, and *Senecio balsamitæ*. A common dry light soil accounts for such distribution.

Across the Delaware River in New Jersey, also in southern Delaware, lie the sand barrens of the Atlantic Coastal Plain. From here have evidently been derived a number of coastal (Carolinian) species. Besides all the above list of xerophytes, *Pinus virginiana*, *P. rigida*, *Aristida oligantha*, *A. purpurascens*, *Scleria triglomerata*, *Quercus marylandica*, *Cassia chamæcrista*, *Strophostyles umbellata*, *Asclepias verticillata*, *Phlox subulata*, *Eupatorium aromaticum* are species present to both floras. Other less characteristic species showing coastal influence are *Typha angustifolia*, *Panicum commonsianum*, *P. addisonii*, *Juncus aristulatus*, *Aletris farinosa* and *Pieris mariana*. *Fimbristylis laxa*, though not found in New Jersey, likewise seems to imply a coastward southern influence.

Distinctive species in the characteristic Conowingo flora showing a northern or Alleghanian influence are *Sporobolus heterolepis*, *Deschampsia cæspitosa*, *Atheropogon curtipendulus*, *Carex glaucodea*, *C.*

bicknellii, Lilium philadelphicum, Quercus ilicifolia, Arenaria stricta, and *Galium boreale.* Of these *Sporobolus heterolepis, Deschampsia cæspitosa, Carex bicknellii* and *Galium boreale* here reach their most southerly recorded stations in the Eastern States.

The species in this district restricted to the Conowingo Barrens are *Panicum annulum, Sporobolus heterolepis, Sphenopholis obtusata pubescens, Deschampsia cæspitosa, Atheropogon curtipendulus, Fimbristylis laxa, Carex bicknellii, Quercus marylandica, Talinum teretifolium, Cerastium oblongifolium, Arenaria stricta, Asclepias verticillata, Phlox subulata, Scutellaria parvula ambigua, Gerardia purpurea parvula,* and *Aster parviceps pusillus.* Of these most are wide-ranging and have been considered.

Of those remaining, *Panicum annulum, Sphenopholis obtusata pubescens,* and *Scutellaria parvula ambigua* seem very local here and occur in areas widely remote over most of the Eastern States. *Talinum teretifolium, Cerastium oblongifolium* and *Aster parviceps pusillus* in the East, at least, are practically confined to magnesian (*i.e.,* Serpentine) soil. *Aster parviceps pusillus,* common here, is only known from the Serpentine Barrens of a small area in southern Pennsylvania and adjacent West Virginia. *Cerastium oblongifolium* and *Talinum teretifolium* range west to Minnesota and Colorado, and toward the western part of their range are adapted to other xerophytic habitats. The range of *Gerardia purpurea parvula* is not as yet understood.

I. List of Species Composing the Flora of the Conowingo Barrens.

* Nearly or quite restricted in Delaware and Chester Counties to Conowingo Barrens.

† Common to surrounding country, but much more frequent on Conowingo Barrens.

‡ Frequent on Conowingo Barrens, but much less common than in surrounding district.

— Those species of the surrounding flora found as mere stragglers on the Conowingo Barrens, also noteworthy introduced species are listed at the end.

Unless otherwise credited, all records are represented by specimens of the writer's collecting.

†1. Osmunda spectabilis L.

Frequent in rich shaded swamps.

Delaware.—Williamson.

2. Pteridium aquilinum (L.) Kuhn.

Frequent on dry upland, open or about edges of thicket.
Delaware.—Bear Hill; Williamson; Lenni; Wawa.
Chester.—Sugartown Barrens; West Chester.

3. Asplenium platyneuron (L.) Oakes.

Frequent on dry or rocky barrens, or open woodland.
Delaware.—Fawkes Run; Preston Run; Bear Hill; Wawa.
Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Sconnelltown; Brinton's Quarry; Unionville.

4. Polystichum acrostichoides (Michx.) Schott.

Frequent on shaded banks and in border-woodland.
Delaware.—Fawkes Run; Bear Hill; Barrens of Middletown.
Chester.—Cedar Barrens.

‡5. Dennstædtia puncticuloba (Michx.) Moore.

Frequent in border-woodland.
Delaware.—Williamson.
Chester.—Cedar Barrens; Unionville.

†6. Pinus virginiana Mill.

A few trees in one locality, on dry open barrens.
Chester.—Serpentine Ridge.

†7. Pinus rigida Mill.

Only on State-line Barrens, where abundant on dry upland.
Chester.—Nottingham Barrens.

8. Juniperus virginiana L.

Frequent mainly in depressions of upland, greenbrier thickets.
Chester.—Cedar Barrens; West Chester; Unionville.
— Nottingham Barrens.

9. Typha angustifolia L.

Scarce; in a quarryhole and pool.
Delaware.—Williamson; Lenni.

10. Andropogon scoparius Michx.

Abundant on dry open barrens. Two forms, but hardly separable. A brownish, much tufted and branched form, and a glaucous, purplish, less tufted, and branched, taller and more wand-like form—both forms abundant and growing together, the latter seemingly more restricted to the Conowingo Barrens. Not distinguished in records.

Delaware.—Fawkes Run; Preston Run; Mineral Hill; Barrens of Middletown; Williamson; Lenni; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry; Marshallton (B. Long); Unionville.

— Nottingham Barrens.

11. ANDROPOGON FURCATUS Muhl.

Frequent in depressions of dry barrens and about edges of thicket.

Delaware.—Fawkes Run (S. S. Van Pelt); Williamson.

Chester.—Sugartown Barrens; Brinton's Quarry.

— Nottingham Barrens.

12. SORGHASTRUM NUTANS (L.) Nash.

Common on dry open barrens.

Delaware.—Fawkes Run; Preston Run; Bear Hill; Mineral Hill; Williamson.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Brinton's Quarry.

13. PASPALUM PUBESCENS Muhl.

Common on dry open barrens.

Delaware.—Preston Run; Lenni.

Chester.—Sugartown Barrens (E. B. Bartram); Serpentine Ridge; Cedar Barrens; West Chester.

14. SYNTHERISMA FILIFORMIS (L.) Nash.

Common on dry open barrens, especially in partial shade.

Delaware.—Fawkes Run; Wawa.

Chester.—Sugartown Barrens (E. B. Bartram); Serpentine Ridge; Cedar Barrens; Unionville.

†15. PANICUM PHILADELPHICUM Bernh.

Abundant on dry open barrens.

Delaware.—Fawkes Run; Mineral Hill; Middletown Barrens; Williamson; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

‡16. PANICUM DICHOTOMIFLORUM Michx.

Frequent in moist to dry border-woodland.

Delaware.—Middletown Barrens.

Chester.—Cedar Barrens.

‡17. Panicum anceps Michx.

Frequent on open grassy border-land.

Delaware.—Preston Run; Williamson; Lenni.

‡18. Panicum depauperatum Muhl.

Frequent or locally abundant on dry barrens or edges of thickets. Apparently more common in Chester than in Delaware County.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Unionville.

— Nottingham Barrens.

†19. Panicum linearifolium Scribn.

Known only from the following specimens.

Delaware.—"Newtown" (B. H. Smith); "Del. Co." (Dr. Geo. Smith).

20. Panicum dichotomum L.

Frequent in dry barren or border-woodland.

Delaware.—Fawkes Run; Middletown Barrens.

21. Panicum barbulatum Michx.

Frequent in dry barren or border-woodland.

Delaware.—Fawkes Run; Wawa.

Chester.—Cedar Barrens.

*22. Panicum annulum Ashe.

Frequent on dry barren banks and edges of thicket.

Delaware.—Fawkes Run; Preston Run; Bear Hill; Mineral Hill; Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Unionville.

— Nottingham Barrens.

23. Panicum huachucæ silvicola Hitchc. and Chase.

Frequent on dry barrens, and edge of thicket.

Delaware.—Fawkes Run; Blue Hill; Williamson; Wawa.

Chester.—West Chester; Unionville.

†24. Panicum scribnerianum Nash.

Frequent on dry open barrens and sandy banks.

Delaware.—Bear Hill; Blue Hill; Mineral Hill; Williamson; Lenni.

Chester.—Serpentine Ridge; West Chester; Sconnelltown; Unionville.

— Nottingham Barrens.

†25. PANICUM SPHÆROCARPON Ell.

Abundant on dry open barrens.

Delaware.—Fawkes Run; Preston Run; Bear Hill; Blue Hill; Mineral Hill; Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry.

— Nottingham Barrens.

‡26. PANICUM BOSCII Poir.

Frequent in dry or rocky border-woodland.

Delaware.—Williamson; "Del. Co." (Dr. Geo. Smith).

‡27. PANICUM CLANDESTINUM L.

Frequent in moist border-land and edges of thicket.

Delaware.—Middletown Barrens; Williamson.

Chester.—Sugartown Barrens.

28. HOMALOCENCHRUS VIRGINICUS (Willd.) Britton.

Common in shade of woodland.

Delaware.—Fawkes Run; Middletown Barrens; Williamson; Wawa.

Chester.—Cedar Barrens; Unionville.

29. HOMALOCENCHRUS ORYZOIDES (L.) Poll.

Frequent in rich swamps.

Delaware.—Williamson.

Chester.—Serpentine Ridge; West Chester; Unionville.

30. ARISTIDA DICHOTOMA Michx.

Abundant on dry open barrens.

Delaware.—Fawkes Run; Preston Run; Mineral Hill; Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; West Chester; Sconnelltown; Brinton's Quarry; Unionville.

†31. ARISTIDA OLIGANTHA Michx.

Scarce; on dry open barrens.

Delaware.—Fawkes Run.

Chester.—Cedar Barrens.

†32. Aristida gracilis Ell.

Common on dry open barrens.

Delaware.—Fawkes Run; Preston Run; Middletown Barrens; Williamson; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Unionville.

†33. Aristida purpurascens Poir.

Frequent on dry open barrens.

Delaware.—Preston Run; Mineral Hill; Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Cedar Barrens; West Chester; Unionville.

34. Muhlenbergia sylvatica Torr.

Frequent in dry woodland and edges of greenbrier.

Delaware.—Fawkes Run; Williamson.

Chester.—Unionville.

†35. Muhlenbergia foliosa Trin.

Frequent or local on border of greenbrier thicket and in partial shade.

Delaware.—Middletown Barrens; Williamson.

36. Sporobolus vaginæflorus (Torr.) Wood.

Common on dry open barrens.

Delaware.—Preston Run; Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Sconnelltown; Unionville.

*37. Sporobolus heterolepis A. Gray.

Dry open barren, on State-line Barrens only. Reported also from southern Lancaster County, Pleasant Grove (J. J. Carter) and New Texas (T. C. Porter), probably on contiguous Serpentine Barrens.

Chester.—Nottingham Barrens.

38. Agrostis perennans (Walt.) Tuckerm.

Common in moist to desiccated woodland.

Delaware.—Fawkes Run; Middletown Barrens; Williamson; Wawa.

Chester.—Sugartown Barrens; Unionville.

39. Agrostis hyemalis (Walt.) B. S. P.

Occasional on dry barren.

Chester.—Cedar Barrens.

*40. Deschampsia cæspitosa (L.) Beauv.

Frequent in moist sandy soil.

Delaware.—Fawkes Run; Crum Creek (J. W. Harshberger); Williamson.

Chester.—Serpentine Ridge; Cedar Barrens; West Chester.

‡41. Danthonia spicata (L.) Beauv.

Frequent on dry open border-land.

Delaware.—Wawa.

Chester.—Unionville.

*42. Atheropogon curtipendulus (Michx.) Fourn.

Local, occasionally abundant, on dry open barrens.

Chester.—West Chester; Brinton's Quarry; Marshallton (B. Long); Unionville.

‡43. Tridens flavus (L.) Hitchc.

Frequent on dry open border-land.

Delaware.—Mineral Hill; Williamson; Lenni.

Chester.—Cedar Barrens; Unionville.

44. Eragrostis pectinacea (Michx.) Steud.

Common on dry open barrens.

Delaware.—Preston Run; Bear Hill; Mineral Hill; Middletown Barrens; Williamson; Lenni.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; Brinton's Quarry; Unionville.

— Nottingham Barrens.

*45. Sphenopholis obtusata pubescens (Scribn. and Merr.) Scribn.

Collected but once, over 40 years ago.

Delaware.—"Newtown" (Dr. Geo. Smith), probably Fawkes Run.

†46. Cyperus aristatus Rottb.

Occasional on damp depressions or banks.

Chester.—Serpentine Ridge (S. S. Van Pelt); Cedar Barrens (S. S. Van Pelt); West Chester (J. W. Harshberger).

47. Cyperus strigosus L.

Frequent in moist depressions, quarry-holes.

Chester.—Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

48. Cyperus filiculmis macilentus Fernald.

Frequent on dry open barren.

Delaware.—Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry.

49. Eleocharis tenuis (Willd.) Schultes.

Abundant on wet sandy depressions.

Delaware.—Mineral Hill; Williamson.

Chester.—Serpentine Ridge; Cedar Barrens; West Chester.

*50. Fimbristylis laxa Vahl.

Common on moist sandy depressions.

Delaware.—Preston Run; Mineral Hill (B. Heritage); Middletown Barrens; Williamson; Wawa.

Chester.—Sugartown Barrens (E. B. Bartram); Serpentine Ridge; Cedar Barrens; West Chester; Marshallton (B. Long); Unionville.

— Nottingham Barrens.

†51. Scirpus atrovirens Muhl.

Frequent in moist soil.

Delaware.—Williamson.

Chester.—West Chester; Brinton's Quarry.

— Nottingham Barrens.

52. Rhynchospora glomerata (L.) Vahl.

Occasional in moist soil.

Chester.—Serpentine Ridge; Cedar Barrens.

†53. Scleria triglomerata Michx.

Frequent on dry open barren, and edges of greenbrier thicket.

Delaware.—Williamson.

Chester.—Sugartown Barrens; Unionville.

— Nottingham Barrens.

†54. Scleria pauciflora Muhl.

Abundant on dry open barrens.

Delaware.—Mineral Hill; Williamson; Lenni (J. H. Redfield); Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Unionville.

— Nottingham Barrens.

Lancaster.—Texas (Dr. Geo. Smith).

*55. Scleria pauciflora caroliniana (Willd.) Wood.

One collection seen.
"Serpentine on West Chester Road" (C. E. Smith).

‡56. Carex lurida Wahl.

Frequent in Serpentine swamps.
Chester.—Serpentine Ridge; Unionville.
— Nottingham Barrens.

57. Carex hystricina Muhl.

In a moist quarry-hole.
Delaware.—Williamson.

58. Carex triceps hirsuta (Willd.) Bailey.

Common on dry open Barrens.
Delaware.—Bear Hill; Mineral Hill; Williamson; Lenni; Wawa.
Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

†59. Carex glaucodea Tuckerm.

Frequent on dry open barrens.
Delaware.—Mineral Hill; Williamson.
Chester.—Serpentine Ridge (S. S. Van Pelt); Cedar Barrens (S. S. Van Pelt); Unionville.
Lancaster.—New Texas (J. J. Carter).

‡60. Carex vulpinoidea Michx.

Frequent in moist soil.
Delaware.—Williamson.
Chester.—Cedar Barrèns.

†61. Carex retroflexa Muhl.

Local or frequent on moist depressions or banks.
Delaware.—Williamson.

62. Carex scoparia Schkuhr.

Frequent on dry barrens.
Delaware.—Williamson.

*63. Carex bicknellii Britton.

Occasional on dry open barrens.
Delaware.—Bear Hill; Williamson.
Chester.—Cedar Barrens.

‡64. Juncus effusus L.

Frequent in Serpentine swamps.
Delaware.—Williamson.
Chester.—West Chester.

‡65. Juncus tenuis Willd.

Frequent along paths, etc., in border-woodland.
Delaware.—Williamson.
Chester.—Cedar Barrens.
— Nottingham Barrens.

†66. Juncus secundus Beauv.

Abundant on dry open barrens.
Delaware.—Fawkes Run (C. E. Smith); Preston Run; Mineral Hill; Williamson; Wawa.
Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Sconnelltown.
— Nottingham Barrens.

67. Juncus marginatus Rostk.

Occasional in moist sandy soil.
Delaware.—Williamson.
Chester.—Sugartown Barrens.
— Nottingham Barrens.

68. Juncus aristulatus Michx.

One specimen seen.—A coastal species scarce so far inland.
Delaware.—"Del. Co." (Dr. Geo. Smith).

‡69. Juncus acuminatus Michx.

Frequent in moist soil.
Chester.—Unionville.
— Nottingham Barrens.

70. Juncoides campestre (L.) Kuntze.

Frequent in dry barren open or woodland.
Delaware.—Fawkes Run.
Chester.—West Chester.

71. Chamælerium luteum (L.) A. Gray.

Occasional in border-woodland.
Delaware.—Williamson.
Chester.—Cedar Barrens (S. S. Van Pelt).

†72. Lilium philadelphicum L.

Frequent or local on edges of greenbrier thicket.

Delaware.—Williamson; Wawa.

Chester.—Cedar Barrens.

— Nottingham Barrens.

73. Aletris farinosa L.

Occasional on dry open barren and banks.

Chester.—Unionville.

— Nottingham Barrens.

‡74. Vagnera racemosa (L.) Morong.

Frequent in border-woodland.

Delaware.—Lenni; Wawa.

†75. Smilax herbacea crispifolia, subsp. nov.

Stem ascending, recumbent at apex, at length slightly elongated, provided with slender tendrils. Leaves ovate or oval, acute at apex, truncate or slightly cordate at base, 5–6 cm. long, firm in texture, usually with crisped or wavy margins, pale-green above, slightly glaucous and glabrous beneath, 7-nerved, on petioles one-quarter to one-third the length of the blades. Leaves of the branches mostly narrower. Umbel 15–25 flowered. Pedicels 8–10 mm. long. Peduncle stout, in fruit exceeding the subtending leaf. Berries blue or purplish-blue, glaucous, 7–8 mm. in diameter.

Differs from *S. herbacea* L. in its little elongated, not freely climbing stem, in its firmer leaves, truncate at base, and in its smaller berries.

Dry soil, southeastern Pennsylvania to Virginia.

Type.—Serpentine, Mineral Hill, Delaware County, Penna., F. W. Pennell 594, coll. Sept. 6, 1908, in Herb. Acad. Nat. Sci. Phila.

Common on dry open barrens and edges of greenbrier.

Delaware.—Mineral Hill; Williamson; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; Unionville.

— Nottingham Barrens.

†76. Smilax glauca Walt.

Common on dry open barrens, mostly about margin of greenbrier thicket.

Delaware.—Fawkes Run; Bear Hill; Mineral Hill; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

— Nottingham Barrens.

†77. SMILAX ROTUNDIFOLIA L.

Abundant in depressions of barrens, frequently climbing high on Juniperus virginiana.

Delaware.—Fawkes Run; Bear Hill; Mineral Hill; Wawa.

Chester.—West Chester; Sconnelltown.

— Nottingham Barrens.

†78. SISYRINCHIUM MUCRONATUM Michx.

Common on dry open barren.

Delaware.—Mineral Hill; Wawa.

Chester.—Sugartown Barrens (E. B. Bartram); Serpentine Ridge Cedar Barrens; West Chester.

‡79. GYROSTACHYS GRACILIS (Bigel.) Kuntze.

Occasional on dry open barren.

Delaware.—Williamson.

Chester.—Brinton's Quarry.

80. LEPTORCHIS LOESELII (L.) MacM.

Occasional on moist shaded banks.

Delaware.—Middletown Barrens.

Chester.—Cedar Barrens.

81. POPULUS GRANDIDENTATA Michx.

Occasional in woodland.

Delaware.—Williamson.

Chester.—Unionville.

— Nottingham Barrens.

82. SALIX HUMILIS Marsh.

Frequent or local on dry open barren.

Delaware.—Williamson.

Chester.—Unionville.

83. SALIX TRISTIS Ait.

Frequent or local on dry open barrens.

Delaware.—Williamson; Wawa.

Chester.—Nottingham Barrens.

84. COMPTONIA ASPLENIFOLIA (L.)

Occasional on dry open barren.

Delaware.—Middletown Barrens; Wawa.

85. Corylus americana Walt.

Common on dry barren, edges of woodland and thicket.

Delaware.—"Crum Creek" (J. W. Harshberger); Lenni.

Chester.—Sugartown Barrens; West Chester.

86. Alnus rugosa (Du Roi) Spreng.

Frequent on dry edges of woodland or in Serpentine swamp.

Delaware.—Middletown Barrens; Williamson.

‡87. Castanea dentata (Marsh.) Borkh.

Frequent in border-woodland.

Delaware.—Fawkes Run.

88. Quercus palustris Du Roi.

Local in moist woodland, borderland.

Delaware.—Fawkes Run.

Chester.—Sugartown Barrens; Cedar Barrens.

†89. Quercus ilicifolia Wang.

Frequent or local on dry open barren.

Delaware.—Fawkes Run.

Chester.—Cedar Barrens; West Chester.

— Nottingham Barrens.

*90. Quercus marylandica Mench.

Locally abundant on dry barren.

Delaware.—Middletown Barrens; Williamson; Lenni; Wawa; "Crum Creek" (J. W. Harshberger).

Chester.—Nottingham Barrens.

91. Quercus alba L.

Frequent in border-woodland.

Delaware.—Fawkes Run.

Chester.—Unionville.

†92. Quercus stellata Wang.

Abundant on dry barren.

Delaware.—Fawkes Run; Blue Hill; Mineral Hill; Middletown Barrens; Williamson.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Unionville.

— Nottingham Barrens.

93. QUERCUS PRINUS L.

Occasional in woodland.

Delaware.—Fawkes Run.

Chester.—Sugartown Barrens.

†94. QUERCUS PRINOIDES Willd.

Frequent on dry open barren.

Delaware.—Fawkes Run; Preston Run; Bear Hill; Mineral Hill; Williamson.

Chester.—Cedar Barrens; Unionville.

— Nottingham Barrens.

†95. COMANDRA UMBELLATA (L.) Nutt.

Frequent or local on dry open barren.

Delaware.—Williamson.

Chester.—Sugartown Barrens.

†96. POLYGONUM TENUE Michx.

Common on dry open barren, rock exposures.

Delaware.—Fawkes Run; Blue Hill; Mineral Hill; Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Sconnelltown; Brinton's Quarry; Unionville.

— Nottingham Barrens.

*97. TALINUM TERETIFOLIUM Pursh.

Local on dry open barren, rock-exposures.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Sconnelltown.

— Nottingham Barrens.

Lancaster.—New Texas (J. J. Carter).

98. SILENE STELLATA (L.) Ait. f.

Frequent on dry edges of greenbrier and rocky places.

Delaware.—Middletown Barrens; Williamson; Wawa.

Chester.—West Chester; Unionville.

— Nottingham Barrens.

*99. CERASTIUM OBLONGIFOLIUM Torr. [including *C. arvense villosum* Hollick and Britton].

Abundant on dry open barrens, banks and edges of greenbrier.

In the material examined I have been unable to detect any constant difference between *C. arvense oblongifolium* (Torr.) Hollick and Britton and *C. arvense villosum* Hollick and Britton [= *C. arvense velutinum* (Raf.) Britton]. The latter seems a condensed form of the drier situations, intergrading perfectly with the normal form. On the other hand, *C. oblongifolium* Torr with us seems quite distinct from *C. arvense* L. Records include forms which have been passing for both varieties.

Delaware.—Fawkes Run; Bear Hill; Blue Hill; Mineral Hill; Middletown Barrens; Williamson; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Sconnelltown [= "Strode's Serpentine" (Dr. Wm. Darlington) type of *C. villosum*]; Brinton's Quarry; Unionville.

— Nottingham Barrens.

Lancaster.—Pleasant Grove (A. A. Heller and J. K. Small); New Texas (J. J. Carter).

*100. Arenaria stricta Michx.

Local on dry open barren, rock exposures.

Delaware.—"Middletown" (I. Burk)—locality likely incorrect.

Chester.—West Chester; Unionville.

— Nottingham Barrens.

101. Syndesmon thalictroides (L.) Hoffmg.

Frequent in dry woodland.

Delaware.—Mineral Hill; Williamson; Wawa.

102. Thalictrum revolutum D. C.

Occasional on dry open barren.

Leaflets abundantly glandular-puberulent in the Nottingham specimens, slightly so or nearly smooth beneath in the Delaware County specimens.

Delaware.—Williamson (B. Long); "Elwyn" (Dr. J. B. Brinton).

Chester.—Nottingham Barrens.

103. Sassafras sassafras (L.) Karst.

Abundant on dry barrens.

Delaware.—Fawkes Run; Blue Hill; Mineral Hill; Wawa.

Chester.—Sugartown Barrens; Brinton's Quarry.

†104. Arabis lyrata L.

Common on dry open barrens, banks and depressions.

Delaware.—Bear Hill; Mineral Hill; Middletown Barrens (-), Williamson; Lenni; Wawa.

Chester.—Sugartown Barrens (E. B. Bartram); Serpentine Ridge; Cedar Barrens; West Chester; Sconnelltown; Brinton's Quarry; Unionville.

— Nottingham Barrens.

105. Saxifraga virginiensis Michx.

Frequent on dry open barren, banks and edges of woodland.

Del.—Middletown Barrens; Williamson; Wawa.

†106. Spiræa latifolia Borkh.

Frequent in Serpentine swamps.

Delaware.—Williamson (Dr. J. B. Brinton, Jos. Crawford).

Chester.—Cedar Barrens; West Chester; Unionville.

— Nottingham Barrens.

107. Rubus frondosus Bigel. (?)

Common, especially on edge of dry barren.

Delaware.—Bear Hill; Williamson.

Chester.—Unionville.

— Nottingham Barrens.

108. Potentilla pumila Poir.

Common on dry open barren.

Delaware.—Fawkes Run; Blue Hill; Mineral Hill; Williamson.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester.

†109. Sanguisorba canadensis L.

Frequent in rich Serpentine swamps.

Delaware.—Fawkes Run (B. H. Smith, S. S. Van Pelt); Williamson.

Chester.—Nottingham Barrens.

110. Rosa humilis Marsh.

Frequent on dry open barren and margin of greenbrier.

Delaware.—Fawkes Run; Bear Hill; Middletown Barrens; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

— Nottingham Barrens.

111. Aronia nigra (Willd) Britton.

Occasional on dry open barren.

Delaware.—Fawkes Run; Wawa.

112. Cassia nictitans L.

Frequent on dry open barren.
Delawrae.—Fawkes Run; Williamson; Lenni.
Chester.—Unionville.

113. Cassia chamæcrista L.

Local on dry open barren, banks and depressions.
Delaware.—Williamson.
Chester.—Nottingham Barrens.

114. Baptisia tinctoria (L.) R. Br.

Common on dry open barren.
Delaware.—Fawkes Run; Williamson; Wawa.
Chester.—Sugartown Barrens; Cedar Barrens; Unionville. — Nottingham Barrens.

‡115. Crotalaria sagittalis L.

Occasional on dry open barren.
Delaware.—Williamson; Lenni.
Chester.—Nottingham Barrens.

116. Stylosanthes biflora (L.) B. S. P.

Occasional on dry open barren or sandy bank.
Delaware.—Mineral Hill (I. Burk); Lenni.

117. Meibomia paniculata (L.) Kuntze.

Common on edges of greenbrier or on banks.
Delaware.—Preston Run; Bear Hill; Mineral Hill; Williamson; Lenni.
Chester.—Sugartown Barrens; Unionville.

118. Meibomia dillenii (Darl.) Kuntze.

Frequent on margin of thicket.
Delaware.—Fawkes Run; Williamson; Lenni.
Chester.—West Chester; Brinton's Quarry.

119. Meibomia rigida (Ell.) Kuntze.

Occasional on dry sandy barren.
Delaware.—Williamson; Lenni.

120. Meibomia marylandica (L.) Kuntze.

Frequent or local on dry sandy barren.
Delaware.—Williamson; Lenni.

121. MEIBOMIA OBTUSA (Muhl.) Vail.

Frequent on dry open barren.
Delaware.—Mineral Hill; Williamson.
Chester.—West Chester; Unionville.
— Nottingham Barrens.

122. LESPEDEZA REPENS (L.) Bart.

Occasional on dry sandy barren.
Delaware.—Mineral Hill; Williamson.

123. LESPEDEZA PROCUMBENS Michx.

Occasional on dry sandy barren.
Delaware.—Williamson.

‡124. LESPEDEZA FRUTESCENS (L.) Britton.

Occasional on dry open barren.
Delaware.—Mineral Hill; Lenni.

†125. LESPEDEZA VIRGINICA (L.) Britton.

Common on dry open barren.
Delaware.—Williamson; Lenni; Wawa.
Chester.—Sugartown Barrens; West Chester; Unionville.

126. LESPEDEZA HIRTA (L.) Hornem.

Frequent on dry open barren, and margin of greenbrier.
Delaware.—Preston Run; Mineral Hill; Lenni.
Chester.—West Chester.

†127. LESPEDEZA CAPITATA Michx.

Frequent on dry open barren.
Delaware.—Fawkes Run; Preston Run; Bear Hill; Middletown Barrens; Williamson.
Chester.—Unionville.

†128. STROPHOSTYLES UMBELLATA (Muhl.) Britton.

Local, frequent on the State-line Barrens.
Chester.—Nottingham Barrens.

129. LINUM VIRGINIANUM L.

Frequent in dry woodland.
Delaware.—Fawkes Run; Bear Hill; Wawa.
Chester.—Unionville.

130. Linum medium (Planch.) Britton.

Occasional on dry open barren.
Delaware.—Wawa.
Chester.—West Chester.

131. Linum floridanum (Planch.) Trel.

Occasional on dry open barren.
Delaware.—Bear Hill.
Chester.—Sugartown Barrens.

132. Polygala verticillata L.

Occasional on dry open barren.
Delaware.—Fawkes Run; Preston Run; Wawa.
Chester.—Sugartown Barrens; West Chester.

133. Polygala sanguinea L.

Occasional on dry open barren.
Chester.—Sugartown Barrens; Serpentine Ridge.

134. Polygala senega L.

One specimen seen.
Delaware.—"Newtown" (Dr. Geo. Smith).

135. Rhus copallina L.

Occasional or local on dry barren.
Chester.—Cedar Barrens; West Chester.
— Nottingham Barrens.

136. Rhus glabra L.

Common about edges of thicket and woodland.
Delaware.—Bear Hill; Middletown Barrens; Williamson School (I. A. Keller).
Chester.—Brinton's Quarry.

137. Acer rubrum L.

Common on dry barren, depressions and border-woodland.
Delaware.—Fawkes Run; Bear Hill; Mineral Hill; Middletown Barrens; Williamson; Wawa.
Chester.—Sugartown Barrens; Brinton's Quarry.

138. Ceanothus americanus L.

Common on dry barren.
Delaware.—Fawkes Run; Preston Run; Mineral Hill; Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

—Nottingham Barrens.

139. Vitis æstivalis Michx.

Frequent on margin of or in greenbrier thicket.

Delaware.—Bear Hill; Middletown Barrens; Williamson; Lenni.

Chester.—West Chester; Unionville.

140. Ascyrum hypericoides L.

Local, only on State-line Barrens.

Chester.—Nottingham Barrens.

141. Hypericum punctatum Lam.

Frequent on dry open barren or depressions.

Delaware.—Bear Hill; Williamson.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

142. Sarothra gentianoides L.

Occasional on dry open barrens.

Delaware.—Fawkes Run.

Chester.—Cedar Barrens; West Chester.

†143. Helianthemum majus (L.) B. S. P.

Frequent on dry open barrens.

Delaware.—Fawkes Run; Preston Run; Williamson; Wawa.

Chester.—Sugartown Barrens; West Chester; Unionville.

—Nottingham Barrens.

144. Lechea minor L.

Occasional on dry open barren.

Chester.—Sugartown Barrens; West Chester.

—Nottingham Barrens.

145. Lechea racemulosa Lam.

Occasional on dry open barren.

Chester.—Cedar Barrens.

—Nottingham Barrens.

146. Lechea leggetii Britton and Hollick.

Occasional on dry open barren.

Delaware.—Williamson; Wawa.

Chester.—Sugartown Barrens (E. B. Bartram).

147. Viola pedata lineariloba D. C.

Occasional on dry open barren.

Chester.—West Chester.

†148. Viola fimbriatula Sm.

Apparently more or less intermediate between this and *V. sagittata* Ait., combining the pubescence of the former with the leaf-outline of the latter. Apparently quite uniform, and constant in characters. As neither *V. fimbriatula* Sm. nor *V. sagittata* Ait. occur, except sparingly, in this district, the idea of direct or recent hybridism is excluded.

Common on dry open barren and banks.

Delaware.—Fawkes Run; Preston Run; Bear Hill; Blue Hill; Middletown Barrens; Williamson; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

— Nottingham Barrens.

149. Kneiffia linearis (Michx.) Spach.

Frequent on dry open barren and banks.

Delaware.—"Crum Creek" (J. W. Harshberger); Williamson (J. B. Brinton); Wawa.

Chester.—Cedar Barrens.

150. Kneiffia fruticosa (L.) Raimann.

Frequent on dry open barren and banks.

Delaware.—"Media" (J. B. Brinton).

Chester.—Serpentine Ridge; West Chester.

151. Zizia cordata (Walt.) D. C.

Frequent on dry open barren and edges of thicket.

Delaware.—Williamson.

Chester.—Unionville.

†152. Angelica villosa (Walt.) B. S. P.

Frequent on dry open barren.

Delaware.—Mineral Hill; Williamson; Wawa.

Chester.—Cedar Barrens (S. S. Van Pelt); Unionville.

— Nottingham Barrens.

‡153. Nyssa sylvatica March.

Occasional in woodland.

Delaware.—Williamson (J. W. Harshberger).

Chester.—Unionville.

154. Azalea nudiflora L.

Frequent on edges of thicket.

Delaware.—Mineral Hill; Williamson; Wawa.

Chester.—West Chester.

155. Pieris mariana (L.) Benth. and Hook.

On dry open barren.

Chester.—Nottingham Barrens.

156. Xolisma ligustrina (L.) Britton.

Frequent on dry barrens.

Delaware.—Middletown Barrens.

Chester.—Cedar Barrens.

— Nottingham Barrens.

157. Gaylussacia baccata (Wang.) C. Koch.

Common on dry open barren.

Delaware.—Fawkes Run; Mineral Hill; Williamson; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Unionville.

— Nottingham Barrens.

158. Polycodium stamineum (L.) Greene.

Frequent on dry barrens, edges of woodland or thicket.

Delaware.—Mineral Hill; Middletown Barrens; Williamson; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Unionville.

— Nottingham Barrens.

159. Vaccinium atrococcum (Gray) Heller.

Frequent on edges of thicket or depressions.

Delaware.—Williamson; Wawa.

Chester.—Sugartown Barrens; West Chester.

160. Vaccinium pennsylvanicum Lam.

Occasional on dry open barren.

Delaware.—Fawkes Run.

161. Vaccinium vacillans Kalm.

Common on dry open barren, borders of woodland, and in woodland.

Delaware.—Fawkes Run; Mineral Hill; Williamson; Wawa.

Chester.—West Chester; Unionville.

‡162. Lysimachia quadrifolia L.

Frequent on dry border-woodland or open.

Chester.—Sugartown Barrens; Cedar Barrens.

163. Diospyros virginiana L.

Occasional or local in woodland.

Chester.—West Chester.

— Nottingham Barrens.

†164. Sabbatia angularis (L.) Pursh.

Frequent on dry open barren, edges of thicket and in moist soil, varying greatly in size according to habitat.

Delaware.—Preston Run (A. Jahn); Mineral Hill (I. Burk); Middletown Barrens; Wawa.

Chester.—Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

— Nottingham Barrens.

165. Gentiana crinita Froel.

Local, on dry open barren. Plants dwarfed. Flowers small for the species, paler blue.

Delaware.—Williamson.

166. Asclepias purpurascens L.

Frequent or local on edge of greenbrier thicket.

Delaware.—Williamson.

Chester.—Sugartown Barrens.

*167. Asclepias verticillata L.

Common on dry open barren, ledges of rock, and on banks.

Delaware.—Fawkes Run; Preston Run; Bear Hill; Mineral Hill; Middletown Barrens; Williamson; Lenni.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Sconnelltown; Brinton's Quarry; Marshallton (B. Long); Unionville.

— Nottingham Barrens.

†168. Acerates viridiflora Ell.

Local on dry open barren.

Delaware.—Williamson; Lenni.

Chester.—Unionville.

— Nottingham Barrens.

*169. Phlox subulata L.

Locally abundant on dry open barren.

Delaware.—Fawkes Run; Preston Run (S. S. Van Pelt); Bear Hill; Mineral Hill; Middleton Barrens.

Chester.—Sugartown Barrens; Serpentine Ridge; West Chester; Sconnelltown; Brinton's Quarry; Unionville.

— Nottingham Barrens.

Lancaster.—Fulton Township (J. J. Carter).

*170. Scutellaria parvula ambigua (Nutt.) Fernald

Scarce, on dry open barren.

Delaware.—"Serpentine on West Chester Road" (Dr. Geo. Smith; "Del. Co." (C. E. Smith).

Chester.—West Chester.

Lancaster.—Fulton Township (J. J. Carter)

‡171. Prunella vulgaris L.

Occasional on dry open barren, or edges of woodland.

Delaware.—Wawa.

Chester.—Cedar Barrens.

172. Koellia flexuosa (Walt.) MacM.

Common on dry open barren, depressions and desiccated soil.

Delaware.—Fawkes Run; Preston Run; Bear Hill; Blue Hill; Mineral Hill; Middletown Barrens; Williamson.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Sconnelltown; Brinton's Quarry; Unionville.

— Nottingham Barrens.

173. Dasystoma pedicularia (L.) Benth.

Occasional in dry woodland.

Delaware.—Fawkes Run; Mineral Hill.

Chester.—Unionville.

*174. Gerardia purpurea parvula, subsp. nov.

Stem 1–6 dm. tall, minutely scabrous above, sparingly branched. Branches spreading. Leaves linear, scabrous above, those of the stem 1–3 cm. long, 1–2 mm. broad, mostly with small clusters in their axils. Pedicels 3–4 mm. long. Calyx-tube campanulate, 3 mm. high, its lobes narrowly lanceolate, 1–1.2 mm. long. Corolla pale rose-purple, about 20 mm. long. Capsule globose, 4–5 mm. in diameter.

Differs from *Gerardia purpurea* L. of the Atlantic Coastal Plain in its smaller size, smaller and paler corollas, and smaller capsules.

Serpentine Barrens of southeastern Pennsylvania.

Type.—Serpentine, Wawa, Delaware County, Penna., F. W. Pennell 2689, coll. Sept. 25, 1910, in Herb. Acad. Nat. Sci. Phila.

Locally frequent in depressions, or edges of woodland.

Delaware.—Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens. — Nottingham Barrens.

‡175. Gerardia tenuifolia Vahl.

Frequent in dry border-woodland.

Delaware.—Fawkes Run.

Chester.—Sugartown Barrens.

176. Houstonia cœrulea L.

Common on dry to moist open barren.

Delaware.—Mineral Hill; Williamson; Wawa.

Chester.—Cedar Barrens; West Chester; Unionville.

‡177. Mitchella repens L.

Frequent in dry border-woodland.

Delaware.—Middletown Barrens.

Chester.—Sugartown Barrens.

178. Galium pilosum Ait.

Frequent on dry open barren.

Delaware.—Mineral Hill.

Chester.—Sugartown Barrens; West Chester; Unionville.

†179. Galium boreale L.

Along border and in greenbrier thicket on State-line Barrens.

Chester.—Nottingham Barrens.

180. Lonicera sempervirens L.

Occasional in greenbrier thicket.

Chester.—Cedar Barrens (A. Jahn).

181. Lobelia spicata Lam.

Common on dry open barren.

Delaware.—Bear Hill; Blue Hill; Williamson; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

182. Hieracium venosum L.

Frequent in dry woodland.

Delaware.—Fawkes Run; Wawa.
Chester.—Sugartown Barrens; Unionville.

‡183. Hieracium gronovii L.

Frequent in dry border-woodland.
Delaware.—Bear Hill; Mineral Hill; Williamson.

†184. Nabalus serpentarius (Pursh) Hook.

Frequent in dry woodland.
Delaware.—Williamson; Wawa.
Chester.—Sugartown Barrens; West Chester; Unionville.

‡185. Ambrosia artemisiæfolia L.

Occasional on dry open barren, probably here introduced.
Delaware.—Williamson.
Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Unionville.

186. Vernonia noveboracensis (L.) Willd.

Frequent on moist open or on moist banks.
Delaware.—Williamson.
Chester.—Cedar Barrens; West Chester; Unionville.

187. Vernonia glauca (L.) Willd.

On a grassy bank.
Delaware.—Lenni.

188. Eupatorium pubescens Muhl.

Local, on dry open barren.
Chester.—Nottingham Barrens.

189. Eupatorium perfoliatum L.

Frequent in moist soil, Serpentine swamps, or occasionally on dry open barren.
Delaware.—Bear Hill; Middletown Barrens; Williamson.
Chester.—West Chester; Unionville.

†190. Eupatorium aromaticum L.

Common on dry open barren and border of woodland.
Delaware.—Fawkes Run; Bear Hill; Mineral Hill; Williamson; Wawa.
Chester.—Sugartown Barrens; Cedar Barrens; West Chester.
— Nottingham Barrens.

191. LACINARIA SPICATA (L.) Kuntze.

Local, on dry open barren.
Delaware.—Williamson.

‡192. SOLIDAGO CÆSIA L.

Frequent in dry border-woodland.
Delaware.—Williamson; Lenni; Wawa.

193. SOLIDAGO BICOLOR L.

Common on border of woodland and in dry woodland.
Delaware.—Fawkes Run; Mineral Hill; Middletown Barrens; Williamson; Lenni.
Chester.—Sugartown Barrens; West Chester.

194. SOLIDAGO RUGOSA Mill.

Common on dry barren, especially about edge of thicket.
Delaware.—Preston Run; Bear Hill; Middletown Barrens; Williamson; Lenni.
Chester.—Sugartown Barrens; West Chester; Unionville.

195. SOLIDAGO ASPERA Ait.

On dry barren.
Delaware.—Lenni.

196. SOLIDAGO JUNCEA Ait.

Occasional or local on dry barren.
Chester.—West Chester (E. B. Bartram).
— Nottingham Barrens.

197. SOLIDAGO NEMORALIS Ait.

Common on dry open barren.
Delaware.—Fawkes Run; Preston Run; Bear Hill; Mineral Hill; Middletown Barrens; Williamson; Lenni; Wawa.
Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.
— Nottingham Barrens.

‡198. SOLIDAGO ALTISSIMA L.

Occasional on moist open.
Delaware.—Williamson.
Chester.—Brinton's Quarry.

‡199. EUTHAMIA NUTTALLII Greene.

In moist places along streams or about border of woodland.

Delaware.—Middletown Barrens.
Chester.—Sugartown Barrens; Unionville.

200. Sericocarpus asteroides (L.) B. S. P.

Frequent in dry woodland.
Delaware.—Wawa.
Chester.—Sugartown Barrens; West Chester; Unionville.
— Nottingham Barrens.

201. Aster undulatus L.

Frequent in dry woodland or thicket.
Delaware.—Fawkes Run; Preston Run; Middletown Barrens; Williamson; Lenni.

202. Aster patens Ait.

Local on dry open barren or banks.
Delaware.—Mineral Hill; Lenni.

†203. Aster lævis L.

Common or local on dry open barren, edges of woodland and thicket.
Delaware.—Fawkes Run; Preston Run; Bear Hill; Middletown Barrens; Williamson; Wawa.
Chester.—Sugartown Barrens (E. B. Bartram); West Chester; Brinton's Quarry; Unionville.

204. Aster dumosus L.

Local, on dry barren.
Chester.—Sugartown Barrens.

205. Aster ericoides L.

Common on dry open barren.
Delaware.—Fawkes Run; Preston Run; Mineral Hill; Williamson; Lenni; Wawa.
Chester.—Sugartown Barrens (E. B. Bartram); Sconnelltown; Brinton's Quarry; Unionville.

*206. Aster parviceps pusillus (Gray) Fernald.

Frequent on dry open barren or rock exposures.
Delaware.—Middletown Barrens; Williamson.
Chester.—Serpentine Ridge; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.
— Nottingham Barrens.

207. Aster lateriflorus (L.) Britton.

Common on dry open barren, edges of woodland or thicket.

Delaware.—Fawkes Run; Preston Run; Mineral Hill; Middletown Barrens; Williamson; Lenni; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester; Brinton's Quarry; Unionville.

208. Antennaria neodioica Greene.

Local on dry open barren.

Chester.—West Chester.

209. Antennaria neglecta Greene.

Frequent on dry open barren.

Delaware.—Williamson; Wawa.

Chester.—Sugartown Barrens; Unionville.

210. Antennaria plantaginifolia (L.) Richards.

Frequent on dry open barren or in woodland.

Delaware.—Fawkes Run; Mineral Hill; Wawa.

Chester.—Sugartown Barrens; Cedar Barrens; West Chester.

211. Gnaphalium polycephalum Michx.

Frequent on dry open barren.

Delaware.—Fawkes Run; Preston Run; Williamson.

Chester.—West Chester; Unionville.

†212. Heliopsis helianthoides (L.) Sweet.

Frequent in Serpentine swamp.

Delaware.—Williamson.

Chester.—West Chester; Brinton's Quarry.

— Nottingham Barrens.

†213. Helianthus giganteus L.

Common in moist depressions, greenbrier thickets, or on banks.

Delaware.—Mineral Hill; Middletown Barrens; Williamson; Wawa.

Chester.—Cedar Barrens; West Chester; Unionville.

— Nottingham Barrens.

214. Helianthus divaricatus L.

Local or frequent on dry open barren or banks.

Delaware.—Williamson.

†215. Senecio balsamitæ Muhl.

Common on dry open barren.

Delaware.—Fawkes Run; Mineral Hill; Williamson; Wawa.

Chester.—Sugartown Barrens; Serpentine Ridge; Cedar Barrens; West Chester; Sconnelltown; Brinton's Quarry; Unionville.

— Nottingham Barrens.

216. Cirsium discolor (Muhl.) Spreng.

Occasional on dry open barren or edge of thicket.

Delaware.—Mineral Hill; Williamson; Lenni.

Chester.—West Chester.

†217. Cirsium muticum Michx.

Frequent in moist depression, greenbrier thicket.

Delaware.—Mineral Hill; Williamson.

Chester.—West Chester.

— Nottingham Barrens.

II. Occasional Species of the Conowingo Barrens, Mostly Stragglers from Surrounding Flora.

1. Asplenium filix-fœmina (L.) Bernh.

Delaware.—Williamson.

2. Dryopteris noveboracensis (L.) A. Gray.

Delaware.—Fawkes Run.

3. Dryopteris marginalis (L.) A. Gray.

Chester.—Cedar Barrens.

4. Phegopteris hexagonoptera (Mx.) Fée.

Delaware.—Williamson; Wawa.

5. Typha latifolia L.

Delaware.—Williamson.

6. Andropogon virginicus L.

Delaware.—Lenni.

7. Paspalum circulare Nash.

Delaware.—Lenni.

8. Panicum capillare L.

Chester.—Cedar Barrens.

9. Panicum gattingeri Nash.

Chester.—Cedar Barrens.

10. Panicum virgatum L.
Delaware.—Lenni.

11. Panicum microcarpon Muhl.
Delaware.—Williamson.

12. Panicum lindheimeri Nash.
Delaware.—Middletown Barrens.

13. Panicum tennesseense Ashe.
Delaware.—Middletown Barrens.

14. Panicum commonsianum Ashe.
Delaware.—Wawa (C. S. Williamson).

15. Panicum addisonii Nash.
Chester.—Brinton's Quarry.

16. Panicularia nervata (Willd.) Kuntze.
Delaware.—Williamson.

17. Cyperus diandrus Torr.
Chester.—West Chester; Unionville.

18. Dulichium arundinaceum (L.) Britton.
Delaware.—Williamson.

19. Eleocharis palustris glaucescens (Willd.) A. Gray.
Chester. West Chester.

20. Scirpus cyperinus (L.) Kunth.
Chester.—Nottingham Barrens.

21. Tradescantia virginica L.
Chester.—Cedar Barrens.

22. Salomonia commutata (R. and S.) Britton.
Delaware.—Williamson.

23. Hypoxis hirsuta (L.) Coville.
Chester.—West Chester.

24. Peramium pubescens (Willd.) MacM.
Delaware.—Middletown Barrens.

25. Achroanthes unifolia (Michx.) Raf.
Chester.—Nottingham Barrens.

26. Carpinus caroliniana Walt.
Chester.—Cedar Barrens.

27. Quercus rubra L.
Delaware.—Williamson; Lenni.

28. Quercus velutina Lam.
Chester.—Unionville.

29. Bœhmeria cylindrica (L.) Sev.
Delaware.—Williamson.

30. Polygonum scandens L.
Delaware.—Lenni.

31. Polygonum sagittatum L.
Delaware.—Williamson.
Chester.—Unionville.

32. Polygonum arifolium L.
Delaware.—Williamson.

33. Benzoin benzoin (L.) Coulter.
Delaware.—Williamson.

34. Rubus occidentalis L.
Chester.—Unionville, yellow fruit.

35. Rubus villosus Ait.
Delaware.—Blue Hill.

36. Amelanchier canadensis (L.) Medic.
Chester.—Unionville.

37. Falcata comosa (L.) Kuntze.
Delaware.—Williamson.

38. Oxalis violacea L.
Chester.—Cedar Barrens.

39. Oxalis stricta L.
Delaware.—Williamson.

40. Euphorbia maculata L.
Delaware.—Wawa.

41. Euphorbia nutans Legg.
Delaware.—Lenni.

42. Euphorbia corollata L.
Delaware.—Mineral Hill; Lenni.

43. Rhus typhina L.
Delaware.—Wawa.

44. Celastrus scandens L.
Delaware.—Williamson.

45. Impatiens biflora Walt.
Delaware.—Williamson.

46. Viola palmata L.
Delaware.—Mineral Hill.

47. Parsonsia petiolata (L.) Rusby.
Chester.—Sugartown Barrens.

48. Sanicula marylandica L.
Chester.—Unionville.

49. Cornus alternifolia L. f.
Chester.—"Willistown Barrens" (C. S. Williamson).

50. Pyrola americana Sweet.
Chester.—Unionville.

51. Pyrola elliptica Nutt.
Delaware.—Williamson.
Chester.—Unionville.

52. Chimaphila maculata (L.) Pursh.
Chester.—Unionville.

53. Chimaphila umbellata (L.) Nutt.
Chester.—Unionville.

54. Kalmia latifolia L.
Delaware.—Williamson.

55. Epigæa repens L.
Chester.—Unionville.

56. Polycodium candicans (C. Mohr) Small.
Chester.—Sugartown Barrens (E. B. Bartram).

57. Apocynum milleri Britton.
Delaware.—Mineral Hill.

58. Asclepias syriaca L.
Delaware.—Wawa.

59. Phlox pilosa L.
Delaware.—Williamson.

60. Trichostema dichotomum L.
Delaware.—Wawa.

61. Scutellaria pilosa Michx.
Chester.—Unionville.

62. Scutellaria integrifolia L.
Delaware.—Mineral Hill.
Chester.—Cedar Barrens.

63. Cunila origanoides (L.) Britton.
Delaware.—Fawkes Run.

64. Chelone glabra L.
Delaware.—Williamson.

65. Leptandra virginica (L.) Nutt.
Chester.—West Chester.

66. Dasystoma flava (L.) Wood.
Chester.—Cedar Barrens.

67. Castilleia coccinea Spreng.
Delaware.—Williamson.

68. Galium triflorum Michx.
Delaware.—Williamson.

69. Galium asprellum Michx.
Delaware.—Williamson.

70. Sambucus canadensis L.
Chester.—Unionville.

1. Viburnum prunifolium L.
Delaware.—Williamson.

72. Lactuca spicata (Lam.) Hitchc.
Delaware.—Williamson; Lenni.

73. Nabalus albus (L.) Hook.
Delaware.—Williamson.
Chester.—Sugartown Barrens.

74. Aster cordifolius L.
Delaware.—Williamson.

75. Aster puniceus L.
Delaware.—Fawkes Run.
Chester.—Unionville.

76. Erechtites hieracifolia (L.) Raf.
Delaware.—Williamson.

77. Cirsium pumilum (Nutt.) Spreng.
Delaware.—Middletown Barrens.

III. Some Prominent Introduced Species.

1. Syntherisma linearis (Kroek.) Nash.
Occasional on dry open barren.
Delaware.—Mineral Hill.
Chester.—Marshallton (B. Long).

2. Anthoxanthum odoratum L.
Common on dry open barren.
Chester.—Serpentine Ridge.

3. Eragrostis pilosa (L.) Beauv.
Occasional on banks, etc.
Delaware.—Lenni.

4. Poa pratensis L.
Common on dry open barren.
Chester.—Cedar Barrens; West Chester; Unionville.

5. Festuca octoflora Walt.

On dry sandy exposures.
Delaware.—Blue Hill.

6. Stenophyllus capillaris (L.) Britton.

Probably introduced, on railroad ballast and barren ground.
Delaware.—Williamson (A. MacElwee).
Chester.—Marshallton (B. Long).

7. Arenaria serpyllifolia L.

On dry sandy banks.
Chester.—Sconnelltown.

RECORDS OF GEORGIA AND FLORIDA ORTHOPTERA, WITH THE DESCRIPTIONS OF ONE NEW SPECIES AND ONE NEW SUBSPECIES.

BY JAMES A. G. REHN AND MORGAN HEBARD.

The following records are based almost entirely on material belonging to the collection of the State of Georgia contained in the State House at Atlanta. This series was submitted to us for examination through the kind services of Mr. J. Chester Bradley, of Cornell University, who collected a large proportion of the specimens. Where no collection is indicated in the following pages the material belongs to the State series, and unless otherwise stated the localities given are in Georgia. A considerable proportion of the species here treated are recorded for the first time from Georgia or Florida, while our knowledge of several of the species has until this date rested on but one or two records.

The new *Chortophaga* is a rather widely distributed form in the Gulf region, while the new *Nemobius* is apparently a localized type.

DERMAPTERA.

LABIIDÆ.

Labia minor (Linnæus).

Atlanta, September 19, 1908. One male.

This species has been recorded from Thomasville.[1]

Labia burgessii Scudder.

Brunswick, April 8. One male.

The United States records for this species, aside from one from Massachusetts no doubt due to accidental introduction, are all from southern and eastern Georgia and Florida and central Alabama.

Anisolabis annulipes (H. Lucas).

St. Simon's Island, September 8, 1904. One female. Tybee Island, June 30 (Dr. D. M. Castle.) One male, one female.

The only previous record of the species from Georgia was from Thomasville.

ORTHOPTERA.

BLATTIDÆ.

Ischnoptera uhleriana fulvescens Sauss. & Zehntn.

Fernandina, Fla. One male.

Isohnoptera borealis Brunner.

Fernandina, Fla. Two males.

Ischnoptera bolliana Sauss. & Zehntn.

Brunswick. One male.

Atlanta, July 6, 1909. One female.

Blattella germanica (Linnæus).

Brunswick. One female.

Blatta orientalis Linnæus.

Atlanta, July 25, 1908. One female.

Periplaneta americana (Linnæus).

Bainbridge, July 15–27, 1909. (J. C. Bradley.) Three males, one female.

Jacksonville, Fla., September 11. Two females.

Periplaneta brunnea Burmeister.

Bainbridge, July 15–27, 1909. (J. C. Bradley.) One male, two females.

Jacksonville, Fla., September 11. One female.

This species has previously been reported from Jacksonville and Thomasville, Ga., as well as Victoria, Tex.

Chorisoneura plocea Rehn.

Marietta, June 7, 1909. One female.

This is but the second specimen known of this species which was originally described from the coast of South Carolina. The pronotum of the Marietta specimen has a meso-caudal patch and a pair of subarcuate lateral bars of dark brown.

Cryptocercus punctulatus Scudder.

Rome, August 31. One female.

Clayton, August 18. One male.

These are the first records of the species from Georgia. The localities show that the species is essentially one of the Appalachian region, as far as its range east of the Sierra Nevada is concerned.

MANTIDÆ.

Stagmomantis carolina (Johannson).

Bainbridge, July 15–27, 1902. (J. C. Bradley.) Two immature individuals.

Tallapoosa, July 24, 1908. One immature individual.

Thesprotia graminis (Scudder).

Bainbridge, July 15–27, 1909. (J. C. Bradley.) One adult male.

PHASMIDÆ.

Diapheromera femorata (Say).

Jasper, October 31, 1907. One female.

This is the most southern exact record known for the species, and on comparison with Pennsylvania material no difference is noticed. A female specimen from Greenville, South Carolina, has also been examined.

ACRIDIDÆ.

Acrydium arenosum (Burmeister).

Bainbridge, July 15–27, 1909. (J. C. Bradley.) Three males.

Neotettix femoratus Scudder.

Chester, May 26, 1904. One female.

Bainbridge, July 15–27, 1909. (J. C. Bradley.) Two males.

All three specimens are short-winged.

Paxilla obesa (Scudder).

Gardi, Wayne County, April 7, 1902. Two females.

This is the first definite Georgia record for the species, which was originally described from that State without specified exact locality.

Tettigidea lateralis (Say).

Chester, May 26 and June 2, 1904. Two females.

Truxalis brevicornis (Johannson).

Atlanta, August 14, 1909. One male.

Rome, August 31. One male.

Toccoa, August 15. One male, one female.

Syrbula admirabilis (Uhler).

Dalton, August 29. One male.

Amblytropidia occidentalis (Saussure).

Albany, March 28. One male.

Orphulella olivacea (Morse).

St. Simon's Island, September 8 and 9, 1909. Two females.

One of these specimens is extremely large when compared with individuals from Connecticut or New Jersey, measuring as follows: length of body, 28.5 mm.; length of pronotum, 5.2; length of tegmen, 25; length of caudal femur, 17.5. The other individual is similar to the normal size of the species as exemplified by topotypic material from the two above-mentioned States.

Orphulella pelidna (Burmeister).

Waynesville. Three males, six females.

Tallulah Falls, August 3, 1909. One female.

Chester, May 30 to June 16, 1904. Two males, one female.

Bainbridge, July 15–27, 1909. (J. C. Bradley.) Two females.

St. Simon's Island, September 8–9, 1909. Two males.

Dichromorpha viridis (Scudder).

Bainbridge, July 15–27, 1908. (J. C. Bradley.) One male.

Okefenokee Swamp, September 11. (J. C. Bradley.) One male, four females.

Waynesville. One female.

Two of the females from the Okefenokee Swamp are macropterous, the other specimens being of the more usual brachypterous type.

This species has been recorded from Savannah, Tybee Island, Thomasville, Waycross and West Point, Ga.

Clinocephalus elegans pulcher (Rehn and Hebard).

St. Simon's Island, September 8, 1909. One male.

This specimen greatly resembles individuals of the same sex from Cedar Keys, Fla.

Arphia granulata Saussure.

Waynesville. Two males, one female.

This is the second record for the species from Georgia, the first being from Thomasville.

Arphia xanthoptera (Burm.).

Austell, September 6. Two males.

The only previous Georgia records are from Sand Mountain, Thomasville and Waycross.

Arphia sulphurea (Fabr.).

Brunswick, April 6, 1902. One male, one female.

The previous exact Georgia records are from Sand Mountain, Jasper and Thomasville.

Chortophaga viridifasciata (De Geer).

Toccoa, August 15. One male.

Dalton, August 29. One female.

Atlanta, July 31, 1909. One female.

Halls, June 7, 1906. One female.

Austell, September 6. One male.

Marshallville, May 5, 1902. One female.

The Halls and Marshallville specimens are in the green phase. Marshallville is the most southern locality from which we have seen true *viridifasciata*, all the other references from localities to the southward prove, as far as we have been able to examine them, to belong to the following species.

Chortophaga australior n. sp.

1905.[1] *Chortophaga viridifasciata* Rehn and Hebard (not of DeGeer), Proc. Acad. Nat. Sci. Phila., 1904, p. 786. [Thomasville, Ga.]
1905. *Chortophaga viridifasciata* Rehn and Hebard (not of DeGeer), *ibid.*, 1905, p. 38. [Miami, Chokoloskee and Key West, Fla.]
1907. *Encoptolophus costalis* Rehn and Hebard (not of Scudder), *ibid.*, 1907, pp. 289, 290. [Ocklockonee River and Thomasville, Ga.; Chokoloskee, Miami, Cedar Keys, Gainesville, Pablo Beach and Jacksonville, Fla.]

Types: ♂ and ♀; Thomasville, Thomas County, Ga. December 10, 1902. (Morgan Hebard.) [Acad. Nat. Sci. Phila.]

This species is closer related to *C. cubensis* than to *C. viridifasciata* and *C. meridionalis*, differing from *cubensis* in the following particulars: the male sex has the fastigium less excavate, the eyes less prominent, the caudal portion of the disk of the prozona less bullate and the median carina of the pronotum more uniformly elevated and less broadly severed; the female has the median carina of the pronotum more arcuate and very narrowly severed, the caudal femora slenderer and the form more compressed (in this respect resembling *viridifasciata*).

From *C. viridifasciata* the new form differs in the less strongly keel-like median carina of the pronotum, in the less acute angle of the caudal margin of the pronotum, in the broader fastigium and in the markedly different color pattern, which is essentially that of *C. cubensis*.

Size medium; form moderately compressed. Head with the occiput moderately arcuate; fastigium considerably declivent, acute-angulate cephalad, the very narrow apex passing into the frontal costa, the male having the cephalic angle much sharper and the fastigial width much less than in the female, the latter with the width slightly more than the length, disk slightly excavated; lateral foveolæ trigonal, not excavate; facial outline nearly straight (♂) or slightly arcuate (♀), subangulate with the fastigium in the male, rounded in the female; frontal costa rather narrow, considerably constricted dorsad of the insertion of the antennæ, slightly so ventrad of the same, moderately expanding toward the clypeal suture, sulcate for a distance ventrad of the ocellus, punctate dorsad; eyes rather prominent in the male, hardly so in the female, reniform-ovate in shape, the length subequal to (♀) or slightly exceeding (♂) that of the infra-

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[1] Probably the following refer to this species:

1904. *Chortophaga viridifasciata* Morse, Publ. No. 18, Carneg. Inst. Wash., p. 33. (Part.)
1905. *Chortophaga viridifasciata* Caudell, Ent. News, XVI, p. 217. [Key West and Palm Beach, Fla.]

ocular sulcus; antennæ subdepressed, the apex more so than the proximal and median portions and very slightly expanded. Pronotum with the median carina considerably elevated, subcristate, not or slightly arcuate cephalo-caudad, the intersection of the principal sulcus being very appreciable, though not deeply severing the crest; lateral carinæ irregular, composed chiefly of tubercles, broken mesad; cephalic margin of the disk obtuse-angulate, caudal margin of the disk rectangulate to slightly acute-angulate; lateral lobes with the greatest depth about equal to the greatest length. Tegmina surpassing the tips of the caudal femora by about the length of the head, rather broad, obliquely rotundato-truncate at the apex; intercalary vein proximad very close to the ulnar vein, mesad equidistant from the ulnar and median veins. Interspace between the mesosternal lobes subquadrate in the male, slightly transverse in the female; metasternal lobes with an extremely narrow interspace in the male, the interspace subquadrate in the female. Caudal femora more robust in the female than in the male, the greatest width contained three and one-half times in the length in the male, three times in the female.

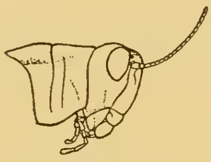

Fig. 1. — *Chortophaga australior* n. sp. Lateral outline of head and pronotum of female type. (×2.)

Green Phase.—Head, pronotum, pleura, caudal femora, a longitudinal bar on the medio-proximal portion of the tegmina, a median, and a costal premedian patch on the same apple-green; remainder of tegmina and venter brownish, the venter inclined toward raw umber, the sutural half of the tegmina mars-brown with a pattern of obsolete darker maculations, blending into the clove-brown areas on the costal half of the tegmina. Dorsum of the caudal femora marked with median, premedian and preapical patches of clove-brown, the median the largest and triangular in shape, the markings being placed in juxtaposition to clove-brown areas on the tegmina; ventral faces of the caudal femora black with two whitish bands, one median and the other preapical, genicular region clove-brown; caudal tibiæ glaucous, the genicular extremity clove-brown with a patellar spot of pale greenish and a broad complete yellowish-white annulus, spines yellowish with black tips; caudal tarsi pale ochraceous. Caudal margin of pronotal disk

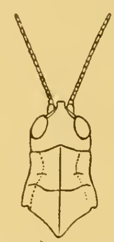

Fig. 2.—*Chortophaga australior* n. sp. Dorsal outline of head and pronotum of female type. (× 2.)

with a number of ill-defined dark blotches. Eyes umber, irregularly divided into two shades; antennæ mars-brown. Wings with the disk yellow.

Brown Phase.—Similar to the green phase except that the green of the latter is replaced with clay color, ochraceous or ochraceous-buff, much marked with clove-brown on the head, pronotum and pleura, and usually with a more or less distinct paler decussate pattern on the dorsum of the pronotum, the lateral lobes of the pronotum more r less striate cephalo-caudad with dark color.

Measurements.

	♂	♀
Length of body	18 mm.	24.5 mm.
Length of pronotum	4.5 "	6 "
Greatest width of pronotum (disk)	3 "	4 "
Length of tegmen	18 "	21.5 "
Length of caudal femur	12 "	13.8 "

Considerably over a hundred specimens of this species have been examined by us in the past few years and the species shares the characters of *Chortophaga* and *Encoptolophus* to such an extent that the above synonym can be explained on that ground. It appears that the species replaces *C. viridifasciata* in at least the extreme southeastern part of the country ranging as far as known from Thomasville and Waynesville, Ga., south to Apalachicola, Miami, Chokoloskee and Key West. Its range probably meets that of *C. viridifasciata* in south-central Georgia as we have seen the latter from Marshallville in that region. No doubt the references to *C. viridifasciata* from the region frequented by the new form will on the examination of the material prove to belong to *australior*. The species is known to us from the following material:

St. Simon's Island, Ga. September 9, 1909. Six males, seven females. (Coll. State of Georgia.)

Brunswick, Ga. April 6. Two females. (Coll. State of Georgia.)

Waynesville, Ga. Five males, two females. (Coll. State of Georgia.)

Thomasville, Ga. Ninety-two specimens (Hebard and Rehn). (A. N. S. P. and Hebard Coll.)

Bainbridge, Ga. July 15–27, 1909. (J. C. Bradley.) Six males, four females. (Coll. State of Georgia.)

Apalachicola, Fla. July 21–23, 1909. (J. C. Bradley.) One male, one female. (Coll. State of Georgia.)

Fernandina, Fla. September 12. One male.

Pablo Beach, Fla. August 11 and 12, 1905. (Hebard and Rehn.) Three males, four females. (A. N. S. P. and Hebard Coll.)

Jacksonville, Fla. August 11, 1905. (Hebard and Rehn.) One female. (Hebard Coll.)

Gainesville, Fla. August 17, 1905. (Hebard and Rehn.) One male. (Hebard Coll.)

Cedar Keys, Fla. August 15, 1905. (Hebard and Rehn.) One male. (Hebard Coll.)

Tampa, Fla. January 16 and 17, 1904. (Hebard.) Three specimens. (Hebard Coll.)

Chokoloskee, Fla. Four specimens. (A. N. S. P. and Hebard Coll.)

Miami, Fla. January, February, July. Key West, Fla. January 18 and 19, 1904. (Hebard.) Thirty specimens. (A. N. S. P. and Hebard Coll.)

Individual variation in size is considerable in the species, this being equally noticeable in both sexes. Numerous slight modifications of the distribution, shape and intensity of the maculations are to be found in any considerable series and occasionally a green individual will exhibit a rusty red suffusion on the dorsum of the head and pronotum.

Hippiscus phœnicopterus (Burm.).

Tallulah Falls. June 19–25, 1909. (J. C. Bradley.) Two males.

Cornelia. July 17, 1909. One female.

Chickamauga, Ga. June 24–26, 1898. (H. L. Viereck.) Two females. (A. N. S. Phila.)

Chester. June 2 and 14, 1909. One male, one female.

This species has previously been recorded from five localities in northern Georgia (Trenton, Sand Mountain, Jasper, Bolton and Stone Mountain) and one in the extreme southern portion (Thomasville).

Hippiscus rugosus (Scudder).

Dalton. August 29. Nine males, three females.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) Six females. The wings of these specimens are yellow or some shade of red.

Dissosteira carolina (Linnæus).

Austell. September 6. Two females.

Pomona. June 3 and 18, 1907. One male, one female.

Chester. June 2, 1904. One male.

Spharagemon bolli Scudder.

Tallulah Falls. June 19–August 8, 1909. Two males, one female.

Spharagemon cristatum Scudder.

Albany. May 6, 1902. One male.

This is the only Georgian record of the species, which is apparently rare east of the Mississippi. The only previous records from the southeastern States are from Dingo Bluffs, N. C., and Tallahassee, Fla.

Spharagemon collare wyomingianum (Thomas).

Fernandina, Fla. One female.

The only previous record of this species from Florida is from Gainesville.

Scirtetica picta (Scudder).

Chester. June 2, 1904. One male.

Albany. March 28 and May 6. One male, one female.

Lanark, Fla. July 20, 1909. One male.

These are the first specific references of the occurrence of the species in Georgia.

Psinidia fenestralis (Serville).

St. Simon's Island. September 9, 1909. Eleven males, two females.

Waynesville. One male.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One male.

Brunswick. September. One male. (A. N. S. P.)

Fernandina, Fla. September 12. One female.

The only previous Georgia records were from Tybee Island and Thomasville.

Trimerotropis citrina Scudder.

St. Simon's Island. September 9, 1909. One male, one female.

Waycross. September 10, 1909. One female.

Austell. September 6. One male, one female.

Chester. May 30–June 14, 1904. One male, six females.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One male, one female.

Apalachicola, Fla. July 21–23, 1909. (J. C. Bradley.) One male.

The Waycross and Austell specimens are distinctly suffused with pale pinkish-red, while the remaining specimens are grayish or very pale ochraceous, the tegminal maculations occurring more or less distinctly in all the individuals.

The previous Georgia records for this species were from Tybee Island, Thomasville, Metcalfe, Marietta, Stone Mountain and Trenton.

Trimerotropis saxatilis McNeill.

Stone Mountain. July 11, 1909. Two males.

This most interesting saxicolous species has been recorded from but two localities in the eastern States—Stone Mountain and Sand Mountain, Ga., where Morse[2] found it frequenting the weathered surfaces of rocky ledges.

The two specimens before us are blackish in general color with the paler maculations of the ventral half of body and of the limbs very decided, the usual pale tegminal markings very dull, poorly contrasted and brownish in color.

Dictyophorus guttatus (Stoll).

Apalachicola, Fla. July 21–23, 1909. (J. C. Bradley.) Three males, two females.

One male and both of the females belong to the melanistic phase of the species.

Leptysma marginicollis (Serville).

Okefenokee Swamp. September 11. One male.

Fernandina, Fla. April 8.

The Okefenokee male is somewhat smaller than a male from Miami, Fla., being about equal in size to specimens of the same sex from Raleigh, N. C.

Schistocerca obscura (Fabricius).

St. Simon's Island, Ga. September 8, 1909. Three males, one female.

Fernandina, Fla. September 12. One female.

These specimens agree fully with material from Gainesville and Pablo Beach, Fla.

Schistocerca americana (Drury).

Atlanta. July 16, 1905. One male.

Waynesville. One male.

Tallulah Falls. June 19–25, 1909. (J. C. Bradley.) One male.

Schistocerca damnifica (Saussure).

Atlanta. April 12. Four males, one female.

Chester. April 8, 1904. One male.

Albany. March 28, 1902. One male.

Waynesville. One female.

Brunswick. April 6, 1902. One male.

The Brunswick individual possesses quite long wings, these measuring 25 mm. in length to the body's 26.5 mm.

Eotettix pusillus Morse.

Thomasville. December 3, 1903. Two females. (Morgan Hebard.) [Hebard Collection.]

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[2] Publ. No. 18, Carneg. Inst., Wash., pp. 15 and 37.

These specimens are perfectly typical of this species, previously known only from Waycross, Ga., and Denmark, S. C.

Melanoplus propinquus Scudder.

St. Simon's Island. September 8–9, 1909. Two males.

Chester. June 14, 1904. One male, one female.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One female.

Paroxya atlantica Scudder.

St. Simon's Island. September 8–9, 1909. One male, three females.

Paroxya floridiana (Thomas).

Apalachicola, Fla. July 21–23, 1909. (J. C. Bradley.) One female.

Okefenokee Swamp. September 11. Four males, seven females.

These specimens are very similar in size to individuals from Pablo Beach, Fla.

TETTIGONIDÆ.

Amblycorypha uhleri Stål.

Toccoa. August 15. Two males.

Tallapoosa. July 24, 1908. One male.

This species has previously been recorded from "Georgia" and Thomasville and Thompson's Mills, Ga.

Microcentrum rhombifolium (Saussure).

Atlanta. September 7, 1907. One male.

Microcentrum retinerve (Burmeister).

Austell. September 6. Three males.

This species is here for the first time recorded with exact data from Georgia.

Orchelimum militare Rehn and Hebard.

Okefenokee Swamp. September 11–16. Two males, three females.

This species was described from Gainesville, Fla., and is known to range to extreme southern North Carolina.

Orchelimum glaberrimum (Burmeister).

Waynesville. One male.

This specimen has the reddish head seen in numerous specimens of the species. The only previous records from the State with exact locality were from Thomasville and Thompson's Mills.

Orchelimum volantum McNeill.

Okefenokee Swamp. September 10. One female.

This specimen has previously been recorded only from Illinois.

Indiana and extreme southern Ontario. When compared with a female from Point Pelee, Ontario, the Okefenokee individual, while slightly larger, is seen to be identical with the exception of the slightly narrower ovipositor.

Neoconocephalus retusus (Scudder).

Waycross. September 10, 1909. Four males, two females.

Conocephalus fasciatus (De Geer).

Okefenokee Swamp. September 11. One female.

This locality and Thomasville are the only Georgia localities from which the species has been recorded.

Atlanticus dorsalis (Burm.).

Tallulah Falls, June 19–25, 1909. One female.

This is the only Georgia record for the species.

GRYLLIDÆ.

Tridactylus apicalis Say.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) Three specimens.

This is the first exact record for the species from Georgia.

Tridactylus terminalis Uhler.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) Two specimens.

This species has previously been recorded from Thomasville by the authors.

Nemobius fasciatus socius[3] (Scudder).

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One male, one female.

Nemobius ambitiosus Scudder.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One male.

The only previous record of the occurrence of this species in Georgia was of its capture at Thomasville.

Nemobius aterrimus Scudder.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) Two males.

The only previous records of this species were from Jacksonville (type locality) and Tampa, Fla.

Nemobius cubensis Saussure.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One male, one female.

The only previous exact Georgia record of this species was of its occurrence at Thomasville.

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[3] The record of *N. maculatus* from Thomasville, Ga., made by the present authors (*Proc. Acad. Nat. Sci. Phila.*, 1904, p. 799) is erroneous, as the specimens are brachypterous individuals of the present species.

Nemobius palustris aurantius n. subsp.

1905. *Nemobius carolinus* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1904, p. 801. (Not of Scudder, 1877.)

Types; ♂ and ♀; Thomasville, Thomas County, Georgia. December 6, 1903. (In sphagnum swamp; M. Hebard.) [Hebard Collection.]

This form shows no constant structural difference to separate it from the more northern *palustris*, but a series of fourteen individuals of both sexes all agree in being most strikingly colored, quite distinct in this respect from true *palustris*. The new form has the head and pronotum ochraceous-rufous, the limbs almost uniform ochraceous and the tegmina shining black or brownish-black. The contrasting coloration is quite distinctive and varies but little in tone in the series. At the present time it seems best to regard *aurantius* as a form of *palustris*, although it may at some future date be shown to be worthy of specific rank.

The types measure as follows:

	♂	♀
Length of body	6.5 mm.	7 mm.
Length of pronotum	1.2 "	1.5 "
Length of tegmen	3.8 "	3.2 "
Length of caudal femur	4.2 "	4.8 "
Length of ovipositor		3.5 "

Gryllus firmus Scudder.

St. Simon's Island. September 8–9, 1909. Four males, three females.

This is the only Georgia record with exact data for the species.

Gryllus rubens Scudder.

Chester. April 7–8, 1904. One male, one female, one nymph.

Dalton. August 26. One male.

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One male.

The only previous Georgia record of this species was from Thomasville.

Miogryllus saussurei (Scudder).

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One female.

This species has been recorded from Roswell, Ga., and "Georgia" without exact locality.

Œcanthus angustipennis Fitch.

Toccoa. August 15. One male.

The only previous Georgia record of this species is from Thompson's Mills (Allard).

Œcanthus quadripunctatus Beutenmüller.

Chester. June 14, 1904. One male, two females.

Atlanta. July 3, 1909. One male, one female.

This species has been recorded from Thompson's Mills and Thomasville, Ga.

Cyrtoxipha columbiana Caudell.

Bainbridge, July 15–27, 1909. One male, one female.

The only previous Georgia record of this species is of its occurrence at Thompson's Mills.

Phylloscyrtus pulchellus (Uhler).

Bainbridge. July 15–27, 1909. (J. C. Bradley.) One female.

Toccoa. August 15. Five males, five females, two immature specimens.

The only previous exact record of this species in Georgia was of its occurrence at Thompson's Mills.

LITTLE KNOWN NEW JERSEY FISHES.

BY HENRY W. FOWLER.

The following notes on rare or neglected fishes from New Jersey, are based on material now in the Academy, unless otherwise stated. I have also mentioned some others to show interesting associations.

Alopias vulpes (Gmelin).

One was reported taken off Atlantic City on May 14, said to have been 15 feet long. Not in the Academy.

Eulamia obscura (Le Sueur).

I examined the jaws of an example, now in the New Jersey State Museum and evidently this species, taken at Perth Amboy in 1850, submitted to me by Mr. S. R. Morse.

Squatina squatina (Linnæus).

The first record of this fish is in 1847, from Delaware Bay,[1] and an old dried skin in the collection of the Academy, without data, is very likely the original specimen. It has also been recorded from Atlantic City.[2]

Dasyatis say (Le Sueur).

One taken at Barnegat in August by Mr. R. B. Farley proves to be this species.

Acipenser sturio Linnæus.

A large example was taken, in a net, in the Delaware River at Beverly late in August. Not in the Academy.

Tarpon atlanticus (Valenciennes).

The first record for this species is by Baird, who says, in 1874, it has "been noted as occurring more or less frequently along the coast of New Jersey."[3] An example, said to have weighed 120 pounds, was reported from Seabright later,[4] and the same record says "several reported between Cape May and Fire Island in the past ten years."

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[1] *Squatina dumerili*, in *Proc. Acad. Nat. Sci. Phila.*, 1847, p. 246.

[2] *Squatina angelus* Gaskill, *Forest and Stream*, XXXVI, August 13, 1891, p. 68.

[3] *Megalops thrissoides* Baird, *Forest and Stream*, III, July 30, 1874, p. 338.

[4] *Forest and Stream*, XXV, August 20, 1885, p. 70.

Other records[5] refer to one taken in a pound at Stone Harbor said to have been 3½ feet long, and one in a net at Atlantic City about the same time, estimated to have weighed 100 pounds. Not in the Academy.

Albula vulpes (Linnæus).

Reported in the New York market, where it was said to have been brought from New Jersey.[6] Not in the Academy.

Though the alewives are very abundant fishes, I have secured but few of *Pomolobus mediocris*, where I found a number at Seaside Park on July 28, 1909 I have a small example of *P. æstivalis* from Jersey City, taken in May, 1909, by Mr. T. D. Keim.

Leptocephalus conger (Linnæus).

A small example was taken at Ocean City during the past summer by Mr. D. McCadden.

Felichthys marinus (Mitchill).

In 1884 many were said to have been reported from the Mullica River.[7] A "salt water catfish" is also reported by Hulit from Asbury Park.[8] Not in the Academy.

Ameiurus natalis prosthistius (Cope).

Mr. J. F. Street secured an example in the Rancocas Creek at New Lisbon, in Burlington County, on September 11, which is the first instance of its occurrence in the Delaware River valley. He also found some very dark examples of *Abramis crysoleucas* at the same time, though they were not preserved.

Fundulus luciæ (Baird).

Dr. R. J. Phillips and the writer found this species in some numbers in the salt ponds at Corson's Inlet, on April 3, associated with *F. heteroclitus macrolepidotus*, *Cyprinodon variegatus* and *Gasterosteus aculeatus*. They were usually found with the killies, though prawns and pursy minnows were occasionally their only companions.

Lucania parva (Baird).

I found this little fish abundant with *F. heteroclitus macrolepidotus* at Manasquan Inlet on July 19, also associated with *Anguilla chrisypa*, *Cyprinodon variegatus* and *Menidia beryllina cerca*.

Gambusia gracilis Heckel.

I again found this species common in the streams about Cape May,

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[5] *Forest and Stream*, XLVII, July 11, 1896, p. 31.
[6] *L. c.*, XI, October 10, 1878, p. 208.
[7] *L. c.*, XXIV, August 14, 1884, p. 50.
[8] *L. c.*, LI, August 27, 1898, p. 169.

such as Pond and New England Creeks, though only few were met with in Coxe's Hall Creek, on October 24, 1909. The latter is the most northern stream in which I have yet noted it. In Fishing Creek it was not found, though *Abramis crysoleucas, Umbra pygmæa, Aphredoderus sayanus, Enneacanthus obesus* and *Eupomotis gibbosus* were common.

Exocœtus volitans Linnæus.

Dr. H. Tucker found 2 examples on the beach at Cape May City during the past August. Though these specimens were in bad condition and not preserved, Dr. Tucker is certain of their identity with Atlantic specimens in the collection.

Fistularia tabacaria Linnæus.

A small example was taken September 3, at Ocean City, by Mr. D. McCadden, with numbers of *Fundulus majalis, Menidia menidia notata, Mugil curema, Hippocampus hudsonius, Trachinotus carolinus, Orthopristis chrysopterus, Stenotomus chrysops, Menticirrhus saxatilis, Spheroides maculatus, Prionotus evolans strigatus* and *Opsanus tau. Seriola zonata, Tautogolabrus adspersus, Tautoga onitis, Paralichthys dentatus, Achirus fasciatus* and *Echeneis naucrates* were also taken at the same place.

Albacora thynnus (Linnæus).

A small example was secured at Sea Isle City on August 8 by Mr. W. J. Fox.

Trichiurus lepturus Linnæus.

Two early records for this species are one from "New Jersey" by Dr. Morris Beasley[9] and another from Egg Harbor by Dr. S. Ashurst.[10] Though I have not found either example in the collection of the Academy, there are a number of other New Jersey specimens.

Rachycentron canadus (Linnæus).

A small example was angled at Ocean City on September 13 and was secured by Mr. McCadden.

Coryphæna hippurus Linnæus.

Four small examples were secured by Mr. Frank Erricson in his pounds at Sea Isle City on August 27, and two of these were received at the Academy through Mr. W. J. Fox.

C. equiselis Linnæus.

This species is virtually recorded[11] from off Sandy Hook in 1875,

[9] *Proc. Acad. Nat. Sci. Phila.*, 1842, p. 200, in donations to the museum.
[10] *L. c.*, 1867, p. 246.
[11] *Lampugus punctulatus* in *Forest and Stream*, V, September 16, 1875, pp. 83 and 85.

though several writers have since stated it has not been recorded from the United States coast. Not in the Academy.

Lobotes surinamensis (Bloch).

An example 23 inches long was taken at Sea Isle City in Mr. Frank Erricson's pounds on June 23, 1910, and received through Mr. W. J. Fox.

Balistes carolinensis Gmelin.

Mr. F. J. Keeley secured a large example in Great Egg Harbor Bay on September 18.

Pseudopleuronectes americanus (Walbaum).

I saw a number of examples taken at Corson's Inlet, on April 3, one of which was at least 16 inches long, which is quite large. Mr. D. McCadden secured 2 examples at Ocean City on September 3.

Astroscopus guttatus Abbott.

One was secured at Sea Isle City on June 8 and another on June 21, from Mr. Erricson's pounds, through Mr. W. J. Fox.

Urophycis regius (Walbaum).

Mr. Fox secured 2 examples at Sea Isle City on April 24.

On November 2, 1909, Mr. B. W. Griffiths and the writer secured some interesting fishes in the Maurice River basin near Elmer, such as *Notropis chalybæus, Schilbeodes gyrinus, Esox reticulatus, Mesogonistius chætodon, Umbra pygmæa, Erimyzon sucetta oblongus* and a number of prawns.

On September 25, 1910, I visited Lake Hopatcong and secured the following in Hurd Cove, near the upper end of the lake: *Abramis crysoleucas, Catostomus commersonnii, Erimyzon sucetta oblongus, Ameiurus nebulosus, Schilbeodes gyrinus, Esox americanus, Umbra pygmæa, Pomoxis sparoides, Acantharchus pomotis, Enneacanthus gloriosus, Lepomis auritus, Eupomotis gibbosus, Micropterus dolomieu,* and *Stizostedion vitreum.* As some of these are distinctly lowland fishes, it is interesting to note them at such a high altitude.

NOTES ON CHIMÆROID AND GANOID FISHES.

BY HENRY W. FOWLER.

The material mentioned in this paper is contained in the museum of the Academy of Natural Sciences of Philadelphia, unless otherwise stated.

CHIMÆRIDÆ.

Chimæra novæ-zealandiæ nom. nov.

For *C. monstrosa* var. *australis* Hector, Trans. N. Zeal. Inst., XXXIV, 1901 (1902), p. 239, Pl. 14, fig. 3, preoccupied by *C. australis* Shaw, Gen. Zool., V, 1804, p. 368, Pls. 158, a synonym of *Callorynchus*.

Of this family only two species are represented in our collection, *C. monstrosa* (L.) from Italy, and *Hydrolagus colliei* (Lay and Bennett) from Pacific Grove, Cal., and Alaska. I wish to call attention to the name *Chimæra neglecta* Ogilby, in Appendix A, *Rep. Com. F. N. S. Wales*, 1887 (1888), p. 23, which is preoccupied by *C. neglecta* Egerton, *Proc. Geol. Soc. London*, IV, 1843, p. 153, for a fossil species. According to Dr. Waite, *C. neglecta* Ogilby is thought to be identical with *Hydrolagus colliei* (Lay and Bennett), and had best be regarded as such, unless found to the contrary, though so far as I am aware this is its only occurrence in the Australian seas. If different, it requires a new specific name.

ACIPENSERIDÆ.

Acipenser sturio Linnæus.

Mediterranean 5, also 3 more dried; Adige, Italy 2; N. Am. 1; Del. R. 1 and 1 dry; Riverton 1; Washington Park 1; scute from Sea Girt, N. J.; skin from Castle Hill Beach, R. I.; Potomac R. 1; dry head without data. Also adult mounted, in Pa. F. Com. Coll.

Acipenser necoarii Bonaparte.

Faun. Ital., Pesc. III, pt. 2, XVI, XVII, 1836, descr. (*A. nacari* B., *l.c.*, Pl. fig. 2). Adriatic.

Nos. 624 and 625, A. N. S. P., cotypes.

Acipenser brevirostrum Le Sueur. Pl. XXXVIII, fig. 1.

Trans. Amer. Philos. Soc., Phila., I, 1818, p. 290. River Delaware.
No. 16,953, A. N. S. P. Type(?).

This example, which I have only recently located in the collection, has been noted by Ryder, with whose remarks I agree. The original number is, however, painted on the side in black paint and not in white. The old Bonaparte Catalogue is still extant, but the number on this specimen does not refer to a sturgeon. I figure this interesting example on account of its historical interest and rarity, as I have found no authentic American figures except Ryder's photographs. Two other examples were examined, from Bayport, Fla., and Delaware Bay at Green Creek, in Cape May County, N. J.

Scaphyrhynchops platorynchus (Rafinesque).

N. Am. 3; no data 3 and 1 dry; Bridger Pass Expedition, in 1856, 1; Kansas 1; Gulf of Mexico 1.

Parascaphyrhynchus albus Forbes and Richardson.

A single example 503 mm. long from "North America" (Smiths. Inst., No. 3) is interesting as having been obtained long before this rare species was described.

POLYODONTIDÆ.

Polyodon spathula (Walbaum).

Kiskiminitas R., Pa., 1; New Orleans, La., 1; East. U. S. 1. Besides 1 dried example from Ohio R. and 2 dry heads. Mounted adult in Pa. Fish Com. Coll.

LEPISOSTEIDÆ.

The living members of this family have long been allowed to fall into a single genus, comprising only four American species. The material studied in the collection of the Academy shows at least twelve species, most of which were pointed out by Cope in 1865. I feel obliged to admit two genera, as in the *Lepisosteus* group no enlarged palatine teeth have been distinguished in any examples I have examined, while in the others, or *Cylindrosteus* group, they occur in the young as well as in the adult.

a. Lepisosteus. No series of enlarged palatine teeth.
- *b.* Eye more than half of space to opercle.
  - *c.* Opercle longer than high..*huronensis.*
  - *cc.* Opercle higher than long...*osseus.*
- *bb.* Eye more than twice to opercle.
  - *d.* Scales smooth..*treculii.*
  - *dd.* Scales crenulate...*clintonii.*

aa. Cylindrosteus. Always a series of enlarged palatine teeth.

e. Mouth-cleft, from snout tip to rictus, longer than rest of head.

f. Scales 60–63.

g. Eye $1\frac{3}{4}$–$1\frac{7}{8}$ to opercle, $2\frac{1}{8}$ in interorbital; rictus width $3\frac{1}{4}$–$3\frac{2}{3}$ in snout....*platostomus.*

gg. Eye $1\frac{1}{3}$ to opercle, 2 in interorbital; rictus width 3 in snout......................*scabriceps.*

ff. Scales 55–58.

h. Eye $1\frac{3}{5}$–$1\frac{3}{4}$ to opercle, 2 in interorbital.

i. Rictus width $4\frac{3}{4}$ in snout..........*productus.*

ii. Rictus width $3\frac{1}{3}$ in snout........*agassizii.*

hh. Eye $2\frac{1}{4}$ to opercle, $2\frac{3}{4}$ in interorbital; rictus width $2\frac{7}{8}$ in snout......*castelnaudii.*

ce. Mouth-cleft, from snout tip to rictus, shorter than rest of head.

j. Scales 57–60.

k. Eye $1\frac{1}{8}$ to opercle......*megalops.*

kk. Eye 3 to opercle....*tristœchus.*

jj. Scales 51–54; eye 2 to opercle *tropicus.*

Lepisosteus huronensis (Richardson). Pl. XXXVIII, fig. 2.

Lepidosteus otarius Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 86. "Platte River, near Fort Riley."

Head $2\frac{1}{2}$–$3\frac{1}{5}$; depth $3\frac{1}{8}$–$5\frac{1}{6}$ in head; D. 8, rarely 7 or 9; A. 9, frequently 8, rarely 7 or 10; P. 12, often 11, rarely 7 or 10; V. 6, rarely 7; scales 62, frequently 63 or 64, rarely 60 or 61; predorsal scales 51, often 50, 52–54; scales around trunk middle 39, often 38, seldom 34, 35, 41–43; snout $1\frac{2}{5}$–$1\frac{3}{7}$ in head; eye $1\frac{1}{5}$–$1\frac{7}{8}$ to opercle; interorbital $\frac{7}{8}$–$1\frac{1}{10}$; length 200–710 mm. Warren County, Pa., 3; Battle Creek in upper Mo. basin 1; Fort Riley, Kan., 1; Wabash R., Ind., 1; Holston R., Va. (dry head); also 6 dry heads and 4 dry skins without data. No. 16,968, A. N. S. P., cotype of *L. otarius* Cope. Figure of Warren County example.

Sarchirus vittatus Raf. and *S. argenteus* Raf. are unidentifiable young, possibly this species? *Lepisosteus longirostris* Raf. may be the adult, but is insufficiently described, and therefore I adopt Richardson's name as the oldest. *Lepidosteus semiradiatus* Ag., *L. harlani* Dum., *L. smithii* D., *L. ayresii* D., *L. copei* D., *L. troostii* D., and *Lepisosteus lineatus* Thomps. agree in the large eye and may be identical. *L. bison* DeK., *Lepidosteus lesuerii* Dum., *L. elisabeth* D., *L. lamarii* D., *L. piquotianus* D. and *L. horatii* D., all have a smaller eye.

Lepisosteus osseus (Linnæus). Pl. XXXVIII. figs. 3, 4.

Lepidosteus crassus Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 86. Probably Bombay Hook, Del.

Head $2\frac{3}{4}$–$3\frac{1}{6}$; depth $2\frac{2}{3}$–$3\frac{7}{8}$ in head; D. 7, seldom 8, rarely 9; A. 9, frequently 8; P. 12, rarely 10, 13 or 14; V. 6, rarely 5; scales 61, seldom 58, rarely 59, 60 or 63; predorsal scales 50, often 49 or 52, seldom 51; scales around trunk middle 42 or 44, seldom 41, 47 or 48; snout $1\frac{2}{5}$–$1\frac{1}{2}$ in head; eye $1\frac{2}{3}$–$1\frac{9}{10}$ to opercle; interorbital $\frac{5}{7}$–$\frac{9}{10}$; length 424–1019 mm. Delaware Bay 1; Potomac R. 4, of which 3 dry; Bayport, Fla., 2 dry; no data 1 dry; Seaford, Del., jaws; Liberty County, Ga., jaws. No. 16,971, A. N. S. P., type of *L. crassus* Cope (figured).

The account by Linnæus is based on Catesby, Bonn., who undoubtedly had this species in view. *Esox viridis, Lepisosteus gavial* Lac., *Macrognathus loricatus* Gray and *Lepidosteus milbertii* Dum. are other synonyms. This species differs from the smooth-scaled *L. huronensis* in having the lateral scales, especially anteriorly, rugosely striated.

Lepisosteus treculii (Duméril). Pl. XXXVIII, fig. 5.

Head 3–$3\frac{1}{6}$; depth 4–$4\frac{1}{3}$ in head; D. 8; A. 8; P. 12; V. 6; scales 58?–60; predorsal scales 51; scales around trunk middle 39–43; snout $1\frac{1}{2}$ in head; eye 2–$2\frac{2}{3}$ to opercle; interorbital $\frac{9}{10}$–1; length 900–1155 mm. Ohio R. 1 (figured) and San Antonio, Tex., 1, both dry skins.

Duméril's account is the earliest I find for this species. *L. oxyurus* Raf. and *Lepidosteus leptorhynchus* Girard are insufficiently described to permit identification. *L. louisianensis* Dum. differs in its small eye.

Lepisosteus clintonii (Duméril). Pl. XXXVIII, fig. 6.

Head $2\frac{7}{8}$–$3\frac{1}{5}$; depth $2\frac{3}{7}$–4 in head; D. 7–8; A. 9, seldom 8; P. 12–13; V. 6; scales 58–66; predorsal scales 50–54; scales around trunk middle 46, sometimes 45; snout $1\frac{3}{7}$–$1\frac{1}{2}$ in head; eye $1\frac{5}{6}$–$2\frac{1}{2}$ to opercle; interorbital $\frac{5}{6}$–$1\frac{1}{10}$; length 365–1178 mm. Delaware R., just below Trenton, 1 dry (figured); Ohio R. 1 dry; no data 2.

Lepidosteus thompsoni Dum. has a still smaller eye, though otherwise agrees.

Cylindrosteus platostomus (Rafinesque). Pl. XXXVIII, fig. 7.

Head $3\frac{1}{2}$–$3\frac{3}{5}$; depth $2\frac{1}{6}$–$2\frac{1}{4}$ in head; D. 7–8; A. 8; P. 12; V. 6; scales 62–63; predorsal scales 54; scales around trunk middle 47–49; snout $1\frac{2}{3}$ in head; eye $1\frac{5}{6}$ to opercle; interorbital $\frac{9}{10}$; length 577–582 mm. "N. Am.," 2.

These examples would appear to be Rafinesque's species as expressed by Kirtland and Duméril. Kirtland's figure shows eye about $1\frac{3}{4}$ to opercle and rictus width about $3\frac{1}{5}$ in snout length. *L.* (*C.*) *oculatus*

Winchell may be a synonym. *Lepisosteus platyrhynchus* DeK. has much fewer scales, and *C. rafinesquii* Dum. is said to have eye 2 to opercle.

Cylindrosteus scabriceps sp. nov. Pl. XXXVIII, figs. 8, 9.

Head $3\frac{1}{6}$; depth $2\frac{7}{8}$ in head; D. 8, I, fulcra 5; A. 8, I, fulcra 6; P. 11, fulcra 1; V. 6, fulcra 3; scales 63 in l. l. to caudal base; predorsal scales about 53; scales around trunk middle 47; snout $1\frac{2}{3}$ in head; mandible $1\frac{4}{5}$; interorbital $6\frac{1}{2}$; dorsal length $2\frac{1}{3}$; anal $2\frac{1}{6}$; caudal, from base medianly of upper lobe $1\frac{7}{8}$; pectoral $3\frac{1}{4}$; ventral $2\frac{2}{3}$; snout width at rictus $6\frac{1}{2}$; eye $1\frac{2}{5}$ to opercle.

Body elongate, well compressed, predorsal region stoutest in width anteriorly, and greatest depth at ventral base. Caudal peduncle well compressed, least depth about $2\frac{1}{4}$ its total length.

Head well depressed, wider than deep, upper profile concave, especially just before eye, lower profile straight, and flattened sides slightly convergent below. Snout well depressed, arising in gentle median slope behind, and width at tip trifle less than half of basal width. Eye trifle elliptical, placed at last third in head length, and $1\frac{2}{3}$ in least interorbital width. Mouth not completely capable of closing, and mandible tip included well within snout tip. Series of minute sharp conic teeth along each edge of jaw externally of more or less unequal size. Just within small teeth a single series of enlarged slender conic teeth, in front of jaw these much larger and others gradually decreasing in size towards rictus, where very little larger than small external teeth. These long teeth uniformly larger in lower jaw, and when jaws close alternate so that their tips fit in sockets in opposite jaw. Front of upper jaw with 3 enlarged canines in transverse series, and mandible with 2 at end of each ramus. Osseus palatine ridge externally with an elongated narrow asperous area, and along its inner edge a series of small pointed teeth, much larger than asperities, and anterior ones largest, others graduated down posteriorly so as scarcely distinguishable toward rictus. An inner elongated area of palatine asperities, becoming wider posteriorly. A narrow median area of vomerine asperities. Along each edge of mandible internally narrow area of minute asperities. Tongue broadly expanded, free, deeply notched in front and upper surface well asperous. Nostrils 2 small pores, superior, near snout tip, distance between anterior and posterior little greater than internasal. Interorbital rather broadly depressed, only slightly convex. Opercle nearly deep as long, and lower edge deeply inclined down convexly in front. Bones on head all with rather conspicuous and coarse rugosities or striæ.

Gill-opening forward about $\frac{4}{7}$ to eye, forming rather broad fold over isthmus. Rakers 4 + 14 short rounded stumps, filaments about half of horizontal eye, and pseudobranchiæ about $\frac{2}{3}$ of filaments. Few osseous scutes along inside edge of gill-opening.

Most all scales entirely smooth, a few about head and anterior predorsal region with a few slight rugosities. Series of enlarged scales along gill-opening above and down to pectoral base quite rugose. L. l. nearly median along side, curving down little low along caudal peduncle side, and each scale in its course with slight notch at posterior apex.

Dorsal origin little before last fourth in entire length of body, or about opposite base of fourth branched anal ray, second and third branched rays subequally longest, fin rounded, and when depressed nearly reaching median caudal base. Anal similar, inserted well before dorsal, and second, third and fourth branched rays subequally longest. Caudal elongate, rounded, and upper median rays longest. Pectoral pointed, $2\frac{3}{5}$ to ventral. Ventral larger than pectoral, inserted trifle nearer latter than anal, and depressed $2\frac{1}{10}$ to anal. Vent close before anal.

Color in alcohol faded dull brownish, back and upper surface darker, paler below. All fins pale brownish, each with a few rather large deeper brown spots, of darker shade on dorsal, anal and caudal, and others all very indistinct. Iris brassy.

Length 344 mm. (13 inches).

Type, No. 621, A. N. S. P. Leavenworth, Kan. E. D. Cope. (Figured.)

Also No. 622, A. N. S. P., paratype, same data. Besides this, are 2 other examples referrible to this species. An alcoholic preparation labeled "San Domingo, West Indies, W. M. Gabb," is uncertain and may have really come from somewhere in the United States, while a dry skin in the Cope Collection has no other data. These specimens show: Head $3\frac{1}{8}$–$3\frac{4}{5}$; depth $2\frac{4}{5}$–$3\frac{1}{3}$; D. 8; A. 8; P. 11–12; V. 6; scales 62–63 in l. l.; predorsal scales 51–55; scales around trunk middle 41–48; snout $1\frac{3}{5}$–$1\frac{2}{3}$ in head; eye $1\frac{1}{3}$–$1\frac{1}{2}$ to opercle, $1\frac{5}{6}$–2 in interorbital; interorbital $\frac{4}{5}$–1 to opercle; length 344–550 mm. This species differs at once from *C. platostomus* in the larger eye and much coarser striations or rugosities on the head.

(*Scaber*, rough; *ceps*, head.)

Cylindrosteus productus Cope. Pl. XXXVIII, figs. 10, 11.

Proc. Acad. Nat. Sci. Phila., 1865, p. 86. San Antonio, Tex.

Head $2\frac{4}{5}$–$3\frac{1}{5}$; depth $3\frac{1}{10}$–$3\frac{3}{5}$ in head; D. 8; A. 7–9; P. 10; V. 6; scales 57–60; predorsal scales 49–54; scales around trunk middle 42–44; snout $1\frac{3}{5}$ in head; eye $1\frac{1}{2}$ to opercle; interorbital $\frac{9}{10}$–1; length 213–449 mm. Battle Creek in upper Missouri basin 2. No. 16,958, A. N. S. P., type of *C. productus* Cope, dry skin (figured).

Cylindrosteus agassizii Duméril. Pl. XXXVIII, fig. 12.

Head $3\frac{3}{5}$; depth $2\frac{3}{5}$ in head; D. 8; A. 7; P. 11; V. 6; scales 55; predorsal scales 47; scales around trunk middle 40; snout $1\frac{2}{3}$ in head; eye $1\frac{1}{2}$ to opercle; interorbital $\frac{7}{8}$; length 420 mm. Dry skin, "North America."

Cylindrosteus castelnaudii Duméril. Pl. XXXVIII, figs. 13, 14.

Head $3\frac{1}{4}$; depth 2; D. 9; A. 8; P. 11; V. 6; scales 58; predorsal scales 52; scales around trunk middle 45; snout $1\frac{2}{3}$ in head; eye $2\frac{2}{7}$ to opercle; interorbital $\frac{7}{8}$; eye in interorbital $2\frac{4}{7}$; length 600 mm. W. coast of Fla., in 1886, by Prof. A. Heilprin 1.

This example agrees with Duméril's account, which seems to be the earliest name for the species. Possibly *Lepidosteus* (*C.*) *latirostris* Girard is also identical, but the account of that species is insufficient. *C. bartonii* D. is another synonym.

Cylindrosteus megalops sp. nov. Pl. XXXVIII, figs. 15, 16.

Head $3\frac{2}{3}$; depth $1\frac{3}{4}$ in head; D. 7, I, fulcra 2 ? (damaged); A. 8, I, fulcra 8; P. 9, fulcra about 8, weak and indistinct distally; V. 6, fulcra 5; scales 57 in l. l. to caudal base; predorsal scales about 51; scales around trunk middle 44; snout $1\frac{4}{5}$ in head; mandible 2; interorbital 5; pectoral $2\frac{1}{4}$; ventral $2\frac{1}{5}$; snout width at rictus $4\frac{3}{4}$; eye $1\frac{1}{6}$ to opercle.

Body moderately elongate, well compressed, predorsal region stoutest in width, and greatest depth at ventral base. Caudal peduncle well compressed, least depth $1\frac{4}{5}$ its total length.

Head well depressed, much wider than deep, upper profile slightly concave, especially about middle of snout. Lower profile similarly approximated, and flattened head sides slightly convergent below. Snout well depressed, arising in gentle median slope behind, and width at tip trifle less than half of basal width. Eye large, trifle elliptical, placed about last $\frac{2}{5}$ in head length, and $1\frac{1}{2}$ in least interorbital width. Mouth completely closing, and truncated mandible tip included well within snout tip. Series of minute sharp conic teeth along each edge of jaw externally of more or less unequal size. Just inside small teeth a single series of enlarged slender conic teeth, towards front of jaw these much larger and others gradually decreasing in size towards rictus, where quite larger still than very small externals. Long teeth uniformly larger in lower jaw, and when jaws close alternate so that their tips fit in sockets in opposite jaw. Front of upper jaw with 4 rather small teeth in transverse series and mandible with 1 enlarged tooth at each corner in front, also a smaller one unsymmetrically on front of left ramus. Osseus palatine ridge externally with an elongated narrow asperous area and along its inner edge a series of small pointed teeth, much larger than asperities, though quite inconspicuous. An inner elongated area of palatine asperities, becoming wider posteriorly. A narrow median area of vomerine asperities. Tongue broadly expanded, free, deeply notched in front and upper surface well asperous. Nostrils 2 small pores, lower inferior and posterior superior, near snout tip, distance between anterior and posterior about $1\frac{1}{3}$ in anterior internasal. Interorbital broadly depressed, very slightly convex. Opercle almost deep as long, and lower edge convexly curved forwards. Bones of head all with rather conspicuous and coarse rugosites or striæ.

Gill-opening forward about half-way to eye, forming rather broad fold over isthmus. Rakers about 5 + 10 short rounded asperous stumps, filaments about half of horizontal eye, and pseudobranchiæ about $\frac{2}{3}$ of filaments. No osseous scutes along inside edge of gill-openings.

Most all scales entirely smooth. Series of enlarged scales along gill-opening above, and down to pectoral base, lower slightly roughened. L. l. nearly median along side, sloping down little low along caudal peduncle side, and each scale in its course with slight notch at posterior apex.

Dorsal origin near last $\frac{3}{11}$ in total length (caudal damaged) or about opposite base of fifth branched anal ray. Anal similar, inserted well before. Caudal elongate, rounded, and upper median rays apparently (damaged) longest. Pectoral pointed, about $2\frac{1}{6}$ to ventral. Ventral trifle larger than pectoral, about 2 to anal, inserted about midway between pectoral and anal origins. Vent close before anal.

Color in alcohol uniform brownish, upper surface scarcely paler.

Length 418 mm. ($16\frac{1}{2}$ inches).

Type, No. 25,371, A. N. S. P. Bayport, Fla. J. B. Wood. Presented by E. D. Cope.

The above is the only example I have seen, and seems to be most closely related to *Lepidosteus grayi* Agassiz, which is said to have smooth scales, snout not longer than rest of head, and a series of enlarged teeth in upper jaw. Agassiz's acount, however, is too incomplete for positive identification. Regan has examined Agassiz's type and says it has a much broader snout than *C. platostomus*, or its width at mouth angles $2\frac{1}{3}$ in upper jaw length. *C. megalops* shows rictus width $2\frac{2}{5}$ in snout length. Regan also thinks *C. zadockii* Duméril may be identical with *C. grayi* Agassiz, though Duméril gives eye $1–2\frac{1}{3}$ in interorbital, and about 2 in postorbital to preopercle edge, besides smaller scales as 61 or 62. The type of *C. grayi* is 600 mm. and the examples of *C. zadockii* 620–660 mm.

(*Μεγαλόφ*, large-eyed.)

Cylindrosteus tristœchus (Schneider). Pl. XXXVIII, fig. 17.

Head $3\frac{4}{7}–3\frac{2}{3}$; depth $2\frac{2}{5}–3\frac{1}{5}$ in head; D. 7–8; A. 8; P. 13–14; V. 6; scales 61–63; predorsal scales 51–53; scales around trunk middle 58–61; snout $1\frac{4}{5}$ in head; eye $2\frac{2}{5}–2\frac{7}{8}$ to opercle; interorbital $\frac{5}{7}–\frac{3}{4}$; eye in interorbital 4; length 1067–1340 mm. Mississippi R. 1 from Dr. Anderson, and 1 from same basin in Louisiana from Dr. S. G. Richardson (figured), both dry skins. Also 2 others without data and 1 dry head.

I allow the identification of the Cuban and Mississippi Valley forms as Duméril, who has examined some of the former, gives the eye in agreement with my Mississippi R. examples, though Poey's figure of *Lepidosteus manjuari* shows the eye only 2 in postorbital to opercle. *Lepisosteus spatula* Lac., *L. albus* Raf., *L. ferox* R., *Lepidosteus* (*Atractosteus*) *berlandieri* Gir. and *A. lucius* Dum. are other synonyms.

Cylindrosteus tropicus (Gill). Pl. XXXVIII, fig. 18.

Head $2\frac{9}{10}$; depth $2\frac{3}{7}$? in head; D. 8; A. 7; P. 14; V. 6; scales 53; predorsal scales 47; scales around trunk middle 45; snout $1\frac{5}{7}$ in head; eye 2 to opercle; interorbital $\frac{5}{6}$; eye $2\frac{1}{2}$ in interorbital; length 770 mm. Nicaragua, 1 from Dr. J. F. Bransford.

AMIATIDÆ.

Amiatus calvus (Linnæus).

Erie, Pa., 1; L. Erie, 1; Ithaca, N. Y., 1; Maryland, 1; Mississippi Valley, 1; also 15 others without data and 1 a dry skin.

Explanation of Plate XXXVIII.

Fig. 1.—*Acipenser brevirostrum* Le Sueur. Type (?). Upper figure to left dorsal view of head; upper figure to right ventral view of head; lower figure a lateral view.
Fig. 2.—*Lepisosteus huronensis* (Richardson). Warren Co., Pa.
Figs. 3, 4.—*Lepisosteus osseus* (Linnæus). · Type of *Lepidosteus crassus* Cope.
Fig. 5.—*Lepisosteus treculii* (Duméril). Ohio River.
Fig. 6.—*Lepisosteus clintonii* (Duméril). Delaware River below Trenton.
Fig. 7.—*Cylindrosteus platostomus* (Rafinesque). "North America"
Figs. 8, 9.—*Cylindrosteus scabriceps* Fowler. Type.
Figs. 10, 11.—*Cylindrosteus productus* Cope. Type.
Fig. 12.—*Cylindrosteus agassizii* Duméril. North America.
Figs. 13, 14.—*Cylindrosteus castelnaudii* Duméril. West coast of Florida.
Figs. 15, 16.—*Cylindrosteus megalops* Fowler. Type.
Fig. 17.—*Cylindrosteus tristœchus* (Schneider). Mississippi River, La.
Fig. 18.—*Cylindrosteus tropicus* (Gill). Nicaragua.

NOVEMBER 1.

MR. CHARLES MORRIS in the Chair.

Forty persons present.

The death of ARTHUR ERWIN BROWN, Sc.D., a Vice-President of the Academy, on the 29th ult., having been announced, the following minute, offered by the Council, was adopted and ordered to be placed on record:

The Academy of Natural Sciences of Philadelphia has heard with deep regret of the death of its senior Vice-President, Arthur Erwin Brown, Sc.D., and desires to put on record its appreciation of the loss it has sustained.

Since his election to membership in 1876 Dr. Brown manifested his interest in the society loyally and efficiently, serving as Curator for seventeen years and as Vice-President since 1900.

Wise in council, efficient and conscientious in the discharge of his official duties, his co-operation was highly esteemed by his associates, while his enlightened sympathy with the progress of the society materially advanced its interests.

His contributions to science were characterized by accuracy and breadth of view and added notably to the importance of the Academy's publications.

Courtesy, candor and consideration marked his intercourse with his fellow-members, who will long hold his memory in affectionate regard.

Their sorrow enables them to sympathize deeply with his sister, to whom they extend their heartfelt commiseration.

Miss H. NEWELL WARDLE made a communication on the Congress of Americanists held in Mexico, September 7 to 14, and on certain Mexican ruins examined incidental to the meeting. (No abstract.)

NOVEMBER 15.

The President, SAMUEL G. DIXON, M.D., LL.D., in the Chair.

Thirty-two persons present.

The deaths of the following persons were announced:

John H. Converse, a member, May 3, 1910;
Richard Wood, a member, September 29, 1910;
Edward S. Buckley, a member, November 15, 1910;
William K. Brewer, a correspondent, November 2, 1910.

Henry Leffmann, M.D., made a communication on mechanical principles in living structures. (No abstract.)

Robert Adams, Jr., was elected a member.

The following were elected correspondents:

Edward B. Poulton, of Oxford, England.
Thomas H. Morgan, of New York.
Lucien Ossian Howard, of Washington.

The following were ordered to be printed:

PRELIMINARY STUDIES OF NORTH CAROLINA ORTHOPTERA.

BY JAMES A. G. REHN and MORGAN HEBARD.

During a considerable portion of the time between April, 1904, and June, 1906, the junior author of this paper resided at Sulphur Springs, altitude 2,500 feet, a few miles from Asheville, North Carolina, and collecting in this order was done on many occasions. The resulting collections, of particular value as showing the character of the Orthopterous fauna of the intermontane valleys of the southern Appalachians, were further supplemented by collections made at Balsam and on the slopes and summit of Mt. Pisgah in the Pisgah Range and on the upper slopes and summit of Jone's Knob, Balsam Range, North Carolina. With these typical localities of the western portion of the State it seemed quite desirable to compare a representive series from some coastal plain locality, and in consequence the junior author secured from Mr. H. S. Brimley an extensive series of material taken chiefly at Raleigh. To still further supplement this the senior author was detailed by the Academy to examine portions of eastern North Carolina, collections being made at Edenton, New Berne and Winter Park near Wilmington in August, 1908.

The result of the study of these combined collections are given in the following pages.[1]

The total number of specimens examined was seventeen hundred and twenty-three, belonging to one hundred and two species, of which seventeen are here recorded from North Carolina for the first time.

The following notes on the localities may be of interest:

Sulphur Springs, Buncombe County, North Carolina. Altitude, 2,500 feet. This locality was found to offer several distinct types of country, in all of which collecting was done, and on a sufficient number of dates to give an almost complete list of the species found in the vicinity. The rolling slopes of the surrounding country where not cleared are covered with a heavy forest of oak, chestnut, maple and other deciduous trees, and in the not heavy undergrowth of these tracts the most interesting species found were *Melanoplus carnegiei*.

[1] See also these *Proceedings*, 1910, pp. 407–453, for a systematic study of the specimens of the genus *Ischnoptera* included in this series.

and *Melanoplus devius*. In the decaying chestnut logs of this woodland *Cryptocercus punctulatus* was also taken, and it is from these wooded areas that the great number of *Ischnoptera* come in the spring to nearby lights. In the open valleys and on the hillsides covered with short grass and low herbage *Eritettix simplex* was taken, while the edge of streams and marshy spots revealed many Tettigids. One small marsh full of cat-tails was found to harbor a large colony of *Truxalis brevicornis*. The poorer clay slopes and hillocks are often overgrown with stunted pines having an undergrowth chiefly of broomstraw, grasses and raspberry vines, and here *Orchelimum agile*, *Orchelimum minor* (in the trees) and several species of *Conocephalus*, including *C. nemoralis*, were taken. Collecting at night was found productive, and the following species were taken attracted to light: *Ischnoptera pensylvanica*, *I. couloniana*, *I. uhleriana*, *I. borealis*, *I. bolliana*, *Microcentrum rhombifolium* and *Microcentrum retinerve*.

Mt. Pisgah (altitude, 5,740 feet) and *Pisgah Ridge*, junction of Buncombe and three other counties, *North Carolina*. On the upper slopes, covered with a heavy but low forest, chiefly composed of chestnut and other deciduous trees, Orthoptera were uncommon. The interesting captures were *Melanoplus devius*, *Gryllus neglectus*, *Nomotettix cristatus*, *Chloealtis conspersa* and *Melanoplus luridus*.

The summit bald proved to be inhabited by *Chorthippus curtipennis*, *Chortophaga viridifasciata*, *Melanoplus amplectens*, *Amblycorypha rotundifolia* and *Arphia sulphurea*.

Jones's Knob (altitude, 6,200 feet), *Balsam Mountains*, *Jackson County*, *North Carolina*. No Orthoptera whatever were found on the "balsam" (*Abies fraseri*) clothed summit of the mountain, but lower in the undergrowth of the heavy deciduous forest, especially in more open level grassy glades, the following interesting captures were made: *Melanoplus amplectens*, *Melanoplus divergens*, *Melanoplus luridus*, and *Atlanticus pachymerus*.

Edenton, *Chowan County*, *North Carolina*. August 20, 1908. At this locality collecting was done in a field of tall weeds and grasses and in wet drains along roadsides. The most important captures were *Orchelimum molossum* and *pulchellum*.

New Berne, *Craven County*, *North Carolina*. August 24, 1908. Three conditions were examined at this locality: first, bush and grass growth in a wet drain, where *Leptysma marginicollis*, *Orchelimum molossum*, *Conocephalus strictus* and *Phylloscyrtus pulchellus* were probably the most noteworthy species taken; second, a wet, meadowy area with low lycopodium-like growth in many places and with interspersed dry spots tangled with smilax, the most striking captures being *Melanoplus decorus, Clinocephalus elegans, Amblytropidia occidentalis, Paxilla obesa, Neotettix femoratus* and *Tettigidea prorsa;* third, tall dry brush in tall rather open pine woods where *Mermiria alacris* and *Schistocerca alutacea* and *americana* were secured.

Winter Park, New Hanover County, North Carolina. August 26, 1908. At this point which is between Wilmington and Wrightsville, collecting was done in a piece of moderate-sized, long-leafed pine woods, the drier portions of which were carpeted with wire-grass and the moister hollows grown up with waist-high grass. The drier sections were frequented by *Arphia xanthoptera, Scirtetica picta, Hippiscus rugosus, Psinidia fenestralis, Syrbula admirabilis, Orphulella pelidna, Melanoplus keeleri* and *Amblycorypha uhleri.* The wet grassy areas were inhabited by *Clinocephalus elegans, Melanoplus decorus, Paroxya atlantica, Orchelimum glaberrimum* and *Odontoxiphidium apterum.* The most striking species found in both habitats was *Mermiria alacris.*

The number of species taken at each of the principal localities was as follows: Edenton, ten; New Berne, twenty-eight; Winter Park, nineteen; Raleigh, fifty-seven; Sulphur Springs, fifty-one; Balsam, four; Jones's Knob, five; Mt. Pisgah, several elevations, fifteen.

A few records from Bayville and Cape Henry, Princess Anne County, Virginia, based on material taken by the senior author in 1908, are included to make the report on that year's collecting complete.

Many species have been recorded from Raleigh by Brimley in a recent paper of his on the Orthoptera of that region,[2] and full credit for the pioneer work in faunistic Orthopterology in North Carolina must be given to his paper and to the very important study of a number of localities in the State made by Morse,[3] both of which are referred to in the following pages.

BLATTIDÆ.

Ischnoptera deropeltiformis (Brunner).

At Sulphur Springs two adult males of this species were taken on May 8 and 10, 1904, an immature male on April 13th of the same year and an immature female captured September 23, 1905. The Raleigh series contains a very interesting lot of ten adult females taken or bred on dates ranging from May 25 to June 25, 1904, and June 7 to July 1, 1905. An immature female taken June 21, 1904, was collected

[2] *Ent. News*, XIX, pp. 16–21, 1908.
[3] *Carnegie Inst. Publ. No.* 18, 1904.

under pine straw and rotten wood in pine woods, while the one adult female with capture datum was taken from under rubbish in field.

The series of females shows quite a little individual variation in general size, the extremes of the series of that sex measuring as follows:

Length of body	13.5 mm.,	17. mm.
Length of pronotum	4 "	4.5 "
Greatest width of pronotum	5 "	6.8 "
Length of tegmen	4 "	4.8 "
Greatest width of abdomen	6.9 "	8.2 "

In coloration two points of variation are apparent: first, the tegmina of the females are decidedly blackish in some specimens, dull brownish in others; second, the femora vary in the presence or absence, or depth when present, of the blackish coloration, the majority of the specimens having the femora ferrugineous like the tibiæ.

Ischnoptera johnsoni Rehn.

A single adult female taken at Sulphur Springs, June 3, 1904, and two adult males secured at Raleigh, May 24, 1905, and June 8, 1904, are contained in the collection. The single Sulphur Springs specimens was taken in low herbage near the edge of the woods.

Ischnoptera pensylvanica (De Geer).

Two males of this species taken at Sulphur Springs, May 25 and 30, 1904, and one of the same sex from Raleigh, June 2, 1904, are in the collection. In one of the Sulphur Springs specimens the blackish area of the disk of the pronotum is very solid and extensive, crowding the yellowish lateral borders to very narrow edgings. The other Sulphur Springs individual and the Raleigh specimen have the more normal type of pronotal coloration.

The specimens taken at Sulphur Springs were captured at night attracted to light.

Ischnoptera divisa Saussure and Zehntner.[4]

The present collection includes five males and two females taken or bred at Raleigh, June 9–15, 1904, and May 22, June 9 and July 6–8, 1905. Data on the specimens inform us that both females were taken by sugaring, one of the males flew into a house at night and three of the same sex were bred.

[4] This is the species referred to by Brimley as *I. couloniana* (*Ent. News*, XIX, p. 16), on the basis of material identified by the senior author. Saussure's *couloniana* has since been shown by us (these *Proceedings*, 1910, p. 433) to belong to another species.

Isohnoptera couloniana Saussure.[5]

A series of eighteen male and twenty female adult individuals from North Carolina have been examined. The Raleigh series contains sixteen males and twenty females, taken from under bark of dead pines or bred on dates ranging from June 2 to July 1, 1904, while two adult males and an immature female were taken at Sulphur Springs, June 5, 1904, at night attracted to light.

The series before us presents a perceptible amount of variation in size and color, the size extremes of both sexes being as follows (all the measured specimens being from Raleigh):

	♂	♂	♀	♀
Length of body	20.5 mm.,	21.5 mm.,	18.5 mm.,	22.5 mm.
Length of pronotum	4.8 "	5 "	4.8 "	6 "
Greatest width of pronotum	6 "	6.5 "	7.2 "	8.2 "
Length of tegmen	9.2 "	21.8 "	7.5 "	8 "

The more usual type of coloration is that described by Blatchley and found in the type of Scudder's synonymous *hyalina*, the disk of the male pronotum being pale reddish ochraceous, while the other extreme, to which belonged the type of *couloniana*, has the same area more or less infuscate, particularly cephalad. The depth of this infuscation is very variable and it is found clearly defined in but five of the males examined, although suggested by points and lines in several others. In the female much the same thing occurs as in the male, but less clearly defined in most of the cases.

Ischnoptera uhleriana (Saussure).

The series of this species before us is quite extensive, consisting of ninety-nine males and six females, ninety-two males having been taken at Sulphur Springs on dates between May 8 and June 13, 1904, and in April, 1906, the remainder of the series being from Raleigh, taken June 1 to July 1, 1904. The memoranda with the latter specimens show they were taken from under the bark of dead trees, attracted to light in houses or bred. The Sulphur Springs specimens were all taken attracted to light.

The coloration of the present series varies but little and then only in the intensification or lightening of the general color. In but one male is there a darker discal area on the pronotum, and in that case the intensification is not strongly marked and the form of the supra-

[5] C. f. these *Proceedings*, 1910, p. 433.
[6] *Orth. Indiana*, p. 183.

anal plate is typical of *uhleriana*. Two of the females have the disk of the pronotum darkened, much as in *divisa*, but the tegmina are of the subtruncate *uhleriana* type and the form of the supra-anal plate is equally distinctive.

Ischnoptera uhleriana fulvescens Saussure and Zehntner.

Seven males from Raleigh, taken in June and July, 1904, are referred to this form.[7]

These specimens were taken under conditions similar to the Raleigh individuals of true *I. uhleriana*.

Isohnoptera borealis Brunner.

While usually mistaken at first sight for *uhleriana*, this species is readily separable by its usually smaller size and distinctly transverse and apically rotundato-arcuate supra-anal plate of the male. A series of forty males of this species from Sulphur Springs were taken on dates ranging from May 6 to June 12, 1904, and a single female was collected at Lillington, Harnett County, on June 28, 1904, by Brimley. The last-mentioned specimen was taken from under a log in a wet place in woods.

The general size is quite below the average of *I. uhleriana*, the male extremes of the present series measuring as follows:

Length of body	12.8 mm.,	14 mm.
Length of pronotum	3 "	3 "
Greatest width of pronotum	3.8 "	4.3 "
Length of tegmen	14.5 "	18 "

The tegmina of the larger specimen are unusually long, no other individual in the series approaching it at all closely in this respect.

From early May to the middle of June this species and *Ischnoptera uhleriana* could be found almost every night about the lights.

Ischnoptera bolliana Saussure and Zehntner.

The series before us consists of four males and two females taken at Raleigh, May 30–31, and June 1–8, bred or attracted to light in houses, and five males taken at Sulphur Springs between May 8 and June 9, 1904. The coloration of the males is quite uniform, the disk of the pronotum being dark with a medio-longitudinal paler bar dividing it in two sections in all the specimens. The females are similar in coloration to the type of the synonymous *Kakerlac schaefferi*.

This was one of the scarcer species at Sulphur Springs where all the

[7] For comments on the relationship and intergradation of *I. uhleriana* and *I. u. fulvescens*, with remarks on the Raleigh series, see the present authors, *Proc. Acad. Nat. Sci. Phila.*, 1910, pp. 439–442.

specimens were taken at night attracted to the lights. The lights referred to here and elsewhere in this paper at Sulphur Springs were the electric lights along the verandas of the Asheville School, which is situated on the edge of the heavy deciduous forest. The roaches attracted to these lights would usually fly about wildly for a time and then rest quietly on the nearby walls and ceilings unless disturbed.

Ceratinoptera lutea Saussure and Zehntner.

A single female from Raleigh, taken June 23, 1904, from under rubbish, is in the collection. It fully agrees with a Florida individual of the same sex.

Cryptocerous punctulatus Scudder.

A most interesting series of this singular roach is now before us, demonstrating the vertical range of the species in North Carolina to be at least three thousand feet, specimens in the collection being from Sulphur Springs, twenty-five hundred feet, and Old Bald Mountain, fifty-five hundred feet elevation. The localities represented are: Sulphur Springs, May 25, June 3–13, 1904, seventy-nine individuals of both sexes, adult and immature; Old Bald Mountain, 5,500 feet elevation, May 14, 1904, three adults and one immature individual. An adult individual in the collection of the Academy taken at Blowing Rock, Watauga County, by Joseph Willcox has also been examined.

These insects are found in the partially decayed chestnut logs in the forest. They were never found except in parts of the logs where the decayed wood was soft, punky and wet. In such places a colony of a number of specimens would be found in galleries just under the bark and in the log itself, often several specimens in close proximity. The localities from which the species is now known are New York; Pennsylvania; Virginia; Kentucky; Cumberland Gap, Kentucky; Tennessee; North Carolina; Sulphur Springs, Old Bald Mountain and Blowing Rock, N. C.; Rome and Clayton, Ga.; California; Glendale and Divide, Ore.

MANTIDÆ.

Stagmomantis carolina (Johannson).

An immature female of this species was taken August 19, 1908, at Bayville, Va., by Rehn. Two adult females in the Hebard Collection are from Montgomery County, Virginia, and South Carolina The latter has the wings roseate.

ACRIDIDÆ.

Paratettix cucullatus (Burmeister).

This species is represented by a series of twenty-one North Carolina specimens from the following localities: Raleigh, April 7, May 19 and 26 and July 8 and 18, 1904, three males and three females; Sulphur Springs, April 24 to June 12, 1904, six males, nine females.

The majority of the specimens show a tendency to approach *P. texanus*, or rather *P. cucullatus texanus* as we believe it should be, but they are certainly more closely related to specimens from Pennsylvania than others from Texas. The data with the Raleigh and Sulphur Springs specimens is to the effect that they were secured on damp, low ground near water.

Acrydium hancocki (Morse).

Three female specimens taken at Sulphur Springs, April, 1906, May 7 and September 28, 1904, belong to this species. An individual of the same sex from White Top, Va., elevation, 5,678 feet, in the Academy collection is inseparable. All four specimens are of the long-winged type, and in all but one Sulphur Springs individual is the pronotum variegated with velvety-black in addition to the paired post-humeral trigonal patches on the same, which are present in all the specimens.

The previous North Carolina records are those of Morse, viz., Asheville, Linville, Pineola, Roan Mountain 5,500 feet, and Roan Valley, while the White Top record is the first one from the State of Virginia.

Acrydium ornatum (Say).

A single short-winged female of this species was taken at Sulphur Springs, May 9, 1904. Morse has recorded it from a number of localities in the State.

Acrydium obscurum (Hancock).

The collection contains an extensive series of this species: eight males and ten females from Raleigh taken April 7 to May 19, 1904, and sixteen males and nineteen females taken at Sulphur Springs, May 1 to 15, 1904. All the specimens in this series are long-winged and numerous shades of ochraceous, rusty-red and deep brown are to be found in it, while a considerable number of individuals possess the paired velvety-black post-humeral trigonal markings.

Morse has recorded this species from Asheville, Pineola, Roan Mountain and Tunis, N. C.

Neotettix femoratus (Scudder).

The statement made by Hancock[8] on Scudder's authority regarding the whereabouts of the type of this species is incorrect. The type is

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[8] *Tettigidæ of N. Amer.*, p. 96.

not lost, and to-day in good condition it forms part of the collection of the American Entomological Society, from which it was described. From the evidence of this important specimen it appears likely that *Neotettix bolivari* and *rotundifrons* Hancock are synonymous with Scudder's species, a possibility pointed out some time ago by Morse.[9]

The present collection contains an interesting series of fifty-six specimens distributed as follows: Winter Park, August 26, 1908, five males, three females, one immature specimen; New Berne, August 24, 1908, four males, one female; Raleigh, June 3–September 7, 1904, six males, seven females; Sulphur Springs, May 6–June 5, 1904, seven males, twenty females, two immature individuals. The series is dimorphic as to the length of the pronotum and wings, the long-winged type being represented by nine specimens, seven of these being in the Sulphur Springs series. The size variation is considerable, the New Berne specimens rather curiously being without exception as small or smaller than the smallest individuals from the other localities. Color presents numerous variations, some are blackish, others dull reddish, some dusty gray-brown, others shades of ochraceous, while the shoulder markings are present in more than half of the series, occasionally with a well-developed humeral "saddle."

The type from Maryland is short-winged and matches in size adult females from Raleigh, the color, however, is more yellowish-ochraceous than in any of the North Carolina specimens.

Morse has recorded this species from fourteen localities in North Carolina extending from Tarboro to Murphy and to an elevation of 5,500 feet on Roan Mountain.

Nomotettix cristatus (Scudder).

A single immature female of this species from 4,500 feet elevation on Mt. Pisgah, taken October 1, 1904, is the only individual of the species in the collection. Morse has recorded it from six localities in the State, but this record carries the vertical distribution to a greater height. This specimen was captured in the undergrowth of the low deciduous forest near its upper limit.

Paxilla obesa (Scudder).

This robust species has long been a will-o'-the-wisp in our work in the southeastern States, and it is with great satisfaction that we are able to record its capture at New Berne, August 24, four males and one female being taken in a wet meadow in company with *Clinocephalus elegans* and *Melanoplus decorus*. This capture considerably ex-

[9] *Publ.* 18, *Carnegie Inst.*, p. 25.

tended the range of the species, the most northern previous record being from Denmark, S. C. The range is now known to extend from Port Orange and De Funiak Springs, Fla., to New Berne, N. C.

The female and one of the males measure as follows:

	♂	♀
Length of body	10.5 mm.,	12.8 mm.
Length of pronotum	9.2 "	11 "
Length of caudal femur	6.7 "	8 "

Tettigidea lateralis (Say).

A series of eighty-two North Carolina individuals are before us, this comprising the following: Winter Park, August 26, 1908, two females; New Berne, August 24, 1908, two females; Raleigh, April, 7–July 18, 1904, twenty-one males, sixteen females; Sulphur Springs, April 2–September 24, 1904, eight males, thirty females; Mt. Pisgah, 4,500 feet elevation, October 1, 1904, one adult male, one immature male, one immature female.

In this series the front margin of the pronotum is found to vary from broadly arcuate to distinctly angulate, regardless of locality or environment. The Raleigh series is overwhelmingly long-winged, but one in the whole thirty-seven individuals being short-winged, while in the thirty-eight Sulphur Springs specimens but two males and twelve females are short-winged. Both Winter Park representatives are long-winged, as well as the single adult from Mt. Pisgah and the two specimens from New Berne. Color variations are numerous and varied, and size variation is quite marked in the larger series.

Tettigidea prorsa Scudder.

An immature male and an adult female taken at New Berne, August 24, 1908, belong to this rare species. The specimens were taken in a wet meadow in company with *Tettigidea lateralis* and *Paxilla obesa*. Both specimens are short-winged, as is also a male individual from Beach Haven, N. J., taken in the spring of 1907, the only other specimen of the species seen.

The range of the species is now known to extend from Georgia to east-central New Jersey, the only records in addition to those mentioned above being from Georgia, North Carolina and Denmark, S. C.

Truxalis brevicornis (Johannson).

Three pairs from Raleigh, taken August 15 to September 15 in or on the edge of marsh, and an extensive series of twenty-four males and five females taken September 18 at Sulphur Springs represent this widely distributed species. The Sulphur Springs series was captured among cat-tails.

All of the males are in the green and brown phase, four of the eight females in a uniform green phase and the remaining four in a uniform brownish phase.

Mermiria alacris Scudder.

This beautiful species was found to be fairly numerous but very wary in oak scrub along the edge of pine woods at New Berne on August 24, and equally numerous but easier to secure in long-leaf pine woods at Winter Park on August 26. Two males and one female were secured at the former locality and five males and four females at the latter. In size there is considerable variation, which appears from the material in hand, comprising Florida material as well the North Carolina series, to be purely individual in character, more marked in the male than in the female sex. The coloration is quite constant, varying only in the extent of facial suffusion and the strength of the medio-longitudinal streak on the head and pronotum.

The only previous North Carolina record for the species is a doubtful one based on a young individual from Salisbury.

Syrbula admirabilis (Uhler).

The localities from which this species is represented in the collections are: Bayville, Va., August 19, one immature female; Edenton, August 20, one male, two females; Winter Park, August 26, two females; Raleigh, August 17–September 2, three males, four females; Sulphur Springs, September 24–October 6, one male, two females.

A variety of habitats are represented as the labels indicate a range of environment extending from dry pinewoods undergrowth at Raleigh and Winter Park to wet woods at Bayville and wet drains at Edenton.

In size the North Carolina specimens are nearer to individuals from New Jersey than they are to the extremely large Florida representatives.

Eritettix simplex (Scudder).

A most interesting series of one hundred and forty-eight specimens of this species taken at Sulphur Springs is in the collection. Of this representation seventy-eight are adult males, sixty-five adult females and five immature individuals, the dates extending from April 2 to June 12, the immature individuals having been taken on April 2 and 13. A pair from Raleigh, taken April 13 and May 5 in broom straw field, have also been examined.

The species was found locally plentiful in the low grasses of the treeless slopes and valleys. The individuals with general color pale yellowish ochraceous were found almost invariably in the very bottom of the valleys, and seemed a color adaptation in their resemblance to the more plentiful whitish pebbles strewn about there.

Several questions have been brought into prominence by the examination of this material, the first being in regard to the name. Fortunately the type of *Gomphocerus simplex* Scudder[10] is still in existence in good condition in the Academy collections, and several efforts to find some valid reason for recognizing the later and very poorly characterized *G. carinatus* Scudder from the "Middle States" having failed, we are under the necessity of uniting the two, *simplex* having six years' priority. At the present time we are not prepared to give any expression on the exact relationship of this species and the western allies with clavate antennæ, viz., *E. virgatus*, *tricarinatus* and *naviculus*.

The other point is relative to the presence of marked dimorphism and dichromatism in this species. The greater majority of the specimens of this species before us possess distinct supplementary carinæ on the dorsum of the head and pronotum, the type of the species belonging to this form, while nine males and seven females, representing both localities, have the supplementary carinæ lacking on the pronotum and weak or lacking on the head. A series of eight males and one female from Sulphur Springs are intermediate between the two extremes, having the supplementary carinæ very faintly and incompletely indicated on the pronotum and faintly or moderately indicated on the head.

There is a great amount of individual variation in the form of the lateral carinæ of the pronotum, some specimens having them subparallel, distinctly not constricted mesad and rarely very slightly convergent cephalad, while the great majority have the carinæ constricted more or less distinctly and sharply immediately cephalad of the middle. There is no correspondence between these two conditions and the presence or absence of supplementary carinæ. The distance between the lateral carinæ of the pronotum is variable. In general size the species varies considerably, particularly in the male sex.

The dichromatism noticed is typically examplified by one form with the general color pale yellowish ochraceous and the postocular bars broad and solid, extending to the tegmina, and vandyke brown in color, while the other type, which is by far the more numerous, has

[10] *Trans. Amer. Ent. Soc.*, II, p. 305, 1869. (Delaware.)

no solid postocular bars and the dorsal surface of the head and pronotum is marked with a pair of longitudinal velvety blackish or brownish lines. Between the two types are numerous individuals which seem to bridge more or less completely the gap between the extremes. In some the dorsum is uniformly dark with distinct broad, postocular bars, in others the dorsum is almost uniform dark while the postocular bars are lacking. The coloration of this species offers a curious parallelism to that of *Psolœssa texana* Scudder which we have recently treated in detail,[11] the pale type with the decided postocular bars being analogous to *Psolœssa buddiana*, the strongly dorsal bilineate type to *P. ferruginea* and the dull form to true *P. texana*.

The range of this species extends from Connecticut (New Haven) to northeastern Alabama (Valley Head and Lookout Mountain), east to Raleigh, N. C. Its zonal correlation would appear to be Carolinian.

Amblytropidia occidentalis (Saussure).

Two adult males and one adult female from Raleigh, taken April 13, 22 and May 19 in broomstraw fields and a series of seventeen immature individuals in three stages of development taken at New Berne, August 24, have been examined.

The only North Carolina records are from Raleigh, Selma and New Berne, these constituting the most northern reliable records for the species.

Orphulella pelidna (Burmeister).[12]

A single female of this species was taken at Cape Henry, Va., August 19, on dry beach grass, while at Bayville, Va., August 19, a single specimen of the same sex was secured at a wet spot in woods. At New Berne, August 24, six males and one female were secured in a wet meadow, while two males and one female were captured in dry pine woods at Winter Park, August 26. A series of twelve males and eleven females taken at Raleigh, July 18 to September 20, were secured in pine woods, in pasture, in stubble field and at the edge of marsh land.

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[11] *Proc. Acad. Nat. Sci. Phila.*, 1908, pp. 381-383.

[12] After numerous attempts to differentiate Scudder's *Orphulella pratorum*, we are compelled to use the oldest available name and allow Scudder's name to remain in abeyance, to be properly associated or relegated to the synonymy at some future date. However, it might be well to state that in using the antennal character given by Scudder (Canad. Entom., XXXI, p. 179) to separate *O. pratorum* and *pelidna*, nearly every specimen from the eastern United States which we have examined, and we have seen nearly a thousand individuals from that region, would fall into *pratorum*. We have never seen any specimens of *Orphulella* from Pennsylvania, the type locality of *pelidna*, except individuals of *O. speciosa*, while New Jersey specimens by Scudder's key would fall into *O. pratorum*. It seems quite likely to us that the antennal length is an unsatisfactory character.

Dichromorpha viridis (Scudder).

A single male of this species was taken in a wet spot in woods at Bayville, Va., August 19, and two males from Raleigh, taken July 18 and 20, on low ground are in the collection.

Morse has recorded the species from Norfolk, Va., and Greensboro, Salisbury and Raleigh, N. C.

Clinocephalus elegans Morse.

In a wet meadow at New Berne, on August 24, and in wet spots with tall grass in pine woods at Winter Park, August 26, this species was found quite numerous, a series of four males, ten females and two immature individuals being taken at the former locality and five males and nine females at the latter.

When compared with typical New Jersey specimens of *C. elegans* and Florida specimens of typical and nearly typical *C. e. pulcher* the North Carolina individuals are seen to be nearly intermediate, although a shade nearer true *elegans*. The peculiar coloration found in some individuals of *C. e. pulcher* is intimated in several specimens from Winter Park, but these lack the extreme development in this line occasionally found in the more southern form. The size is decidedly larger than the average of typical *elegans*, but in the male sex *pulcher* is distinctly larger than the North Carolina specimens of that sex.

The measurements of a pair from Winter Park are as follows:

	♂	♀
Length of body	18 mm.,	23.5 mm.
Length of pronotum	4 "	4.6 "
Length of tegmen	9.2 "	12 "
Length of caudal femur	10.8 "	13.8 "

Chloealtis conspersa Harris.

A pair of this boreal species was taken by the junior author, a male from an elevation of 4,500 feet on Mt. Pisgah, October 1, 1904, and a female from the summit of Jones's Knob, Balsam Mountains, 6,200 feet elevation, October 7, 1905. Morse has recorded this species from Jones's Peak (Jones's Knob) and Steestachee Bald in the Balsam Mountains, at elevations of from 5,500 to 6,000 feet. These constitute the only records for the species in North Carolina.

Both specimens here recorded were taken amid the undergrowth of deciduous forests.

Chorthippus curtipennis (Harris).

Three males and four females of this species were secured at the summit of Mt. Pisgah, elevation 5,740 feet, on October 1, 1904, where it was the most plentiful species of the summit bald. Morse has recorded the species from Balsam, 4,500–5,700 feet, Cranberry, Linville, Grandfather Mountain, 4,500–5,000 feet, Roan Mountain and Roan Valley. From these records, all at present known from the State of North Carolina, it would seem that the species ranges in that State from about 3,200 feet (Cranberry) probably to the highest points in the State where suitable environment occurs.

Arphia xanthoptera (Burmeister).

The Sulphur Springs collection contains two males and five females of this species taken September 9 to 29, while two males from Raleigh taken September 2, a pair from New Berne taken August 24 and two females secured August 26, at Winter Park are in the collections. At Winter Park it frequented spots in the pine woods and the labels of the Raleigh material show it was secured at that place in pine woods and in field of broomstraw. High open scrub near pine woods was the habitat frequented at New Berne.

The species has been recorded from a number of North Carolinan localities, but the Winter Park and New Berne records are the first from the coast region.

Arphia sulphurea (Fabricius).

At Sulphur Springs this species was taken on dates extending from April 2 to June 13, a series of eighteen males and ten females being secured. Raleigh is represented by ten males and three females taken April 27 to May 19. On May 14, two males were taken at 5,700 feet elevation on the summit bald of Mt. Pisgah, this being the highest point from which the species has been recorded in North Carolina.

Chortophaga viridifasciata (De Geer).

This widely distributed species is represented by a series of ten males and fifteen females from Sulphur Springs, taken on dates ranging from April 13 to September 29. Two males and one female were also taken on Mt. Pisgah at an elevation of 4,500 feet on October 1. Three of the females in the Sulphur Springs series are extremely large for the species, one of the three, which are quite uniform, measuring as follows: length of body 31 mm.; length of pronotum 8; length of tegmen 27.2; length of caudal femur 16.5. The remainder of the series is nearer what might be called the usual size of the species. But one male in the Sulphur Springs series is in the green phase, although seven of the fifteen females are in the same condition. The Mt. Pis ah female is in the green phase.

Hippiscus phœnicopterus (Burmeister).

A series of ten males and four females from Sulphur Springs, taken May 8 to June 13, 1904, and two males and one female from Raleigh, secured May 19 to July 21, 1904, in old fields represent this species.

Two males from Sulphur Springs and the female from Raleigh have the head, pronotum and caudal femora greenish, a condition seen in specimens from other localities and which is analogous to that noticed in some individuals of the genus *Gomphocerus.* This species is one of the forms which appears in the spring in company with *Eritettix simplex, Chortophaga viridifasciata, Arphia sulphurea* and *Hippiscus apiculatus* in the open grassy areas.

Hippiscus rugosus (Scudder).

Sulphur Springs is represented in the series of this species by six males and five females, taken September 2 to 29, while five males and two females secured at Raleigh August 4 to September 2 in pasture and broomstraw field are in the collection. Three males and four females were taken at Winter Park, August 26 on sandy spots in pine woods, where the species was numerous. The specimens from Winter Park are particularly interesting in that while the males are no larger than individuals of that sex from Sulphur Springs the females are considerably larger, in this respect exceeding any seen by the authors.

This species is now known to range on the Atlantic slope from southern Maine (Norway) to northern Florida (Lake City).

Hippiscus apiculatus (Harris).[13]

Twelve males and thirteen females, taken at Sulphur Springs April 13 to June 13, 1904, constitute the first record for the species from North Carolina and the first in the east with definite data from south of the District of Columbia.

The subdecussate pale pronotal markings are more or less marked in twelve specimens.

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[13] It is unfortunately necessary to substitute this name for "*Hippiscus tuberculatus*" of authors, which is quoted from *Acridium tuberculatum* Palisot de Beauvois (*Ins. Rec. d'Af. et Amer.*, p. 145, pl. 4, fig. 1) whose figure clearly pictures this species, but who placed as a reference to the species *Gryllus tuberculatus* Fabricius, an Old World species belonging to another genus, with which he considered his material from the United States identical. In consequence his name is not available and the next must be taken. Harris's *Locusta apiculata* (In Hitchcock, *Rep. Geol. Mass.*, 2d ed., p. 576, 1835) is merely a renaming of Beauvois's species appearing in this form:

"*Locusta L.*

apiculata. tuberculata P. de Beauv. F?"

Although unaccompanied by a diagnosis, this name is clearly intended to replace the misidentified *tuberculatum* of Beauvois, and as such we are under the the necessity of using it.

Dissosteira carolina (Linnæus).

A single female taken at New Berne, August 24, and one of the same sex from 4,500 feet elevation on Mt. Pisgah, taken October 1, 1904, have been examined.

Spharagemon bolli Scudder.

This species is represented by two males and four females from Sulphur Springs, taken September 18–24, and three males and one female from Raleigh taken August 19–September 9 in pinewoods.

The Raleigh female is somewhat larger than the average of the species.

Scirtetica picta (Scudder).

This species was found on bare sandy spots in pinewoods at Winter Park, August 26, two males and four females being taken. These specimens show an approach to *S. marmorata*, but this does not appear to be as decided as in the case of Eure, North Carolina specimens examined by Morse.[14] The two localities here given are the only ones in North Carolina from which the species has been recorded, though doubtless it occurs in all suitable locations in the eastern part of the State.

Psinidia fenestralis (Serville).

On the dunes at Cape Henry, Va., August 18, three males of this ammophilous species were taken, while a pair was secured on bare sandy spots in pine woods at Winter Park, August 26.

The only previous North Carolina records were from Eure and Tarboro.

Trimerotropis maritima (Harris).

One male and six females taken at Cape Henry, Va., August 18, are of particular interest, as they furnish additional evidence on Morse's observations[15] regarding the presence at this locality of examples apparently intermediate between *T. maritima* and *T. citrina* in addition to typical examples of each. Two of the females distinctly tend toward *T. citrina* in the color of the caudal tibiæ, although the general coloration and minor structural features are essentially the same as in *maritima*. No typical *citrina* were taken by us at Cape Henry, where *maritima* occurred on the bare strand and on the *Ammophila* covered dunes.

Trimerotropis citrina Scudder.

This species, which six years ago was known from east of the Mississippi River by but one State record, has now been recorded in the

[14] *Publ. No.* 18, *Carneg. Inst.*, p. 37.
[15] *Publ. No.* 18, *Carneg. Inst.* Wash., pp. 22 and 37.

eastern and southeastern States from nearly fifty different localities. In the collection before us is a series of eight males and three females from Raleigh, taken July 8 to September 13, and two males and four females from Sulphur Springs, secured September 27 and 29, 1905.

The records of this species in the eastern States extend from Maryland to northern Florida (Pablo Beach, Jacksonville, Carrabelle, Apalachicola, Ft. Barrancas and Warrington) and the coast of Mississippi (Gulfport), vertically distributed from sea-level to at least 2,500 feet (Sulphur Springs), wherever suitable environment occurs, the species being distinctly xerophilous. The Raleigh individuals were taken on sandy or dusty roads or at electric lights. This is a midsummer species, only occasional tattered individuals being found as late as the middle of September.

Leptysma marginicollis (Serville).

This paludicolous species is represented by a series of ten males and five females taken at Raleigh, on May 13 and September 9, 1904, and a single immature male taken at New Berne, August 24, 1908. The Raleigh specimens are fairly uniform in size.

Schistocerca alutacea (Harris).

At New Berne a single male of this species was taken in scrub near pine woods on August 24, while three males and three females were secured at Winter Park in dry spots in long-leaf pine woods, August 26. The New Berne specimen is of the yellowish fasciate type, while the Winter Park individuals are of the dull russet and vandyke brown type, very similar in coloration and size to specimens from the pine barren region of New Jersey. The Winter Park representatives all lack the medio-longitudinal stripe.

Schistocerca americana (Drury).

This species is represented by five males, two taken at Sulphur Springs, May 15 and June 5, 1904, two secured at the summit of Mt. Pisgah, 5,700 feet elevation, October 4, 1904, and the fifth captured at New Berne, August 24, 1908.

Schistocerca damnifica (Saussure).

A series of eleven males and six females taken at Sulphur Springs on dates ranging from April 2 to May 15 and from September 18 to 29, 1904, and five males, and one female taken at Raleigh, March 9 to April 13, and September 7, 1904, represent this species. The Sulphur Springs males are rather small when compared with the Raleigh individuals of that sex. At Sulphur Springs the specimens were all captured in the undergrowth along the edge of the deciduous forest.

Melanoplus atlanis (Riley).

This widely distributed species is represented by thirty-nine North Carolina individuals distributed as follows: Raleigh, July 1–24, July 22, August 3–15, September 22, twelve ♂, eight ♀; Lillington, June 28, one ♂; Sulphur Springs, May 6, June 13, September 18–28, six ♂, three ♀; Edenton, August 20, two ♂, one ♀; New Berne, August 24, two ♂, four ♀.

Melanoplus scudderi (Uhler).

This species is represented by a Raleigh series of seven males and ten females, taken August 25 and September 2–22, 1904. These specimens average about the same size as individuals from New Jersey. Upland fields, pastures and pine woods were frequented by this species at Raleigh.

Melanoplus carnegiei Morse.

This interesting form is represented by fourteen males and seventeen females taken at Sulphur Springs, September 17–29 and October 7, 1904 and 1905. The series is fairly uniform in size and with but little variation in general coloration. The only previous records for this species are the original ones from Denmark and Spartanburg, S. C., and Blue Ridge, Ga. In the vicinity of Sulphur Springs this was the most abundant short-winged *Melanoplus*. It was found usually in the undergrowth of the woods in the more open situations.

Melanoplus deceptus Morse.

In the Academy collection there is a single imperfect male of this species from "Tennessee." The only previous records were from Balsam (Jones's Peak), N. C., and Jasper, Ga.

Melanoplus devius Morse.

A series of six males and ten females from Sulphur Springs taken September 9 to 29, 1904–1905, and two males, seven females and one immature individual taken on the higher wooded slopes (5,000 feet) of Mt. Pisgah, October 1, 1904, represent this species, previously known only from Wytheville, Va., and Topton, N. C. Both lots exhibit some individual variation in size, although this is more pronounced in the Sulphur Springs specimens, particularly the males. However, the original measurements given by Morse cover the extremes in size before us, the Pisgah females averaging very slightly smaller than Sulphur Springs individuals of the same sex. The Pisgah males are so few in number that comparison of that sex is of little value, but measurements of the females from both localities show that the apparently shorter femora of the Pisgah females is much more than a mere proportional reduction. The average difference is 1.4 mm., the Sulphur Springs specimens averaging 12.9 (12.5–13.5), the Pisgah series 11.5 (11.2–11.8). The Mt. Pisgah specimens are, as a rule, darker and somewhat less contrasted than the Sulphur Springs series. The length of the furcula is, as stated by Morse, quite variable.

The species was never found in the least plentiful about Sulphur Springs. Its habitat proved to be constantly sylvan.

Melanoplus decorus Scudder.

This little-known species is represented by six males and one female from Winter Park, taken August 26, 1908, and four males from New Berne, August 24, 1908. In size there is quite a little variation as the caudal femora of the males range between 9.5 and 11.2 millimetres in length. The general coloration varies appreciably from a general gamboge-yellow to fawn color, while the coloration of the face varies from uniform with the body to walnut-brown. The blackish coloration of the tubercle of the subgenital plate of the male is quite striking.

The previously unique types were taken at Dingo Bluff, N. C.

At New Berne the species occurred in a piece of moist meadow land, and at Winter Park it frequented high grass in wet spots in long-leaf pine woods. The species was scarce at New Berne, but more numerous at Winter Park.

Melanoplus amplectens Scudder.

At Balsam this species was found at elevations of from 3,500 to 4,000 feet on October 7, 1905, while the same day it was secured at 5,000 feet elevation on Jones's Knob. On October 1, 1904, it was taken at 4,500 feet and 5,700 feet (summit) on Mt. Pisgah. Balsam is represented by two males and eight females, Jones's Knob by two males and three females and Mt. Pisgah by two males and six females.

Morse has already called attention to the variability of this species, and our material substantiates his remarks. The variation in the length of the tegmina is very considerable in some specimens, the extremes of the males measuring 4.2 and 7 mm., of the females 5.5 and 8, all measured being from Mt. Pisgah except the male with shortest tegmina, which is from Balsam. All the specimens of this species were found in distinctly sylvan surroundings where grass was present in some quantities, excepting in the case of those taken on the summit bald of Mt. Pisgah.

Melanoplus divergens Morse.

Three males and three females of this species taken at Balsam, 4,000 feet elevation, on October 7, 1905, are practically topotypes.

Morse's specimens having been secured at 5,000–6,000 feet at the same locality. The males all exceed the maximum body length given by Morse by at least 4 millimeters, but the other measurements of that sex and of the female are around Morse's maximum. These specimens were all taken in a grassy glade covered with a scattering growth of deciduous trees.

Melanoplus femur-rubrum (De Geer).

All the North Carolina material of the *femur-rubrum* series seen is referable to De Geer's species, although the more austral *propinquus* has been recorded from the State. The series before us includes the first records from the coastal section of the States, the localities represented being: New Berne, August 24, 1908, two males; Edenton, August 20, 1908, two males, three females; Raleigh, August 20, September 4–10, four males, six females; Sulphur Springs, September 18–27 and October 6, 1904, eight males and six females.

At Edenton it was found in grassy drains and in high weeds. and at New Berne in meadow land.

Melanoplus keeleri (Thomas).

This interesting species was found generally distributed, but scarce in pine woods at Winter Park, August 26, where three males and three females were taken. Raleigh is represented in our series by one male and three females taken in pine woods, broomstraw and upland field on August 19 and September 13 and 22, 1904.

These specimens are very slightly smaller than individuals from Pablo Beach, Fla., but equal to or very slightly larger than the measurements given by Scudder in his Revision of the Melanopli. The only localities for this species from the State in addition to the above are Smithville, Dingo Bluff and "North Carolina."

Melanoplus luridus (Dodge).

A series of twenty-seven specimens represent this species, distributed as follows: Balsam, 3,500–4,000 feet, October 7, 1904, four males, two females; Jones's Knob, Balsam Mountains, October 7, 1905, five males, one female; Mt. Pisgah, 4,500 feet, October 1, 1904, eight males, seven females. Morse has recorded the species from a number of localities in the mountains of North Carolina. This appears to be the most plentiful species of *Melanoplus* on all the mountains of this region at altitudes above 4,000 feet.

Melanoplus femoratus (Burmeister).

A single male of this species taken at Sulphur Springs, June 2, 1904, is in the collection. Morse has recorded it from the same locality.

Paroxya atlantica Scudder.

At New Berne a single female of this species was taken in wet meadow land on August 24, while at Winter Park it was fairly numerous in wet grassy depressions in pine woods, where, on August 26, seven males and two females were secured.

The specimens show a decided approach to the more northern form *Scudderi*, which is probably but a geographic race, the tegmina and caudal limbs in the North Carolina individuals being somewhat shorter than in Florida specimens.

This is the first record of the species from North Carolina.

Paroxya floridiana (Thomas).

This moisture-loving species is represented by one male and two females from Raleigh, taken August 22 and September 9, 1904, two females from Edenton, taken August 20, and two of the same sex from New Berne, secured August 24. At Edenton and New Berne it occurred on grasses in wet drains, while the Raleigh specimens are labelled "swamp" and "edge of marsh."

TETTIGONIIDÆ.

Scudderia texensis Saussure and Zehntner.

A male of this species, taken at New Berne, August 24, an individual of the same sex from Raleigh, taken August 30, and a female from Winter Park, taken August 26, are in the collection. The New Berne specimen was taken in scrubby undergrowth at the edge of open pine woods, at Winter Park it occurred in pine woods, while at Raleigh the species was secured in a broomstraw field. The present records are the first from North Carolina.

Scudderia curvicauda (De Geer).

A single female of this species from Raleigh, taken August 30, in pine woods, has been examined.

Scudderia furcata Brunner.

Three males and three females from Raleigh, taken in pine woods September 2–7, 1904, one male and three females from Sulphur Springs, September 17–28, 1904–5, and a pair from Bayville, Va., taken in mixed woods undergrowth, August 19, represent this species. Previous to this writing Raleigh was the only exact locality in the Atlantic States between New Jersey and southern Georgia from which the species had been recorded.

Scudderia cuneata Morse.

A male of this species from Raleigh represents the most northerly point at which the species has been taken. It was secured September

9, 1904, and is labelled "edge of marsh." No doubt this is the form recorded by Brimley as *S. furcifera*,[16] which latter might readily be mistaken for this species, although its range is entirely southwestern and Mexican.

The previous records of *cuneata* are Alabama (type locality), Thomasville, Ga., and Pablo Beach and Miami, Fla. It is apparently a purely Lower Austral form.

Amblycorypha oblongifolia (De Geer).

A single male taken at New Berne, August 24, and another individual of the same sex taken at Bayville, Va., August 19, represent this species. At the former locality the species was taken in high weeds along a wet drain and at the latter it was secured in mixed woods undergrowth. These records are the first from either State.

Amblycorypha rotundifolia (Scudder).

This interesting species is represented by two specimens taken at high elevations, one, a female, from 6,000 feet on Jones's Knob, Balsam Mountains, October 7, 1905, the other, a male, from 5,740 feet on Mt. Pisgah, Pisgah Ridge, October 1, 1904. These individuals show no points of difference from Indiana specimens. The specimen from Mt. Pisgah was beaten from the low bushes growing on the summit bald, while the individual from Jones's Knob was found in the forest undergrowth.

Aside from one record from Georgia, these are the only positive records of the species from the South Atlantic States.

Amblycorypha uhleri Stål.

Three males taken at Raleigh, August 20–September 4, 1904, in pine woods and at light, and a single male secured at Winter Park, August 26, 1908, in wire grass in pine woods, represent this austral species. The Winter Park specimen has a somewhat larger tympanum than the other specimens and the pronotum is also relatively broader caudo-dorsad, but it is not separable from other specimens of the species examined. The same individual is yellowish in coloration instead of green, the color being extremely protective in the dry wire grass. The two localities given above are the only ones in the State from which the species has been recorded, Brimley having already recorded it from the first-mentioned.

Microcentrum rhombifolium (Saussure).

A single female from Raleigh, taken August 25, 1904, and an indi-

[16] *Ent. News*, XIX, p. 19.

vidual of the same sex from Sulphur Springs, taken September 14, 1904, represent this species.

These records are the first with exact data from the State.

Microcentrum retinerve (Burmeister).

An interesting series of this species, consisting of seventeen males and one female, taken at Sulphur Springs, September 22–October 8, 1904–1905, is in the collection. This series is uniform in size and in all the males the tympanum is washed with two shades of brown proximad of the stridulating vein, which is also uniformly of the lighter shade of brown.

These specimens were all captured after dark attracted to light. No exact record of the occurrence of the species in North Carolina has been previously published.

Neoconocephalus mexicanus (Saussure).

Two females of this species, one from Raleigh, taken May 13, 1904, the other from Sulphur Springs secured, September 18, 1904, represent this austral species. These localities are the only ones in the State at which the species has been taken, the previous records being "North Carolina" (Karny) and Brimley's Raleigh information. The Sulphur Springs individual was attracted to light at night and so captured.

Neoconocephalus palustris (Blatchley).

A single male from Raleigh, taken in wet meadows, August 4, 1904, is in the collection. Brimley has recorded it from this locality, which is the only one in the Southern States at which the species has been secured.

Neoconocephalus retusus atlanticus (Bruner).

The material examined in the present connection corroborates the opinion previously expressed by us[17] regarding the relationship of *retusus* and *atlanticus*. The series before us consists of six males and one female taken at Sulphur Springs, September 18 to October 6, 1904–1905, and four males and two females from Raleigh taken August 31–September 7, 1904, at light, in garden and in grassy places in pine woods. A single immature female taken at Bayville, Va., August 19, 1908, has also been examined. The Sulphur Springs series shows both color phases and is quite uniform in size, being almost typical *atlanticus*, as determined by comparison with paratypes. The Raleigh series is all in the green phase and shows little individual

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[17] *Proc. Acad. Nat. Sci. Phila.*, 1907, p. 303.

size variation, but very strongly approaches *retusus* in the longer limbs and ovipositor. This tendency is so great that the specimens are almost intermediate in character and can hardly be referred more to one than to the other.

As this interesting case can well be demonstrated by figures, the following measurements made from average individuals, when taken with those previously given by us,[18] show the extent of geographic size variation in this species:

♂	Asheville, N.C.	Raleigh, N.C.	Waycross, Ga.
Length of body	23 mm.,	24.5 mm.,	26 mm.
Length of pronotum	7 "	7.2 "	7.8 "
Length of tegmen	33 "	35 "	35.5 "
Length of caudal femur	19 "	20.8 "	23.5 "

♀	Asheville, N.C.	Raleigh, N.C.	Waycross, Ga.
Length of body	29. mm.,	24.5[19] mm.,	29.5 mm.
Length of pronotum	6.8 "	6.8 "	7.5 "
Length of tegmen	33.5 "	34. "	41.5 "
Length of caudal femur	21.8 "	24.2 "	28 "
Length of ovipositor	32.5 "	35 "	38.5 "

True *N. retusus* has been recorded from "Georgia," Waycross and Thomasville, Ga., St. Augustine and Chokoloskee, Fla. The record of *atlanticus* at Thomasville, Ga., made by the authors,[20] is erroneous, due to the non-association of the sexes, the record of *atlanticus* being based on males and that of *retusus* from the same locality on the easily recognizable female. A male of *atlanticus* from Montgomery County, Virginia, in the Hebard collection, has also been examined by us.

Orchelimum militare Rehn and Hebard.

A single male of this species was taken in high grass in moist spots in pine woods at Winter Park on August 26. The specimen is distinctly smaller than Georgia individuals, but otherwise it is quite typical. The range of the species is carried a considerable distance northward by the capture of this specimen.

Orchelimum glaberrimum (Burmeister).

A pair of this species was taken in meadow land at New Berne, on August 24, a single female in high grass in wet spot in pine woods at

[18] *Supra*, p. 304.
[19] Body considerably shrunken.
[20] *Proc. Acad. Nat. Sci. Phila.*, 1904, p. 795.

Winter Park, August 26, two males in a wet drain at Edenton, August 20, and one adult and one immature female in undergrowth in woods at Bayville, Va., August 19. A single male from Raleigh taken August 30, at edge of marsh, is also in the collection.

The specimens from North Carolina all have the head more or less decidedly reddish, and should be regarded as representing *O. erythrocephalum* Davis if this is considered a valid species, which the present authors believe is not the case. Sufficient material is in hand, from about a dozen localities ranging from New Jersey to north-central Florida to demonstrate to our satisfaction the great amount of individual variation in this species in the coloring of the head as well as that of the dorsum of the pronotum. The emphasis placed on the characters separating *erythrocephalum* from *vulgare* in the original description of the former, tends to mislead one, as *vulgare* is quite distinct in cercal and other characters and *glaberrimum* with which the specimens of *erythrocephalum* should have been compared is not mentioned.

Regarding the presence or absence of spines on the ventral carinæ of the caudal femora, the following notes made from fourteen specimens of this species may be of interest: three specimens have 0–0, one 0–1, two 0–2, one 0–3, four 1–2, one 1–4, one 2–4, one 3–3. In size the species regularly increases southward, north-central Florida specimens being extremely large when compared with New Jersey, Delaware and Maryland individuals. Thomasville, Ga., representatives are hardly smaller than Jacksonville and other north Florida individuals, while North Carolina specimens are about intermediate in size between those from Georgia and Delaware. As has already been pointed out by the present authors, the length of the tegmina is quite variable.

Orchelimum agile (De Geer).[21]

A series of eleven males and two females taken at Sulphur Springs, September 17–29, 1904 and 1905, and a single female taken at Raleigh, September 17, 1904, in upland pasture represent this species. The diversity in size in the Sulphur Springs series is considerable, aside

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[21] After carefully examining the literature bearing on the identity of the much-discussed *Locusta agilis* De Geer, we are compelled to retire Harris's *vulgare* in favor of the much older De Geerian name, which we believe to be undoubtedly based on the same insect. De Geer's locality was Pennsylvania and Harris's Massachusetts, and a comparison of material from the two States shows no reason for their separation. De Geer's figure is, to us, sufficient to fix the species. We are also of the opinion that *Orchelimum gracile* Harris is a synonym of *Conocephalus fasciatus* (De Geer).

from the length of the tegmina and wings which vary independently of general size. The coloration, however, does not vary in as marked a degree, being chiefly limited to the depth of infuscation of the median portion of the pronotal bar. The Raleigh female and one Sulphur Springs male are ochraceous instead of greenish or greenish-yellow in general color.

A single specimen of this species from Montgomery County, Virginia, in the Hebard Collection is the only record of the species from that State. Brimley has recorded the species from North Carolina at Raleigh.

Orchelimum molossum Rehn and Hebard.

This species, which was previously known only from northern Florida (Pablo Beach and Gainesville) and Georgia (Thomasville and Thompson's Mills), is represented by two males and two females taken in a wet drain at Edenton, August 20, a single female taken in high weeds on moist ground at New Berne, August 24, and five males and one female taken at Raleigh, September 4–31, 1904. In all probability the record of the closely allied *O. nitidum* at Raleigh made by Brimley[22] really relates to this species. A specimen from Roslyn, Va., in the Academy's collection, taken in September by Mr. Caudell, shows this species to range to the vicinity of Washington. The North Carolina specimens exhibit considerable individual variation in size, but as is the case with *O. glaberrimum*, the average individual from Virginia and North Carolina is smaller than Georgia and Florida examples. The paired pronotal lines are sometimes absent, and vary considerably in intensity when present.

Orchelimum minor Bruner.

This beautiful species is represented by three males taken in low pines, fifteen to twenty feet from the ground at Sulphur Springs, September 2 and October 6, 1905, and a single female from Raleigh, taken September 20, 1904. Material has also been examined in this connection from Thompson Mills, Ga., and Atsion, N. J., the latter taken October 8, 1903, by the junior author.

The five males before us show very little individual variation in size, and as no measurements have ever been published for the species it seems desirable to give the more important ones of the specimens before us.

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[22] *Ent. News*, XIX, p. 20.

♂

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Atsion, N. J.	16.5 mm.,	4 mm.,	15 mm.,	13 mm.
Sulphur Springs, N. C.	15.8 "	4 "	15 "	12.2 "
"	15.5 "	4 "	15 "	12 "
"	16 "	4.2 "	16 "	13 "
Thompson Mills, Ga.	15 "	4.2 "	15 "	13.8 "

♀

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.	Length of ovipositor.
Raleigh, N. C.	19 mm.,	4.5 mm.,	16.8 mm.,	14.8 mm.,	11 mm.

The coloration is very rich and is more contrasted in the female than in the opposite sex. The colors vary but little in intensity in the five males, the green alone being slightly weaker in one individual than in the others. The paired yellowish lines on the dorsum of the abdomen are pronounced in most of the specimens, but distinct in all.

The range of this arboreal species is now known to extend from southern New Jersey south to north-central Georgia, Sulphur Springs being at the highest elevation (2,500 feet) from which the species has been recorded.

Orchelimum spinulosum (Redtenbacher).

Three males and one female from Raleigh, taken September 9, 1904 from grassy edge of marsh, belong to this species, described from "North Carolina" and since unreported. Specimens from Chestnut Hill, Philadelphia and Tinicum, Pa., taken by the authors, show the range of the species to extend considerably to the northward.

Orchelimum pulchellum Davis.

A pair taken at Raleigh, August 22 and 30, 1904, in a cat-tail swamp and at edge of marsh and a single male taken in a wet drain at Edenton, August 20, represent this species. Originally described from Dennisville, Helmetta and Trenton, N. J., this beautiful species is now known to range from north-central New Jersey (Helmetta) to eastern North Carolina. The original describer compared the species with *nigripes*, but its relationship is not with that species, the cerci being decidedly different. It is, in fact, much nearer to *O. spinulosum* and less closely to *O. minor*, the form of the cerci being of much the same type in the three. The Raleigh individuals are somewhat larger than the Edenton specimen.

Conocephalus strictus (Scudder).

Xiphidium strictum of authors.

Three adult females taken at Raleigh, September 9–20, 1904, and two adult and three immature females secured at New Berne, August 24, 1908, belong to this species. At the former locality the species occurred in pasture, in broomstraw field and in grass along edge of marsh, while at New Berne it was taken in a piece of open meadow land.

The only previous record of the occurrence of the species in the southeastern States is Brimley's Raleigh note.

Conocephalus ensiferus (Scudder).

Xiphidium ensiferum of authors.

This species is represented by a series of eight males and eight females taken at Sulphur Springs, September 2–29, 1905, and five males and five females secured at Raleigh, August 16 to September 9, 1904. At Raleigh it was secured at electric lights, at grassy edge of marsh, in grassy places in pine woods and in broomstraw field.

A pair from Raleigh and one female from Sulphur Springs are long-winged. The individuals before us vary but little in size. The localities cited above are, with the addition of Fort Reed, Fla., the only ones in the southeastern States from which the species is known. The Fort Reed record was based on immature material and, as intimated at the time, may belong to another species.

Conocephalus fasciatus (De Geer).

Xiphidium fasciatum of authors.

This widely distributed species is represented in the present series by two males and one female from Sulphur Springs, September 18–28, 1904; three males and two females from Raleigh, August 15 to September, 1904; a pair from New Berne, August 24, 1908, and a single female from Edenton, August 20, 1908. These localities are the only ones in North Carolina at which the species has been captured.

Conocephalus brevipennis (Scudder).

Xiphidium brevipenne of authors.

A single female from Edenton, August 20, 1908, and another specimen of the same sex from New Berne, August 24, 1908, represent this well-known species. With the addition of Brimley's Raleigh record one has all the known data on the occurrence of the species in North Carolina. At Edenton it was taken in a wet drain and at New Berne it occurred in open meadow land.

Five males from Bayville, Va., August 19, and one male from

Cape Henry, Va., August 18, have also been examined. At the former locality it occurred in low growth in mixed woods and at the latter among dune growth.

Conocephalus saltans (Scudder).

Xiphidium saltans of authors.

One male and three females from Sulphur Springs, September 18 to 28, 1904–1905, represent this species. The only previous records for the southeastern States are from Raleigh, N. C., and Thomasville, Ga.

Conocephalus nemoralis (Scudder).

Xiphidium nemorale of authors.

This easily recognized species is represented by a series of fifteen males and eight females, taken at Sulphur Springs, September 2 to October 6, 1904–1905. One female is long-winged, the bold pattern of the venation found in this species being proportionately more pronounced, giving this individual a peculiar appearance. Both sexes vary considerably in size, but in no case does this seem to be decided enough to prevent ready recognition of the species.

This is the only record of the species from the South Atlantic States.

Odontoxiphidium apterum Morse.

A single female of this species from Winter Park, taken August 26 in high grass in a wet spot in pine woods, considerably extends the range of this species northward. All the previously known records are of captures in Georgia and Florida. The Winter Park specimen is somewhat smaller than Pablo Beach, Fla., individuals, but otherwise inseparable. The specimen secured was the only one of the species seen.

Atlanticus dorsalis (Burmeister),

Four females of this species taken at Sulphur Springs, September 24, 1904, constitute the first record of the species, occurrence in North Carolina. The specimens were captured in the forest undergrowth and were the only ones noticed about the locality.

Atlanticus pachymerus (Burmeister).

A single male of this species was secured at an elevation of six thousand feet on Jones's Knob, Balsam Mountains, October 7, 1905. It was taken in the forest undergrowth.

GRYLLIDÆ.

Ellipes minuta (Scudder).

Two individuals of this species were taken at Sulphur Springs, June 12, 1904 on damp sand beside a stream. Brimley has recorded this species from Raleigh, the only previous record from either of the Carolinas.

Nemobius fasciatus (De Geer).

From a careful study of a considerable series of material belonging to this and the following form, it seems necessary to consider them but geographic races of one and the same species. The evidence of intergradation is so great that it is almost impossible to place specimens from certain localities in one or the other of the two forms. As the only character by which *socius* could be separated from *fasciatus* is the length of the ovipositor relative to that of the caudal femur, the following measurements of the female individuals in the present series, in addition to some typical specimens of *socius* from other localities, may be of interest.

Caudal femur.	*Ovipositor.*									
	mm. 5.8	mm. 6	mm. 6.2	mm. 6.8	mm. 7	mm. 7.2	mm. 7.5	mm. 7.8	mm. 8	mm. 8.2
6.4 mm	T*									
6.8 mm	T							S	P	
7 mm			TT R	R			P			
7.2 mm		R					S		B	
7.5 mm					R			S R		
7.8 mm							C R			
8 mm						S		R		
8.5 mm										P

* T = Thomasville, Ga.
C = Cedar Keys, Fla.
R = Raleigh, N. C.
S = Sulphur Springs, N. C.
P = Mt. Pisgah, N. C.
B = Bayville, Va.
Each letter indicates a specimen.

One series consists of five females from Sulphur Springs, secured September 17 and 24, 1904, and thirteen males and four females from 4,500 feet elevation on Mt. Pisgah, captured October 1, 1904. A single female from Bayville, Va., August 19, 1908, has also been examined. Of these specimens but one male is macropterous (Mt. Pisgah) and but one female (Mt. Pisgah) has tegmina almost as long as the body.

The Pisgah and Sulphur Springs lots each contain a single specimen having the ovipositor slightly shorter than the caudal femur, but as this is the exception and not the rule, we have considered the material from those localities to be *N. fasciatus*, while in our Raleigh series but one in seven has the ovipositor longer than the caudal femur, so we have placed the latter locality's representatives under *N. fasciatus socius*. The specimens tabulated above show the following differences in the proportion of these two parts:

Ovipositor longer (+) or shorter (−) than caudal femur.

Bayville, Va	.8 mm.	+
Mt. Pisgah, N. C	.5 mm.	+
"	1.2 mm.	+
"	.8 mm.	+
"	.3 mm.	−
Sulphur Springs, N. C	1.0 mm.	+
"	.3 mm.	+
"	.3 mm.	+
"	.8 mm.	−
Raleigh, N. C	.5 mm.	−
"	.3 mm.	−
"	.2 mm.	+
"	.2 mm.	−
"	.8 mm.	−
"	.8 mm.	−
"	.2 mm.	−
Cedar Keys, Fla	.3 mm.	−
Thomasville, Ga	.8 mm.	−
"	.7 mm.	−
"	.4 mm.	−
"	1.0 mm.	−

The Sulphur Springs specimens are paler, more rufous and with more decided pattern than the other and more usual specimens. These may represent *N. canus* Scudder, but the structural characters given for that form do not hold in the present specimens, so it seems more desirable to consider them slightly aberrant *fasciatus*. A number of such pale colored individuals from Massachusetts, New Jersey and Maryland have been examined by us.

Typical *Nemobius fasciatus* appears to be replaced in the entire Lower Austral zone of the southeastern States by *N. fasciatus socius* although, as shown above, material from the borderland of the two forms is more or less intermediate in character.

Nemobius fasciatus socius Scudder.

This southern race of *N. fasciatus* is represented by two males and eight females from Raleigh, taken July 8–18, August 16–30 and September 2–20, 1904, and one male from New Berne, secured August 24, 1909. Of this series one pair from Raleigh are macropterous, the remainder being brachypterous.

The Raleigh specimens were taken in pine woods, in stubble and broomstraw field, in grass around edge of marsh and at electric lights.

Nemobius maculatus Blatchley.

Two males from Sulphur Springs, taken September 24, 1904, and two individuals of the same sex from Raleigh, secured September 15, 1904, are referred to this species after comparison with typical Indiana material.

This is the first authentic record of the species for the southeastern States.[23]

At Raleigh the species was taken at the edge of a marsh.

Nemobius carolinus Scudder.

One male and two females from Balsam, taken at an elevation of 3,500 feet on October 7, 1905, and a pair from Raleigh, secured August 4 and September 5, 1904, represent this species.

The Raleigh specimens are somewhat larger than the Balsam individuals and the male proves the occurrence of macropterism in this species, the other representatives being of the usual brachypterous type.

At Raleigh the species was taken from under a plank in a garden and at light in house, while at Balsam the specimens were captured among damp grasses in the heavy deciduous forest.

The only previous North Carolina record is that of the types, which had no exact locality.

Gryllus pennsylvanicus Burmeister.

A series of six males and three females taken at Sulphur Springs, May 10–27 and June 5 and 13, are before us.

Gryllus neglectus Scudder.

Two males and two females taken at 4,500 feet elevation and on the summit bald of Mt. Pisgah, October 1, 1904, are referable to this form,

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[23] The record of this species from Thomasville, Ga., made by the authors (*Proc. Acad. Nat. Sci. Phila.*, 1904, p. 799) is erroneous, the material having been brachypterous individuals of *N. fasciatus socius*.

which appears worthy of some designation whether specific or varietal. The measurements of these specimens are as follows:

	♂	♂	♀	♀
Length of body............	16.5 mm.,	15.5 mm.,	20 mm.,	18 mm.
Length of tegmen..........	9 "	9.8 "	9 "	7.5 "
Length of caudal femur	10 "	10.8 "	11 "	11.5 "
Length of ovipositor......			13 "	12.5 "

The original measurements of this species for some reason are erroneous, this being the case with all the species of *Gryllus* measured in the same paper,[24] the dimensions being little more than half the usual size of the forms. Allowance for this may cause the synonymizing with *neglectus*, of Blatchley's *Gryllus americanus*, the chief diagnostic characters of which, when compared with *pennsylvanicus* and *abbreviatus*, were stated to be the slender build, short tegmina and ovipositor. When compared with an authentic pair of *americanus* in the Academy's collection the Mt. Pisgah individuals are slightly larger but otherwise inseparable.

Gryllus rubens Scudder.

This southern form is represented by a series of nine males and fourteen females from Raleigh, taken on dates ranging from April 16 to June 21 and also on September 7 and 13, 1904, a single male from Sulphur Springs taken June 5, a single male from Edenton, secured August 20 and one female from New Berne taken August 24.

There is a very great amount of individual variation in size in both sexes, the proportions of thirteen females from Raleigh being as follows:

Caudal femur.	*Ovipositor.*								
	10 mm.	10.8 mm.	11.5 mm.	11.8 mm.	12 mm.	12.2 mm.	12.5 mm.	12.8 mm.	14 mm.
10 mm............	1	1	....	1	....	....	....	....	....
10.5 mm............	....	....	1	....	....	1	....	....	....
11 mm............	....	....	....	....	2	....	....	....	....
11.2 mm............	....	....	....	....	....	....	....	....	1
11.5 mm............	....	....	....	....	....	....	2	1	....
12 mm............	....	....	....	....	....	....	2	....	....

[24] *Boston Journ. Nat. Hist.*, VII, pp. 427–429.

The above-mentioned records are the first for the species from North Carolina. At Raleigh it occurred in gardens, pastures, in broomstraw fields, in open places in woods and under rubbish, while at Edenton it was taken among weeds in a wet spot.

Œcanthus angustipennis Fitch.

A single male from Sulphur Springs, taken September 29, 1904, is the first record of the species from North Carolina. An immature individual secured at Bayville, Va., August 19, 1908, constitutes the first Virginia record for the species.

Œcanthus latipennis Riley.

A female individual in the istar preceding the adult condition taken August 19, 1908, at Bayville, Va., is the first record of the species in that State. It was taken in pine woods undergrowth.

Œcanthus quadripunctatus Beutenmüller.

Four males and two females from Raleigh, taken June 29, August 30 and September 22, 1904, and one female from Sulphur Springs, September 24, 1904, represent this species. At Raleigh it occurred on garden weeds, in broomstraw and in upland fields.

Two males and one female were taken in heavy tangles among low dunes at Cape Henry, Va., August 18, 1908, these constituting the first Virginia record for the species.

Œcanthus nigricornis Walker.[25]

Two females taken at Raleigh, September 7 and 22, 1904, represent this rather robust species. One was taken in an upland field, the other from alders along stream in pine woods.

This is the first record of the species from North Carolina.

Anaxipha exigua (Say).

Three males and two females taken at Raleigh, August 30 and September 9, 1904, belong to this species. Two males and two females secured at Bayville, Va., August 19, 1908, constitute the first record of the species in the latter State. At Raleigh it was captured in grasses around edge of swamp, while at Bayville it was taken in tall grass and brush in a wet spot in pine woods.

Phylloscyrtus pulchellus (Uhler).

This beautiful species is represented by three males and two females taken at Raleigh, September 9, 1904, and a single female captured at

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[25] We find it impossible to use the name *fasciatus* for this species, as Fitch did not propose it as a new name, but merely erroneously identified De Geer's *Gryllus fasciatus* which is clearly a *Nemobius*. After examining the literature, we fully agree with previous authors who have reached this conclusion.

New Berne, August 24, 1904. A pair from Bayville, Va., secured August 19, 1908, are the first individuals of the species recorded from that State.

At Bayville it occurred in company with *Anaxipha exigua* in a grassy and bushy wet spot in pine woods; at New Berne it was captured in rank growth along a drain and at Raleigh it was also taken with *Anaxipha* on bushes bordering swampy land.

Hapithus agitator Uhler.

A pair of specimens from Raleigh, taken in pine woods September 7, 1904, are particularly interesting as they are practically intermediate between *H. agitator* and *H. quadratus*. There seems to be little doubt but that *quadratus* is a southern race of *agitator*, the differential characters being the greater size, the proportionately longer legs and more complex venation. The Raleigh individuals have distinctly longer legs than specimens of true *agitator*, though their general relationship appears to be very slightly nearer the northern form. Taken with the measurements already given by the authors,[26] the proportions of the Raleigh specimens may be of interest.

	♂	♀
Length of body	10.5 mm.,	11.5 mm.
Length of pronotum	1.8 "	2 "
Length of tegmen	6.3 "	7.5 "
Length of caudal femur	8.5 "	9.3 "
Length of ovipositor	....	7.5 "

[26] *Proc. Acad. Nat. Sci. Phila.*, 1907, p. 318.

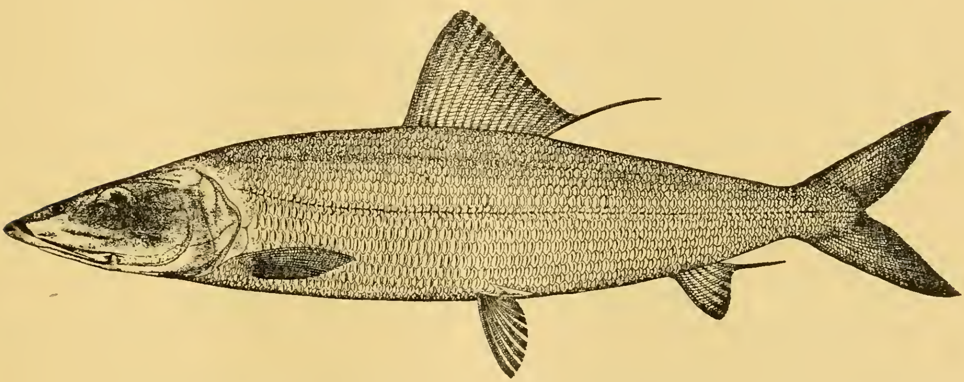
A NEW ALBULOID FISH FROM SANTO DOMINGO.

BY HENRY W. FOWLER.

DIXONINA gen. nov.

Type *Dixonina nemoptera sp. nov.*

Body elongate, robust, fusiform. Head elongate, slender, compressed, attenuate. Snout conic, pyramidal, well protruded beyond mandible. Eye moderate. Adipose eyelid well developed. Mouth large, horizontal. Maxillary strong, large, nearly to middle in head length, slips below broad membranous preorbital. Premaxillaries moderate, non-protractile. Lateral edge of upper jaw formed by maxillary. Jaws, vomer and palatines with villiform teeth. Coarse



blunt paved teeth in broad areas on basibranchial, sphenoid and pterygoid bones. Tongue broad. Nostrils small, together. Interorbital and head above mostly depressed. Opercle moderate, firm. Preopercle with posterior membranous edge more produced behind below. Rakers short asperous tubercles, few in number. Pseudobranchiæ present. Gill-membranes entirely separate, free from isthmus, fold across anteriorly with its hind edge plicate. No gular plate. Body covered with rather small brilliantly silvered scales, head naked, and fins minutely scaled. Belly convex, covered with usual squamation. Lateral line complete. Dorsal moderate, inserted well before ventral. Anal well behind dorsal, small. Pectoral small, also ventral. Coloration uniform.

This interesting genus is the second known among the living representatives of the family *Albulidæ*. From *Albula*, with its single alleged exotic species ranging through all tropical seas, it differs at once in the last rays of both the dorsal and anal being produced in long filaments, and its more slender head with a longer maxillary.

Named for Samuel G. Dixon, M.D., LL.D., President of the Academy of Natural Sciences of Philadelphia, in slight recognition of his appreciation and encouragement of ichthyology.

Dixonina nemoptera sp. nov.

Head $3\frac{1}{2}$; depth $4\frac{3}{5}$; D. v, 16, I; A. III, 6, I; P. I, 16; V. I, 8; 76 scales in l. l. to caudal base (squamation injured); 9 scales obliquely back from dorsal origin to l. l.; 7 scales obliquely forward from anal origin to l. l.; 30 predorsal scales; head width $2\frac{2}{5}$ in head length; head depth at occiput $1\frac{9}{10}$; snout $2\frac{3}{5}$; eye $5\frac{2}{3}$; snout tip to maxillary end $2\frac{1}{12}$; mandible $2\frac{3}{5}$; interorbital $4\frac{4}{7}$; first branched dorsal ray $1\frac{7}{8}$; last dorsal ray $1\frac{9}{10}$; first branched anal ray $3\frac{3}{4}$; last anal ray $3\frac{1}{4}$; least depth of caudal peduncle $4\frac{1}{2}$; pectoral 2; ventral $2\frac{5}{7}$.

Body fusiform, rather robust or thick, sides flattened, upper profile apparently more convex than lower, deepest at dorsal origin, edges all rounded. Caudal peduncle compressed, least depth about $1\frac{4}{5}$ its length.

Head moderately compressed, robust, surfaces above and below rather depressed and but slightly convex, sides rather flattened and not approximated below or above, profiles inclined similarly to form attenuated contour. Snout long, ending in rather obtuse conic tip, width basally about $1\frac{1}{2}$ its length, depressed above posteriorly, sides rather flattened and approximating slightly above. Eye moderate, round, close to upper profile, slightly before center in head length. Adipose eyelid thick, well expanded over entire orbital region, aperture narrow, slit of which lower anterior edge forms flap over lower posterior edge, which extends well forward. Mouth large, well inferior, long snout protruding well forward beyond mandible tip, and gape not quite opposite eye front. Lips thick, fleshy, firm. Maxillary nearly back till opposite eye center, greater part concealed below broad preorbital, and distal expansion about $\frac{3}{5}$ of eye. Supplemental maxillary well expanded, its distal expansion little more than distal maxillary width. Narrow bands of firm conic teeth in each jaw, in upper only extending back along each premaxillary about half its length, along mandibular edge extending much further back. Vomer with crescentic patch of teeth similar and parallel to those in upper jaw. Pterygoids, sphenoid and basibranchials with broad bands of obtuse molar-like teeth. Tongue thick, broadly triangular, edges narrowly free. Mandible depressed, rami not elevated inside mouth. Nostrils together, nearer eye than snout tip, anterior small pore with fleshy rim exposing posterior in narrow crescent. Interorbital space slightly concave. Supraorbital ridge rather prominent, especially anteriorly. Hind edge of preopercle inclined posteriorly, and obsolete ridge inclined anteriorly. Opercle rather small.

Gill-opening forward about opposite eye center. Rakers $4 + 9$ short depressed finely asperous tubercles. Filaments about $\frac{4}{5}$ of eye. Pseudobranchiæ about $\frac{2}{5}$ of eye. Isthmus rather broad, thick, lower surface level. Branchiostegals about 14, each indicated on branchiostegal membrane by slight incision on its lower surface.

Scales cycloid, inner edges mostly crimped, outer or exposed edges thin or membranous and ragged, marked submarginally with a concurrent vertical ridge or striation, the true edge of the scale. Scales disposed in even horizontal series, and all over trunk of about uniform size. All fins densely covered with minute scales. Pectoral depressible below a horizontal scaly ridge, and basally covered with moderate-sized scales. Ventral with free pointed axillary scaly flap, length about $\frac{2}{3}$ fin, and moderately small scales on its base. Lateral line complete, nearly midway along side of body and straight. Tubes simple, horizontal, only pore at hind end exposed, opposite middle of emargination of hind or vertical striation on scale.

Dorsal origin about midway between snout tip and caudal base, first branched ray highest, though but trifle longer than last which is filamentous, otherwise branched rays graduated down to penultimate which is shortest. Anal small inserted behind depressed dorsal, or nearly at last $\frac{3}{7}$ in space between ventral origin and caudal base. Pectoral small, pointed, not quite half way to ventral. Ventral inserted nearly opposite seventh dorsal ray base or about midway between pectoral origin and last anal ray base. Caudal forked, small, lobes similar (ends damaged), apparently about equally pointed and also sharp. Vent about opposite depressed ventral tip.

Color in alcohol faded brilliant silvery-brassy or brownish, scales all quite bright. Fins and head also all same shade, and all more or less uniform, dorsal and caudal scarcely darker. Dull dusky streak over snout just behind its tip to beginning of preorbital groove. Head paler below than above. Iris dull brownish.

Length 15 inches (caudal damaged).

Type, No. 1597, A. N. S. P. Santo Domingo, West Indies. Prof. W. M. Gabb.

Only known from the above-described example taken many years ago in Santo Domingo with specimens of *Albula vulpes* (Linnæus), of the same size and sex, differing chiefly as pointed out above. *Albula vulpes* further differs in having the preopercular membrane extended back nearly to the gill-opening above, besides having the preopercle entirely inclined anteriorly along its hind edge and ridge. *Albula* also shows other minor differences, such as the aperature of the adipose eyelid, a simple opening and not folded over below, snout much shorter, and the eye more median in the head length. The accompanying figure is shown with the caudal fin restored, the tips of which are now damaged.

(*Νῆμα*, thread; *πτερόν*, fin; with reference to the last dorsal and anal rays.)

DECEMBER 6.

PHILIP P. CALVERT, PH.D., in the Chair.

Sixteen persons present.

DR. BENJAMIN SHARP made a communication on Ambergris and Spermaceti. (No abstract.)

DECEMBER 20.

The President, SAMUEL G. DIXON, M.D., LL.D., in the Chair.

Thirty-one persons present.

The death of C. O. Whitman, a Correspondent, December 6, 1910, was announced.

The reception of papers offered for publication under the following titles was reported:

"Bermuda Shells," by E. G. Vanatta (December 7, 1910).

"A Note on the Genus Lolliguncula," by S. Stillman Berry (December 12, 1910).

The following were ordered to be published.

NOTES ON SOME LITTLE-KNOWN FISHES FROM THE NEW YORK DEVONIAN.

BY BURNETT SMITH.

Machæracanthus and other Fish Remains from the Oriskany Sandstone.—So far as the writer has been able to learn the literature of Paleontology contains no reference to the occurrence of fish remains in the Oriskany sandstone of New York. Beyond the boundaries of the State fossils of this nature have been reported from beds which are believed to be contemporaneous with the type Oriskany. Eastman[1] mentions the scales of *Thelodus* from "Oriskany sandstone" at Nictaux Falls, N. S., while Newberry,[2] in his monograph makes the following statement: "Neither in New York nor farther south has the Oriskany sandstone yet furnished any remains of fishes, but it is to be expected that when sought for patiently and discriminatingly they will be discovered. In Canada, north of Lake Erie, where the characteristic fossils of the New York Oriskany are associated with those of the Corniferous limestone, spines of *Machæracanthus* and fragments of plates with a stellate tuberculation, probably of *Macropetalichthys*, have been found."

In the vicinity of Syracuse, N. Y., the presence of bone fragments and of spines in the phosphatic nodules of the Oriskany has been known to local collectors for some time. Several years ago Mr. Charles E. Wheelock, of Syracuse, obtained a spine from one of these concretions at Britton's quarry, Onondaga County (just south of the Syracuse city line). This specimen has unfortunately been lost, but the writer feels that he can accept without reserve the determination of so careful an observer as Mr. Wheelock.

In 1908, Mr. Charles Hares, then a graduate student at Syracuse University, while studying the stratigraphic relations of the Oriskany sandstone, brought to my notice a number of fragmentary fossils from the phosphatic nodules at the quarries east of Manlius, Onondaga County.

With the exception of a few obscure pieces of bone, some collected

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[1] *New York State Museum Memoir 10*, p. 13.
[2] *Monographs U. S. G. S.*, vol. XVI, p. 25.

from the rock in place and one from a drift boulder, no other specimens have until recently come to the attention of the writer. It is to Mr. Wheelock that we are again indebted for the discovery of additional and better preserved material. This latter, together with two of the Manlius specimens, allow of the determination of one genus, *Machœracanthus*, with certainty, and it is believed that characters differing from those of previously described species indicate that the form in question is new. It is not, however, thought advisable to introduce a new specific name, for it is possible that the features observed may be merely the result of individual variation in some long-known species of the genus.

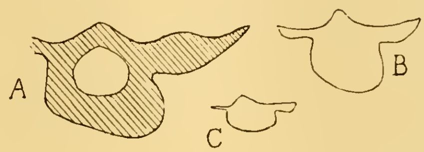

Fig. 1.—A and B, proximal cross sections, and C, distal cross section of *Machœracanthus* spines from the Oriskany sandstone of Onondaga County, New York. B and C are sections of the same spine. All are enlarged twice.

The Oriskany *Machœracanthus* may be briefly described as follows: Spines having a measured width of 16.5 mm. Length probably exceeding 100 mm. This would be a spine of about the size of *M. peracutus* Newb. and *M. sulcatus* Newb., but much smaller than *M. major* Newb. The angle of convergence of the sides of the spine is less than in any of the above-mentioned species, one measurement showing that the width decreases from 10 mm. to 3 mm. through a length of 54 mm. The curvature is apparently about the same as that met with in *M. peracutus*. Central cavity large. The cross section of the spine is highly characteristic and changes greatly in its outline distally. In the more proximal portions the spine is marked by very sharp "wings" and an angulated ridge is present on the outer (?) side while the inner (?) carries a much rounded and swollen ridge. Distally the "wings" are shorter, while the two ridges, though still maintaining their general character, become less pronounced. External surface punctate with distally convergent striæ.

These Oriskany specimens are distinguished from those previously described by the cross section. In this feature they most resemble *M. longœvus* Eastman[3] from the New York Hamilton, while in general

[3] *New York State Museum Memoir 10*, p. 85, pl. 2, fig. 8.

proportions they approach *M. peracutus.* Location and Horizon—Oriskany sandstone; Manlius and Britton's Quarry, Onondaga County, New York.

The writer believes that it is not out of place to append here the following notes concerning the range and distribution of the described species of *Machæracanthus.*

Machæracanthus peracutus Newb.

Middle Devonian. Columbus and Delaware limestones of Ohio, Onondaga (Corniferous) limestone of New York.

Machæracanthus sulcatus Newb.

Middle Devonian. Ohio. Onondaga limestone of New York. Gaspé sandstone of Canada.[4]

Machæracanthus major Newb.

Middle Devonian, Columbus and Delaware limestones of Ohio.

Machæracanthus longævus Eastman.

Middle Devonian. Hamilton of New York.

Machæracanthus bohemicus (Barrande).

Devonian of Europe.

The specimens from the vicinity of Syracuse definitely extend the range of the genus to the Oriskany sandstone and, as stated before, probably represent a new species. We know, however, practically nothing of the morphology of *Machæracanthus,* and if, as has been suggested, it is a gigantic Acanthodian, the probability is strong that even in one individual spines might have occurred whose curvatures and cross sections differed greatly.

In addition to the fossils assignable to *Machæracanthus,* the Manlius locality has yielded other though much less satisfactory fish remains. These are so poorly preserved that little can be said of them beyond the fact that they present the appearance of badly weathered Arthrodiran plates.

Note on the Plates of Dinichthys halmodeus (Clarke)?—The structure of the abdominal armor in *Coccosteus* and especially in *C. decipiens* Ag. has been well understood for many years. The other genera of Arthrodires, however, seldom furnish us with anything but scattered plates, and this is more particularly true of the ventral shield. In

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[4] *New York State Museum Memoir 10,* p. 191.

Dinichthys Eastman,[5] Dean[6] and Von Koenen[7] have described more or less complete specimens of the ventral covering with its elements in nearly the positions occupied during the life of the animal. In these cases the several species of *Dinichthys,* to which the ventral shields have been referred, are typical examples of the genus. The ventral armor of the primitive species usually included in *Dinichthys* (such as *D. halmodeus*) has until recently remained unknown.

In the summer of 1908 the writer was so fortunate as to obtain a specimen of the ventral armor of a small arthrodire from the Marcellus shale (Middle Devonian) of central New York. Although no definite specific determination has been attempted, it is highly probable that the specimen in question represents the plastron of *Dinichthys halmodeus* (Clarke). Though originally described as *Coccosteus,*[8] most recent authors have included this species in *Dinichthys,* all agreeing, however, that it holds a position only slightly removed from the former ancestral genus. The chief reasons for assigning this armor to *D. halmodeus* are (1) similarity of superficial tuberculation, (2) geographical and geological position, and (3) the fact that this ventral shield possesses just such primitive characters as would naturally correspond with those exhibited by the dorsal plates and head shields of the type material of the species.

A detailed description of this ventral shield has been given elsewhere,[9] and for our present purposes it is sufficient to say that the plates are in their original position, the antero-ventromedian and postero-ventromedian, both postero-ventrolaterals, and one antero-ventrolateral are practically entire, while the other antero-ventrolateral is mostly retained. The outline of this latter plate can, however, be restored from that of its well-preserved fellow on the other side. In addition to these ventral plates the specimen shows both the antero-dorsolaterals and the right postero-dorsolateral. Two other bones associated with those already named were originally regarded as a probable suborbital and as a possible antero-superognathal. A

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[5] C. R. Eastman, "On the Relation of Certain Plates in the Dinichthyids," *Bull. Mus. Comp. Zool.,* Harvard, vol. XXXI, pp. 26, 27, pl. I, fig. 2, and pl. IV.

[6] Bashford Dean, "On the Vertebral Column, Fins, and Ventral Armoring of Dinichthys," *Trans. N. Y. Acad. Sci.,* vol. XV, pp. 157–163, pls. VII and VIII; "Note on the Ventral Armoring of Dinichthys," *Trans. N. Y. Acad. Sci.,* vol. XVI, pp. 57–60, pl. III.

[7] A. von Koenen, "Ueber einige Fischreste des norddeutschen und bömischen Devons," *Abhandl. k. Gesell. Wiss.,* Göttingen, vol. XL.

[8] John M. Clarke, "New and Rare Species of Fossils from the Horizons of the Livonia Salt Shaft," *Rep. State Geologist,* New York, 1893, p. 161.

[9] Burnett Smith, "On Some Dinichthyid Armor Plates from the Marcellus Shale," *Am. Nat.,* vol. XLIII, Oct., 1909.

more careful examination of these bones has led the author to reconsider these provisional determinations and to come to the conclusion that the elements in question are in no way connected with the head-shield, but are part of the "clavicular" and lateral armoring.

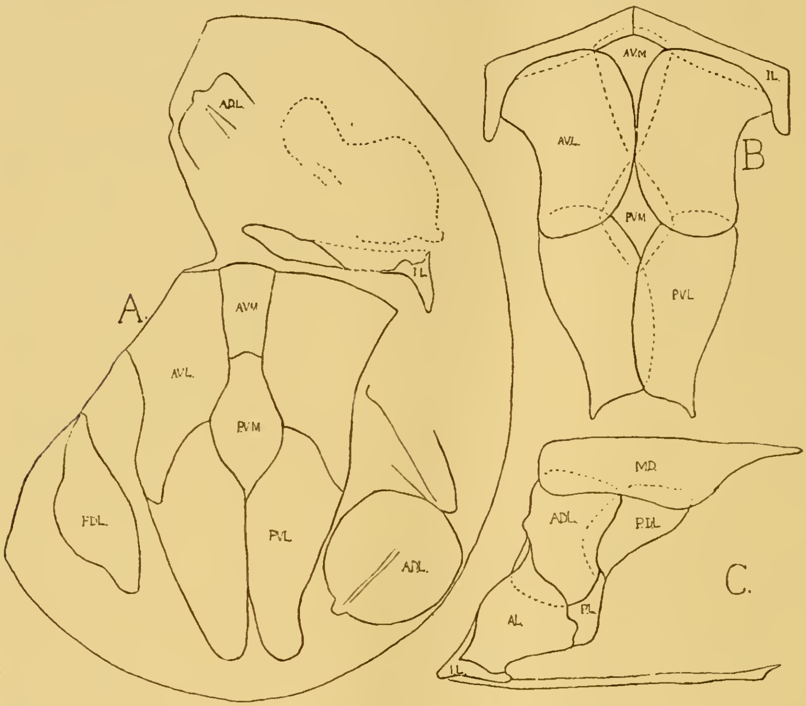

Fig. 2.—A, *Dinichthys halmodeus* (Clarke)? Marcellus shale near Syracuse, N. Y. Black lines are traced from a photograph. Dotted lines represent restored outlines. In the case of the interlateral the dotted lines follow impressions in the matrix. Length of ventral shield about 195 mm.

B, *Coccosteus decipiens* Ag. Restoration of the ventral armor (modified from Traquair).

C, *Coccosteus decipiens* Ag. Restoration of abdominal armor side-view (modified from Traquair).

A.V.M., antero-ventromedian; P.V.M., postero-ventromedian; A.V.L., antero-ventrolateral; P.V.L., postero-ventrolateral; P.D.L., postero-dorsolateral; A.D.L., antero-dorsolateral; I.L., interlateral; A.L., anterolateral; P.L., posterolateral; M.D., dorsomedian.

Fig. 2 A represents a tracing taken from the photograph of the original specimen. The plates of the ventral shield are all capable of certain identification, as are also the two antero-dorsolaterals and the postero-dorsolateral. Immediately forward of the ventral shield is a group of bones which at first appear to be hopelessly confused.

If, however, we examine Traquair's[10] restoration of *Coccosteus decipiens* Ag., we find that in this region occur two well-defined transverse elements which are terminated at their outer extremities by processes which are directed backward and upward. In the specimen here considered it can be proved by a careful examination of impressions on the matrix that the bone originally believed to be an antero-superognathal is not a short compact element, but is in reality a fragment once connected with a long transverse bone which borders the anterior margin of the left antero-ventrolateral. The part believed to be a gnathal then becomes the upwardly and backwardly directed fork of the interlateral shown in Traquair's restoration of *Coccosteus decipiens*. The evidence for this interpretation is twofold—(1) the shape of the bone corresponds to the Coccostean interlateral and (2) the bone is in exactly the position where we might expect to find such an element.

In *Coccosteus decipiens* this interlateral plate has a rodlike ventral portion and a lateral portion with its two processes, one directed dorsally, the other posteriorly. Between these two processes fits the lowest plate of the lateral armoring, namely, the anterolateral. This anterolateral articulates behind with the small posterolateral and above it overlaps the antero-dorsolateral. It therefore serves to link the ventral to the dorsal shield.

If, now, we turn to the higher species of *Dinichthys*, such as *D. intermedius* Newb., we find that apparently the Coccostean interlateral, the Coccostean anterolateral and perhaps even the Coccostean posterolateral have fused together into one large bone, the so-called "clavicular." We say apparently, for though some specimens exhibit the condition shown in Newberry's classic illustration,[11] others occur with the two components (the lower rodlike portion and the upper platelike portion) separate. Eastman[12] has homologized the broad portion of the "clavicular" with the Coccostean anterolateral and its lower portion with the Coccostean interlateral.

Though not wishing to express too hasty an opinion, the author believes that the restoration of *Dinichthys* would present fewer difficulties if we could regard the lower (interlateral) portion of the "clavicular" as an element distinct from the upper (anterolateral) portion.

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[10] R. H. Traquair, "On the Structure of *Coccosteus decipiens*, Agassiz," *Ann. and Mag. Nat. Hist.*, 6th ser., vol. V, 1890, p. 125.

[11] *U. S. G. S.*, Monographs XVI, pl. XLVIII. See also Hussakof, in *Mem. Am. Mus. Nat. Hist.*, vol. IX, part III, p. 133.

[12] *New York State Museum Memoir 10*, p. 119.

Considering, now, the specimen dealt with in this paper, we find that the interlateral shows no positive evidence of fusion with any other bone and seems to agree with the condition met with in *Coccosteus decipiens*. Further, it may be stated that its posterior margin looks as if it might have carried the thin blade found in *D. intermedius*, but the condition of preservation hardly warrants a final decision on this point.

If, now, we examine the plate which was at first believed to be a suborbital, we find that it is apparently only a part of a larger bone, the fragments of which lie (in the figure) to the left of the big mass. When a reconstruction of this bone is attempted, its outline is, in a general way, quite similar to that made by the combined antero- and posterolaterals of *Coccosteus* or the broadly expanded upper portion of the "clavicular" in *Dinichthys*. The author offers the suggestion, therefore, that this bone probably represents a lateral plate of some kind. In support of this suggestion it may be said that the bone in question occupies just such a position as that in which we might expect to find a lateral plate when the entire abdominal armor is so crushed that the dorsal and ventral plates are brought into the same plane. According to this hypothesis, the plate was not only brought into the horizontal plane, but also rotated forward through an angle of about ninety degrees. The same pressure pushed the left antero-dorsolateral backward while it turned over with its outer side exposed. The right antero-dorsolateral in coming to rest in the same plane with the others was pushed far forward of its natural position.

Though realizing that any conclusions in regard to the strictly lateral armoring which may be based upon this specimen are only tentative, the author believes that he may safely express the opinion that the interlateral in this Marcellus Dinichthyid occupies practically its normal position, that in this respect it agrees with *Coccosteus*, and that it offers a clue which may be of importance in properly orienting the "clavicular" (be it one element or two) in the higher Dinichthyids.

Acanthodian Remains from the Marcellus Shale.—These remains of Acanthodians are quite fragmentary, but the extreme rarity of the members of this order in the Paleozoic strata of North America render advisable a short description of these two Middle Devonian specimens. One specimen collected by the writer came from the Marcellus shale of the Kimber Springs Ravine, southwest of Onondaga Valley, N. Y. It comprises but a single spine less than 15 mm. in length. The proximal portion is imperfect, but distally it tapers off in a graceful curve to the nearly complete point. Three longitudinal grooves and ridges are plainly visible.

The other specimen was collected from the Marcellus shale of Richfield, N. Y., by the late Prof. C. E. Beecher. It forms part of the Newberry Collection at the American Museum of Natural History. Newberry was fully aware of the nature of the fossil, for he refers to Acanthodian remains very briefly on page 61 of his monograph as having been collected by Beecher from this horizon. Subsequent authors have not mentioned it. This Richfield specimen displays a spine, numerous scales and an undetermined plate. The fossil lies in a bedding plane of the thinly laminated shale in such a way that when the block was broken a portion of the fish adhered to the rock on either side. An examination of the spine indicates that the Richfield and Kimber Springs specimens are specifically identical. The spine, though less perfectly preserved, exhibits the same proportions, curve and longitudinal ridges. When complete it must have been over 33 mm. in length. The scales are relatively large, four-sided and apparently unsculptured. The specimen is of good size for an Acanthodian, and though any estimate of its length must be very rough, we are undoubtedly justified in assuming that the complete fish was at least 175 mm. long.

Though Acanthodian remains have been reported from the Lower and Upper Devonian of the Atlantic Border province and from the Upper Devonian of the New York province, these specimens represent the earliest examples of undoubted Acanthodians which have been found in the latter region.

In the Atlantic Border province the following forms have been reported:[13] *Acanthodes semistriatus* Woodward, *Cheiracanthus costellatus* Traquair, *Climatius latispinosus* (Whiteaves) from the Lower Devonian of Campbellton, N. B., and *Diplacanthus striatus* Ag., *D. horridus* Woodward, *Acanthodes affinis* Whiteaves, *A. concinnus* Whiteaves from the Upper Devonian of Scaumenac Bay, Quebec.

In the New York province we have: *Acanthodes* (?) *pristis* Clarke, Rhinestreet shale, Upper Devonian, near Sparta, N. Y. An unnamed Acanthodian, Marcellus shale, Middle Devonian, Richfield, N. Y., and Kimber Springs, near Onondaga Valley, N. Y.

[13] C. R. Eastman, *New York State Mus. Mem. 10*, pp. 13, 16, 17. Also O. P. Hay, *U. S. G. S.*, Bull. 179, pp. 273, 274.

BERMUDA SHELLS.

BY E. G. VANATTA.

The following lists are based upon land shells collected by Mr. Stewardson Brown during 1905, 1908, 1909; and land and fresh-water shells collected by E. E. Vanatta and the author during 1910. All the species listed are recent specimens now in the collection of the Academy of Natural Sciences of Philadelphia.

It is interesting to have found living examples of some of Mr. A. Gulick's fossil species, showing that they are not very old, especially since one proved to belong to the Old World genus *Kaliella*.

Separate lists of the various localities are given, as the distribution of some of the species seems to be local and not general. It is to be hoped that future collectors will not mix the specimens from the different islands.

Messrs. Boyer and Keeley examined the diatoms which we gathered at Pembroke Marsh and pronounced them all fresh-water forms.

Polygyra plana (Dunker).

Helix microdonta Desh. in Fer. Hist., I, 1839, p. 6, pl. 72, fig. 13. Not *Helix microdonta* Desh., Enc. Meth., II, 1832, p. 266 (= *Stylodonta unidentata* Dillw., 1817).

Helix plana Dkr., Philippi, Abb. Bes. Conch., I, Oct., 1843, p. 51, *Helix*, pl. 3, fig. 11.

Helix delitescens (Shutt.) Bland, Ann. Lyceum N. H. N. Y., VII, April, 1860, p. 134, 140, 360.

Helix cheilodon (Say MSS.) Bland, Ann. Lyceum N. H. N. Y., April, 1860, p. 141.

Helix ringens Lane, Five Essays: The History of the Spiral Snail, Bermuda, p. 2, pl. 1, fig. 3. (Mr. F. T. Frith, the librarian at the Bermuda Public Library, informed me that this book was published about 1892.)

Polygyra microdonta Desh., Pilsbry, Trans. Conn. Acad., X, 1900, p. 493, pl. 62, fig. 3.

Bermuda specimens were submitted by Dr. Pilsbry to Prof. Dr. Joh. Thiele, of Berlin, for comparison with the type of *Helix plana* Dunker contained in the Königl. Zoologisches Museum, who kindly replied as follows: "Ein Vergleich ihrer *Polygyra plana* von Bermudas mit dem typischen Exemplar der Dunkerschen Sammlung ergiebt die vollständige Uebereinstimmung; die Oberfläche zeigt dieselbe feine Streifung."

Eulota similaris (Fér.).

In *Five Essays: The History of the Spiral Snail,* Rev. W. G. Lane states that *Helix hortensis* is found in a few gardens, but his figures and remarks about the color apply to *Eulota similaris* Fér. which is quite abundant.

St. Georges (collected by Major A. J. Peile, R. A., and author):

Helix pisana Müll.
Helicella ventricosa Drap.
Eulota similaris Fér.
Polygyra plana Dkr.
Thysanophora selenina Gld.
Bifidaria pellucida hordeacella Pils.
Bifidaria servilis Gld.
Bifidaria rupicola Say.
Vallonia pulchella Müll.
Obeliscus swiftianus Pfr.
Rumina decollata L.
Cæcilioides acicula Müll.
Pœcilozonites bermudensis Pfr.
Pœcilozonites circumfirmatus Redf.
Zonitoides minuscula Binn.
Succinea bermudensis Pfr.
Helicina convexa Pfr.

Sandy I. (collected by L. Mowbry):

Polygyra plana Dkr.
Helicina convexa Pfr.

Jones I. (L. Mowbry, collector):

Polygyra plana Dkr.

Bailey's Bay:

Helicella ventricosa Drap.
Eulota similaris Fér.
Polygyra plana Dkr.
Polygyra appressa sculptior Chad.
Bifidaria p. hordeacella Pils.
Zonitoides minuscula Binn.
Helicina convexa Pfr.

Harrington Sound, near Shark's Hole:

Helicella ventricosa Drap.
Eulota similaris Fér.
Polygyra plana Dkr.
Polygyra a. scupltior Chad.
Thysanophora selenina Gld.
Bifidaria rupicola Say.
Bifidaria p. hordeacella Pils.
Obeliscus swiftianus Pfr.
Subulina octona Brug.
Rumina decollata L.
Cæcilioides acicula Müll.
Pœcilozonites bermudensis Pfr.
Pœcilozonites goodei Pils.
Pœcilozonites circumfirmatus Redf.
Zonitoides bermudensis P. & V.
Zonitoides minuscula Binn.
Kaliella turbinatus Gul.
Agriolimax lævis Müll.
Milax gagates Drap.
Milax sowerbyi Fér. *var.*
Succinea bermudensis Pfr.
Helicina convexa Pfr.

Church Cave, near Tucker's Town:

Helicella ventricosa Drap.
Polygyra plana Dkr.
Thysanophora selenina Gld.
Thysanophora hypolepta Shutt.
Pupoides marginatus Say.
Bifidaria rupicola Say.
Bifidaria p. hordeacella Pils.
Vertigo numellata Gul.
Vertigo marki Gul.
Vertigo eyriesii Druet.
Strobilops hubbardi Brown.
Subulina octona Brug.
Cæcilioides acicula Müll.
Pœcilozonites circumfirmatus Redf.
Pœcilozonites reinianus Pfr.
Pœcilozonites goodei Pils.
Zonitoides bermudensis P. & V.
Zonitoides minuscula Binn.
Kaliella turbinata Gul.
Succinea bermudensis Pfr.
Helicina convexa Pfr.
Carychium bermudensis Gul.

Near Ducking Stool:

Helicella ventricosa Drap.
Eulota similaris Fér.
Polygyra plana Dkr.
Thysanophora selenina Gld.
Bifidaria rupicola Say.
Bifidaria p. hordeacella Pils.
Rumina decollata L.
Zonitoides minuscula Binn.
Milax gagates Drap.
Succinea bermudensis Pfr.
Helicina convexa Pfr.

Hamilton:

Helicella ventricosa Drap.
Eulota similaris Fér.
Polygyra plana Dkr.
Bifidaria rupicola Say.
Bifidaria p. hordeacella Pils.
Vallonia pulchella Müll.
Opeas gracile Hutt.
Rumina decollata L.
Vitrea lucida Drap.
Agriolimax lævis Müll.
Milax gagates Drap.
Milax sowerbyi Fér. *var.*
Succinea bermudensis Pfr.
Helicina convexa Pfr.

Sandy Hill, near Hamilton:

Helicella ventricosa Drap.
Vitrea lucida Drap.
Succinea bermudensis Pfr.
Helicina convexa Pfr.

White Id.:

Helicella ventricosa Drap.
Eulota similaris Fér.
Polygyra plana Dkr.
Thysanophora selenina Gld.
Bifidaria rupicola Say.
Bifidaria p. hordeacella Pils.
Opeas micra Orb.
Zonitoides minuscula Binn.
Helicina convexa Pfr.

Fairyland:

Helicella ventricosa Drap.
Polygyra plana Dkr.
Thysanophora selenina Gld.
Thysanophora hypolepta Shutt.
Pupoides marginatus Say.
Bifidaria servilis Gld.
Bifidaria p. hordeacella Pils.
Bifidaria rupicola Say.
Vallonia pulchella Müll.
Opeas gracile Hutt.
Subulina octona Brug.
Rumina decollata L.
Cæcilioides acicula Müll.
Pœcilozonites circumfirmatus Redf.
Vitrea lucida Drap.
Zonitoides minuscula Binn.
Succinea bermudensis Pfr.
Helicina convexa Pfr.
Melampus coffea L.
Melampus flavus L.
Detracia bulloides Mont.
Alexia m. bermudensis Pfr.
Leuconia occidentalis Pfr.
Carychium bermudensis Gul.
Blauneria heteroclita Mont.
Pedipes tridens Pfr.
Plecotrema cubensis Pfr.

Paget Parish, near Hamilton (E. E. Vanatta):

Helicella ventricosa Drap.
Eulota similaris Fér., one specimen was scalariform.
Polygyra plana Dkr.
Thysanophora selenina Gld.
Thysanophora hypolepta Shutt.
Bifidaria rupicola Say.
Bifidaria p. hordeacella Pils.
Opeas micra Orb.
Subulina octona Brug.
Rumina decollata L.
Pœcilozonites bermudensis Pfr.
Pœcilozonites circumfirmatus Redf.
Vitrea lucida Drap., two specimens were sinistral.
Zonitoides bermudensis P. & V.
Zonitoides minuscula Binn.
Kaliella turbinata Gul.
Milax gagates Drap.
Succinea bermudensis Pfr.
Helicina convexa Pfr., a very large form.

Hungry Bay:

Helicella ventricosa Drap.
Eulota similaris Fér.
Polygyra plana Dkr.
Thysanophora hypolepta Shutt.
Bifidaria p. hordeacella Pils.
Pœcilozonites circumfirmatus Redf.
Zonitoides minuscula Binn.
Helicina convexa Pfr.

Port Royal:

Helicella ventricosa Drap.
Polygyra plana Dkr.
Pœcilozonites circumfirmatus Redf.

PUPOIDES MARGINATUS Say.
BIFIDARIA RUPICOLA Say.
BIFIDARIA P. HORDEACELLA Pils.
ZONITOIDES MINUSCULA Binn.
SUCCINEA BERMUDENSIS Pfr.
HELICINA CONVEXA Pfr.
CARYCHIUM BERMUDENSIS Gul.

Somerset:

HELICELLA VENTRICOSA Drap.
EULOTA SIMILARIS Fér.
POLYGYRA PLANA Dkr.
THYSANOPHORA SELENINA Gld.
BIFIDARIA SERVILIS Gld.
BIFIDARIA P. HORDEACELLA Pils.
BIFIDARIA RUPICOLA Say.
RUMINA DECOLLATA L.
PŒCILOZONITES BERMUDENSIS Pfr.
PŒCILOZONITES CIRCUMFIRMATUS Redf.
ZONITOIDES MINUSCULA Binn.
AGRIOLIMAX LÆVIS Müll.
MILAX SOWERBYI Fér. *var.*
SUCCINEA BERMUDENSIS Pfr.

DESCRIPTIONS OF NEW SPECIES.

Physa caliban n. sp. Fig 1.

Shell imperforate; elongate, oval; thin; light chestnut-brown; apex dark red, acute, smooth under a lens; suture impressed, marked by a white line with a dark red line at the lower edge; spire conical, composed of 5 slightly convex whorls; sculptured with irregular growth lines which form slight crenulation at the suture, but no microscopic spiral lines on the shells examined. Aperture irregularly oval, acute above and evenly rounded at base, outer lip thin and arcuate, columella dark red, rather thick, with a thin callus spreading out over the parietal wall. In alcoholic specimen the mantle has 3 digitations at posterior angle and 5 at the columella. The central tooth of the radula has 5 cusps and the lateral have 8 subequal cusps, the sickle-shaped marginal fig. 1 has 8 nearly equal cusps.

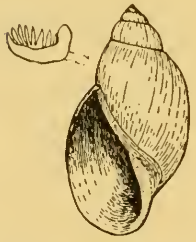

Fig. 1.—*P. caliban* n. sp.

Alt. 10.5, diam. 5.25 mm.

Locality.—Pembroke Marsh, at Hamilton, Bermuda. Very plentiful.

This species differs from *P. pomilia* Conr. by its darker color, dark red columella and rougher surface; and from *P. cubensis* Pfr. by the lack of the white fold on the columella, higher spire and darker color. Type No. 100,334, The Acad. Nat. Sci. Phila.

Planorbis uliginosus n. sp. Fig. 2.

Shell perspective umbilicate; lenticular; moderately thick; grayish-brown; with a cream-colored band near the white lip. Spire nearly flat, concave in middle, composed of $2\frac{3}{4}$ slightly convex whorls, the last forming a rather raised ring about the sunken apex. The body whorl is rounded with perceptible angulation above the periphery. The base is convex, obtusely angular at the edge of the deep umbilicus

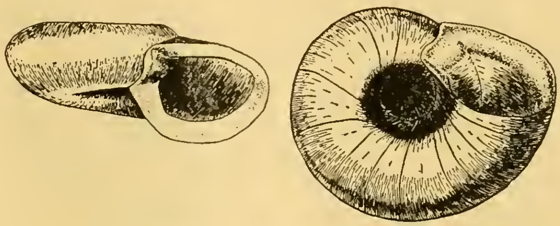

Fig. 2.—*Planorbis uliginosus* n. sp.

and showing a few very indistinct spiral scratches near the lip. Aperture oblique, orbicular, with a convex very heavy white callus, covering the inside of the lip and parietal wall. The columella is heavy, rather straight, but not forming much of an angle with the base. The surface is covered with fine irregular growth lines above, but smoother on the base. No spirals seen under a high magnification, except the above-mentioned scratches. Young specimens are more corneous, and resemble *P. dilatatus* Gld. Sometimes young ones have a very dark brown lip edge.

Alt. 1.3, diam. 3 mm.

Locality.—The types are from Pembroke Marsh, near Hamilton, Bermuda; quite plentiful.

This shell differs from *P. dilatatus* Gld. by its thick lip, stronger keel, more depressed body whorl, higher spire. It has a larger umbilicus than *P. a. avus* Pils. not so flat as *P. rubellus* St., and lacks the very strong keel of *P. alabamensis* Pils. Types in the collection of the Acad. Nat. Sci. Phila., No. 100,336.

Planorbis imus n. sp. Fig. 3.

Shell perspective umbilicate; carinate; lenticular; thin; grayish-yellow; apex depressed; spire convex, truncate, sides descending to the acute periphery. Suture impressed, whorl $2\frac{1}{2}$, moderately convex, surface covered with close incremental striæ. Aperture oblique, sagittate, broader than high, peristome thin, superior edge arcuate, nearly vertical above keel, then gradually slopes to angle of outer lip, basal margin evenly arcuate, columella narrow, parietal wall indented by the peripheral keel, covered with a thin callus.

Alt. 3.03, diam. .92 mm.

Locality.—Bermuda; collected by W. M. Rankin. Type in the collection of the Acad. Nat. Sci. Phila., No. 82,410.

This shell differs from *P. exacutus* Say by the smaller size, the position of the keel at the periphery instead of near the base, the

Fig. 3.—*Planorbis imus* n. sp.

more vertical aperture and shallower umbilicus. It is more depressed than *P. alabamensis* Pils. and *P. dilatatus* Gld. The aperture is not so oblique in *P. rubellus* St., has a more rapid increase of whorl, narrower umbilicus and lighter color.

Ancylus (Ferrissia) bermudensis n. sp. Fig. 4.

Shell oval, greatest width in front, high, thin, horn color, apex with microscopic radial striæ, situated near the posterior right margin, anterior slope convex, posterior and right side concave, left side

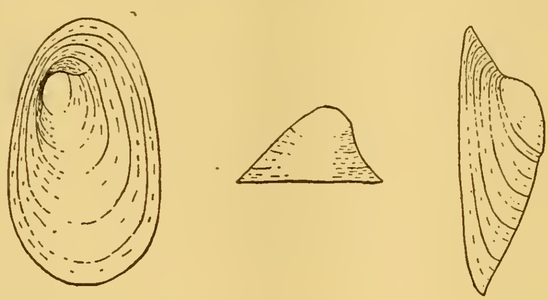

Fig. 4.—*Ancylus bermudensis* n. sp.

nearly straight. Surface marked with concentric lines of growth and a few obscure radial lines.

Alt. .90, diam. 1.73, length 3.10.

Locality.—Ditch in Pembroke Marsh, near Hamilton, Bermuda.

This rare limpet is smaller and smoother than *A. radiatus* Guild. and *A. textilis* Guppy. *A. irroratus* Guild. has stronger concentric sculpture.

A. havanensis Pfr. is larger and more elliptical. Type in the collection of the Acad. Nat. Sci. Phila., No. 100,338.

Paludestrina bermudensis n. sp. Pilsbry. Fig 5.

"The shell is perforate, turrite, the spire regularly tapering to the small but obtuse apex; thin but moderately strong, white under a thin yellowish cuticle, in life generally black from ferrous incrustation. Whorls six, strongly convex, the first one planorboid above. Aperture ovate, the peristome thin, continuous, appressed to the preceding whorl for a short distance, above the perforation.

"Length 4.9, diam. 2.1 mm.; length of aperture 1.9 mm.

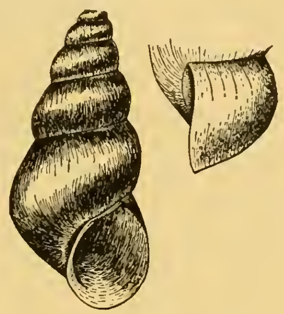

Fig. 5.—*P. bermudensis* Pils.

"Ditch in Pembroke Marsh, near Hamilton, Bermuda. Type No. 100,340, Acad. Nat. Sci. Phila., collected by E. G. and E. E. Vanatta, March 2, 1910. Also a pond near the entrance to Harrington Sound (Owen Bryant) and Paynter's Vale (C. Abbott Davis).

"The measurements of other specimens are as follows:

"Alt. 6.8, diam. 3 mm., whorls $6\frac{3}{4}$ (largest specimen).
" 4.5 " 2.3 " " $5\frac{1}{2}$ (broad phase).
" 4.9, " 2.1 " " 6 (slender phase).

"It was found in very copious quantity, and seems to be generally distributed where suitable water occurs. It differs from *Paludestrina nickliniana* (Lea) and its large form *attenuata* (Hald.) by the conspicuously more minute apical whorls. The denticulation of the central and lateral teeth also is finer. The whorls of *P. bermudensis* are more convex than in *P. tenuipes* (Couper)." (Pilsbry).

Pisidium volutabundum n. sp. Fig. 6.

Shell equivalve, suborbicular, umbones moderately prominent, thin, horn color, superior margin nearly straight, anterior margin subtruncate, inferior margin arcuate, posterior margin convex. Surface finely striate with irregular lines of growth. Hinge arcuate, narrow, ligament scar concave with a slight longitudinal ridge in the center. The right valve with one large cardinal and two laterals at each end, the lower ones the largest. The left valve provided with two cardinals the lower recurved and a little anterior, a very heavy lateral at each end of the hinge line, with a deep groove between it and the edge of the shell.

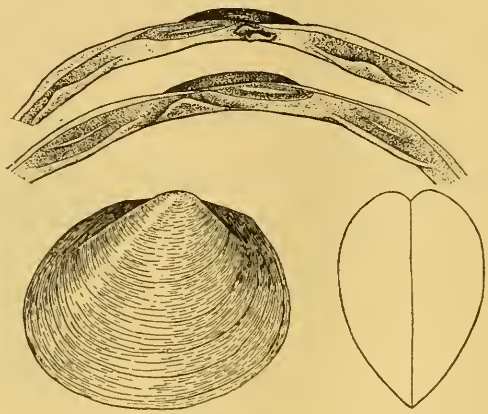

Fig. 6.—*Pisidium volutabundum* n. sp.

Alt. 2.56, diam. 1.73, length 3.13 mm.

Locality.—Pembroke Marsh, near Hamilton, Bermuda; collected by E. E. Vanatta.

This clam is more truncate than *P. abditum* Prime with higher beaks and is more orbicular than *P. noveboracense* Prime.

Type in the collection of the Acad. Nat. Sci. Phila., No. 100,335.

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

1910

The following Reports were ordered to be printed:

REPORT OF THE RECORDING SECRETARY.

Sixteen meetings have been held during the year with an average attendance of twenty-five. Communications were made by Benjamin Sharp, Henry Leffmann, William M. Wheeler, Henry A. Pilsbry, John M. Macfarlane, John W. Harshberger, Thomas H. Montgomery, Henry W. Fowler, Arthur Erwin Brown, Edward J. Nolan, Charles S. Boyer, Thomas S. Stewart, Hugo Bilgram, Silas Shumo, Frank J. Keeley, T. Chalkley Palmer, William B. Davis, William H. Van Sickel, Henry Skinner, Chester A. Reeds, Edgar T. Wherry, F. Lynwood Garrison, Witmer Stone, Samuel N. Rhoads, and Miss N. H. Wardle. But few of these were reported for publication.

Thirty-three papers were presented for publication, as follows: Henry W. Fowler, 6; Henry A. Pilsbry, 3; James A. G. Rehn and Morgan Hebard, 3; James A. G. Rehn, 2; T. Chalkley Palmer, 2; R. Southern, 1; Bryant Walker, 1; Harold Sellers Coulton, 1; H. A. Pilsbry and J. H. Ferris, 1; H. A. Pilsbry and A. P. Brown, 1; C. S. Sargent, 1; Margaret Harris Clark, 1; Henry W. Fowler and Richard J. Phillips, 1; J. Percy Moore, 1; Edward J. Nolan, 1; Thomas Barbour, 1; Katherine J. Busch, 1; Francis W. Pennell, 1; Clarence B. Moore, 1; Edgar F. Smith, 1; T. D. A. Cockerell, 1, and Burnett Smith, 1.

Thirty-one of these have been printed in the PROCEEDINGS, one has been returned to the author, another (by Mr. Clarence B. Moore) forms the second part of the fourteenth volume of the quarto JOURNAL. The number is beautifully illustrated and the Academy is again indebted to Mr. Moore for the entire cost of publication.

The following are the statistics of publication for the year: PROCEEDINGS, 720 pages and 43 plates; JOURNAL, 110 pages and 20 plates; ENTOMOLOGICAL NEWS, 484 pages and 14 plates; TRANSACTIONS OF THE AMERICAN ENTOMOLOGICAL SOCIETY (Entomological Section of the Academy), 306 pages and 4 plates; MANUAL OF CONCHOLOGY, 94 pages and 16 plates, making a total of 1,714 pages and 97 plates.

Seven members and three correspondents have been elected. The deaths of sixteen members and five correspondents have been announced. The Academy sustained a severe loss in the death of Dr. Arthur E. Brown, the senior Vice-President, whose services to the society were recognized in a minute of appreciation and regret placed on the records and published in the PROCEEDINGS.

The resignation of membership of C. H. Smyth, Jr., was accepted.

A resolution was adopted providing for the participation of the Academy in a meeting to be held by the American Philosophical Society for the reception of portraits of the late Isaac Lea and Henry C. Lea. The President, Dr. Dixon, was requested to act as the Academy's representative on the occasion.

The Secretary has devoted such time as could be secured from routine work to the accumulation of material for the proposed detailed history of the Academy in course of preparation for the celebration of its Centenary in 1912.

The index to the publications will be completed on the issue of the last number of the PROCEEDINGS for 1910. The alphabetical arrangement of the index to the genera and species, a rather trying piece of work, will be accomplished as promptly as possible, so that the supplementary volume may be issued in connection with the Centenary.

EDWARD J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

During the fiscal year just closed the roll of correspondents was changed by five deaths and three elections. The deceased were Peter MacOwen, R. Bowdler Sharpe, Alexander Agassiz, Eduard Van Beneden and William H. Brewer. Those elected are Prof. Edward B. Poulton, Prof. Thomas Hunt Morgan, and Dr. L. O. Howard.

The year was noteworthy for the many learned congresses and events of scientific interest in which the Academy was invited to participate. Among the most important of these were the following: The Third International Congress of Botany; the International Institute of Agriculture; the Eighth International Zoological Congress; the Semicentennial Anniversary of the Entomological Society of Russia; the International Hygiene Exhibition at Dresden in 1911; the Eleventh International Geological Congress; the International Agro-geological Conference; the Seventeenth International Congress of Americanists; the First International Congress of Entomology; the Solvay Institute of Sociology; the Tenth International Congress of Geography and the American Association of Museums.

Most of these invitations were acknowledged by suitable letters expressive of the Academy's interest and appreciation. Delegates, most of whom were in attendance at the meetings, were appointed as follows: To the Third International Congress of Botany, Prof. J. C. Arthur; to the Eleventh International Geological Congress, Dr. Richard A. F. Penrose and Dr. Edgar T. Wherry; to the Eighth International Zoological Congress, Prof. E. G. Conklin and Prof. Ludwig v. Graff, and to the First International Congress of Entomology, Dr. Henry Skinner.

A rather larger number than usual of letters requesting information or assistance were either answered by the Corresponding Secretary or referred to other officers of the Academy.

A tabulated statement of the correspondence for the year follows:

Communications Received.

Acknowledging receipt of the Academy's publications	223
Transmitting publications to the Academy	56
Requesting exchanges or the supply of deficiencies	11
Invitations to learned gatherings	14
Notices of deaths of scientific men	6
Circulars concerning the administration of scientific institutions, etc	19
Biographies and photographs of correspondents	3
Miscellaneous letters	92
Total received	424

Communications Forwarded.

Acknowledging gifts to the Library	1,084
Acknowledging gifts to the Museum	59
Acknowledging photographs and biographies	3
Requesting the supply of deficiencies in periodicals	67
Letters of sympathy and congratulation, etc	4
Miscellaneous letters	89
Diplomas and notices of election of correspondents and delegates	6
Annual Reports and other publications sent to correspondents	424
Circular letters	91
Total forwarded	1,827

Respectfully submitted,

J. Percy Moore,

Corresponding Secretary.

REPORT OF THE LIBRARIAN.

During the past year the growth of the Library has consisted of 6,449 pamphlets and parts of periodicals, 942 volumes, 148 sheets and engravings and 64 maps, making a total of 7,603.

They have been received from the following sources:

In exchange from societies and editors	3,228
I. V. Williamson Fund	2,806
United States Department of Agriculture	376
General appropriation	257
Authors	226
Editors	184
James Aitken Meigs Fund	184
United States Department of the Interior	63
United States Treasury Department	35
Thomas B. Wilson Fund	34
United States Department of Commerce and Labor	21
Dr. Benjamin Sharp	16
Imperial Geological Survey of Japan	11
United States War Department	10
Estacion Sismologica de Cartuja	10
Pan-American Union	10
Dr. Edward J. Nolan	9
East Indian Government	9
Marine Biological Laboratory, Woods Hole	8
Pennsylvania Department of Agriculture	6
Illinois Geological Survey	5
Dr. Philip P. Calvert	5
Publication Committee, Academy	5
Massachusetts Agricultural Experiment Station	5
Université de Genève	5
Michigan Geological and Biological Survey	5
United States Brewers' Association	4
New York Agricultural Experiment Station	4
Commission de la Belgica	4
Lowell Observatory	3
Pennsylvania State Library	3
American Associations of Museums	3
Observatoire Astronomique d'Upsala	3
E. G. Vanatta	3
Pennsylvania Department of Fisheries	3
H. A. Pilsbry	3
Delaware County Institute of Science	2
Argentine Government	2
Congrès Internationale de Botanique	2
Illinois Bureau of Labor Statistics	2
Geological Survey of Georgia	2
Cuerpo de Ingenieros de Minas del Peru	2
Ministère de l'Agriculture de la Republique Argentine	2
Maryland Weather Bureau	2
Maryland Geological Survey	2
Mississippi State Geological Survey	2
Pennsylvania Department of Health	1
State Geological Survey of North Dakota	1
Funk & Wagnalls Co	1
Department of Fisheries, New South Wales	1
Ministerio de Colonizacion de Bolivia	1
William J. Fox	1
Florida State Geological Survey	1
Dr. Thomas A. Storey	1
State University of Oklahoma	1
Long Island Railroad Co	1
Stewardson Brown	1
F. W. Putnam	1
Iowa Geological Survey	1
Sir Robert W. Best	1
French Government	1
Dr. Henry Skinner	1
Provinicial Museum, Victoria, B. C	1
Royal Society	1
Dr. S. G. Dixon	1
Franciscan Fathers, Saint Michaels, Ariz	1
Danish Government	1
Carnegie Foundation for Advancement of Teaching	1
Clarence B. Moore	1
Conservation Commission of Maryland	1
Bureau of British Marine Zoology	1
Commissioners on Fisheries and Game, Massachsuetts	1
Geological Survey of New Jersey	1
Marshall H. Saville and George G. Heye	1

These accessions were distributed to the several departments of the library as follows:

Journals	5,717	Helminthology	34
Agriculture	405	Medicine	30
Geology	304	Mineralogy	26
Botany	270	Ornithology	24
Voyages and Travels	133	Physical Sciences	24
General Natural History	125	Ichthyology	21
Entomology	123	Bibliography	13
Geography	97	Chemistry	7
Anatomy and Physiology	76	Herpetology	6
Anthropology	62	Mathematics	5
Mammalogy	39	Encyclopedias	4
Conchology	38	Unclassified	20

Five hundred and forty-three volumes have been bound, being but little more than the unbound accessions of the year. The accumulation of unbound volumes has been nearly all put in proper shape by the liberal appropriations of the few preceding years.

A careful count of the books now in the possession of the Academy furnishes the following statistics:

Journals	32,926	Geography	640
Geology	3,851	Mathematics	577
General Natural History	3,458	Mammalogy	430
Botany	3,405	Ichthyology	405
Voyages and Travels	2,307	Helminthology	311
Anatomy and Physiology	1,961	Philology	298
Anthropology	1,573	Chemistry	293
Entomology	1,379	Herpetology	204
Ornithology	1,054	Meigs Library (Miscellaneous)	1,794
Conchology	952	Warner Library (Miscellaneous)	132
Dictionaries and Encyclopedias.	891	Library of the Entomological Section (American Entomological Society)	4,150
Agriculture	882	Unclassified	374
Medicine	809		
Bibliography	744		
Physical Science	690		
Mineralogy	671		67,161

This is an increase of 15,912 volumes since the enumeration of 1901. In view of the strictly special character of the library this should be regarded as a gratifying exhibit. It represents the steady current growth of the collections, no large libraries having been received *en bloc.* The separate pamphlets have not been counted, but an estimate has been made of the number of volumes those still unbound would make if arranged uniformly with the rest of the collection.

Many of the volumes in the library of the Entomological Section are duplicates of those on the shelves of the Academy. There is an apparent falling off of 121 volumes on Conchology instead of an increase, but this is accounted for by the fact that the Conchological journals were formerly placed with the special books on that subject, whereas they have now been transferred to the section of Journals and Periodicals, where they properly belong. Similarly some of the books in the Meigs Library have been removed from the miscellaneous collection, which is only retained because of a condition imposed by the donor, John G. Meigs.[1] The separated books have been placed with related works in the general library.

Special attention may be called to the following accessions:

Nature Notes. London. Eighteen volumes.
Giornale Arcadico di Scienze, Roma. Seventeen volumes.
Mémoires de la Société Géologique de France; Paléontologie. Volumes V–XVI.
Annales de l'Université de Grenoble. Twenty-one volumes.
Thurston's *Castes and Tribes of Southern India.* Seven volumes.
Grote, Vogt and Hofer's *Süsswasser Fische von Mitteleuropa.*
George G. Heye Expedition, *Contributions to South American Archæology.*

The Academy is indebted to His Royal and Imperial Highness the Grand Duke Ludwig Salvator of Austria for the gift of twenty-three superbly illustrated volumes, the privately printed records of many years of travel and exploration. The works relate for the most part to the geography, physical characters, ethnography and history of some of the islands of the Mediterranean Sea and are finely illustrated with hundreds of figures and plates. The collection includes a beautiful panorama, twelve feet in length, of the Bay of Alexandrette, the ancient *Alexandria ad Issum.*

The books were secured through the active interest of the late Dr. Theodore de Thodorovitch, who, as a member of the Academy and in his official capacity as Austro-Hungarian Consul, represented the claims of the library as a depository of the desired works based on its importance to students of science and its liberality of administration.

It is a cause of sincere regret that the death of Dr. de Thodorovitch before the arrival of the volumes deprived the Academy of the opportunity of making to him the acknowledgment of obligation he so well deserved.

We are also indebted to the Hon. Maurice Francis Egan, our Minister to Denmark, for his co-operation in securing by exchange the valuable publications of Dr. Wesenburg-Lund's Fresh-water Laboratory, which we were not able to procure through the booksellers.

The following new serials have been added to the library during the year:

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[1] See Report of Librarian for 1895.

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

LIBRARY, LECTURE ROOM, AND LABORATORIES.

STACK IN REAR.

Geologische Rundschau. Leipzig.
Biologische Zeitschrift. Moscow.
Der Pilzfreund. Lucerne.
Nature Study Review. Urbana.
Midland Naturalist. Notre Dame.
Der Naturfreund. Godesberg.
Unsere Welt. Godesburg.
Natur. Leipzig.
Bolletino del Museo Civico di Firenze.
South African Journal of Science.
Folia Hæmatologia. Leipzig.
Proceedings of the Association of Economic Biologists. London.

In the course of a careful revision of the arrangement and cataloguing of the journals as now placed in the stacks, fifty numbers, nearly all unimportant, could not be found. Some of these may be misplaced, although a careful search has been made for them, and others may be returned. These were not reported in 1904 when the last account of stock was taken, because of the lack of a shelf-list of the section of Journals and Periodicals, so that the loss extends over an undetermined number of years. Since that account was taken two works, then reported missing, have been returned, but sixteen others cannot be found. It may be that some of these have been illegally borrowed and will be also brought back, but it is much to be feared that a volume of the *Pennsylvania Geological Survey Reports,* Catlin's *Indians,* edition of 1841, Jardine's *Wilson's Ornithology,* Wolle's *Diatoms,* Gurney's *Distillation* (of which the title-card was also stolen from the catalogue) and Chavasse's *Advice to a Wife* have been taken by the most detestably mean of all thieves, the one who appropriates for his own use what is being held for the general good.

It is believed that these losses were all incurred before the arrangement of the library in the stacks.

The Librarian attended the International Conference of Archivists and Librarians in Bruxelles, August 28–31. The proceedings were not of much importance to the Academy, but the brief visit to Belgium, especially to the towns between Antwerp and Bruxelles, was full of delight and profit.

It gives the Librarian much pleasure to again acknowledge his indebtedness to his Assistant, William J. Fox, who, by his co-operation in the work of the Publication Committee, as well as of the Library, has afforded the opportunity for progress with the proposed detailed history of the Academy.

Efficient service has also been rendered by Furman Sheppard Wilde, who has been an assistant in the library since last February.

Edward J. Nolan,
Librarian.

REPORT OF THE CURATORS.

The plans outlined in the Curators' report for 1909 for alterations in the exterior of the building, made possible by the appropriation of $60,000 by the Commonwealth of Pennsylvania at the last session of the Legislature, have been successfully carried out.

The walls of the original green-stone building have been encased in granite, brick and terra cotta, which effectually checks any further deterioration and makes this wing uniform in appearance with the new library wing on Cherry Street. Granite and terra cotta facings have also been added to the middle brick building to bring it into harmony with the other two. A number of the windows have been altered with the object of furnishing additional light and conforming to the general architectural design, while new doorways have been constructed at the entrances on Race and Nineteenth Streets.

The results of the alterations are very satisfactory, making one harmonious building of the several wings that have been erected at different periods since the Academy first occupied its present site.

A slight alteration was made during the year in the library building, by which two office rooms on the gallery were thrown together, making a commodious Council room, to which the bookcases and other furnishings of the old Council room have been transferred. Additional radiators were erected in the herbarium, and two laboratory tables and a number of rugs were purchased for the work-rooms and offices of the scientific staff.

The building operations which were in progress during the greater part of the year naturally interfered with any extensive rearrangement of the exhibits. The north wing had to be closed entirely for several months and the cleansing and replacing of the cases have only just been completed.

In the middle wing the entire exhibition series of Mammals has been removed from the cases, the floors of which were then repainted and the specimens, after being carefully cleansed, were replaced.

The skeleton of the Indian Elephant "Bolivar" was articulated and placed beside the mounted skin, while several other large skeletons were remounted.

On the bird gallery the labelling of the exhibition collection was practically completed.

In addition to the work on the Mammals and Osteological collection, Mr. McCadden, the taxidermist, has prepared a number of skins and skeletons for the study collection, including the skeleton of a Lesser Sperm Whale.

A large amount of research and routine work has been done by members of the staff in connection with the study collections as outlined in the accompanying special reports.

Beside this, Dr. J. P. Moore has cared for the collection of annelids and has studied and described the extensive collections dredged in the North Pacific by expeditions representing the U. S. Bureau of Fisheries, Leland Stanford University, and the University of California, from which the Academy receives duplicates. Numerous other specimens of worms submitted by institutions and individuals have been identified.

Mr. H. W. Fowler has cared for the collection of fishes and, beside routine work, has critically studied and reidentified the batoid, chimæroid and ganoid fishes and part of the clupeoids, preparing seven papers for the Academy's PROCEEDINGS.

Mr. J. A. G. Rehn, in the portion of his time devoted to Entomology, has studied the North Carolina Orthoptera in the Academy collection and that of Mr. Morgan Hebard and prepared a paper on the subject for the PROCEEDINGS, as well as on the collection of Georgia and Florida Orthoptera submitted by the Georgia State Entomologist, from which the Academy received duplicates. He has likewise published a revision of the genus Ischnoptera.

Miss H. N. Wardle has continued the cataloguing of the Archæological collection.

The Curators are also indebted to Mr. E. T. Cresson, Jr., for aid in the entomological department, and to Messrs. S. S. Van Pelt and Bayard Long for voluntary work in mounting and caring for the local collection of plants.

A number of important field trips were taken during the year in the interest of the Academy. Dr. H. A. Pilsbry spent several months in Arizona making collections of Mollusks, Reptiles and Plants. Mr. Vanatta spent some weeks in Bermuda, and Dr. Moore was at Martha's Vineyard during the summer, both of them obtaining interesting invertebrate material, while Mr. Stewardson Brown, during a month's sojourn in Jamaica, secured a valuable series of the plants of the island.

Through the liberality of Mr. Morgan Hebard, Mr. Rehn was enabled to join him on another tour of the Western States in search of Orthoptera and a large collection was made in which the Academy shares. Numerous local collecting trips were also taken by members of the staff.

Among the important accessions of the year may be mentioned the valuable unique specimens obtained by Mr. Clarence B. Moore during his continued investigations among the Indian mounds of the southern United States, for the accommodation of which Mr. Moore has presented another mahogany and plate-glass exhibition case.

Dr. Amos P. Brown has presented an extensive series of mollusks obtained by him during several trips to Jamaica during the year, and Mr. Joseph Crawford, who accompanied him on one trip, has presented a collection of Jamaican plants.

The H. H. Smith 1905–09 collections of fresh-water mollusks of Alabama were obtained by purchase, and a collection of birds from Chihuahua, Mexico, was presented by Dr. William E. Hughes. A number of mammals were also received from the Zoological Society of Philadelphia.

Thirty-one storage cases and two hundred insect boxes were procured during the year.

There has been a good attendance of visitors to the Museum, especially on Sunday afternoons, and a marked increase is noticeable in the number of school classes which have visited the institution under the charge of their teachers.

A number of visiting specialists have made use of the study collections during the year in the various departments of the Museum, and specimens have been loaned to the following: W. W. Eggleston, L. W. Riddle, Bayard Long, Ivar Arividson, W. E. Clyde Todd, Robert Ridgway, P. Wytsman, C. H. Eigenmann, D. G. Elliot and J. C. Merriam.

Samuel G. Dixon,
Henry A. Pilsbry,
Witmer Stone,
Curators.

Report of the Department of Mollusca.

During the past year continued progress has been made in the arrangement of the study collections of mollusks. About half of the alcoholic series has been overhauled and classified in the new storage cases. No work has been done on the display collection owing to building operations.

Over 4,000 lots have been added to the collection, the number of individual specimens being estimated at over 25,000. Among the more interesting gifts to the collection the following may be mentioned: series of Jamaican and Panamic land snails collected by Dr. Amos P. Brown; South American shells sent by Dr. H. von Ihering of the Museu Paulista, Brazil, and a series from the Kaibab and Kanab plateaus, Arizona, collected by Messrs. J. H. Ferriss and L. E. Daniels in 1909. Mr. Clarence B. Moore and Mr. Y. Hirase have continued to contribute valuable material.

Through illness the Department was deprived of the services of Mr. Vanatta during six months of the year, but he took advantage of the period of convalescence to collect an extensive and valuable series of the mollusks of Bermuda. Mr. Vanatta has demonstrated that Bermuda has a fresh-water fauna containing no less than five genera of mollusks. Hitherto it has been supposed that no native fresh-water mollusks existed there.

Work on the Manual of Conchology has been directed to the Hawaiian family *Achatinellidæ*.

Papers have been published by the Special Curator during the year on the mollusks of Mexico; of the Chiricahua Mountains, Arizona; on land mollusks of Panama, and of Jamaica (in collaboration with Dr. Brown); on Haitian Oligocene fossils, etc. Mr. Vanatta has prepared a paper on the mollusks of Bermuda for publication in the Proceedings.

The Special Curator spent three months, beginning August 15th, in the exploration of southern New Mexico and Arizona, in company with Messrs. Ferriss and Daniels. The Hachita Grande, Santa Rita, Baboquivari, Dragoon and other mountain ranges were studied. It is believed that the observations made will add materially to our knowledge of the zoogeography of the arid southwest. The collections are also interesting systematically, since a large number of species new to science was encountered.

Henry A. Pilsbry,
Special Curator.

REPORTS OF THE SECTIONS.

Biological and Microscopical Section.

Nine regular and eight informal meetings have been held during the year, with the usual attendance. The membership is the same in number as last year, one resignation having occurred and one new member being admitted. In accordance with custom, the proceedings at the meetings have consisted chiefly of oral communications, in which each member present has shared, of microscopical studies, many of which have represented original work. It is to be regretted that in an association composed of amateurs whose time is limited work of much scientific value is impossible. There are lines, however, along which the Section may direct good work and it is suggested that a descriptive catalogue of the local cryptogamic flora, not heretofore published, be attempted, in conjunction, possibly, with other Sections of the Academy.

Among papers presented and published are two by Mr. T. Chalkley Palmer: *A New Diatom*, and *Stauroneis Terryi.*

At a special meeting of the Section held in April, in the Library of the Academy, an exhibition of microscopical objects was presented to a large audience. A number of papers also were read and are noted in the PROCEEDINGS.

The officers elected for the ensuing year are as follows:

Director	J. Cheston Morris, M.D.
Vice-Director	T. Chalkley Palmer.
Recorder	Charles S. Boyer.
Treasurer	Thomas S. Stewart, M.D.
Curator	F. J. Keeley.
Corresponding Secretary	Silas L. Schumo.

CHARLES S. BOYER,
Recorder.

ENTOMOLOGICAL SECTION.

The scientific communications made to the Section during the year have been published in the ENTOMOLOGICAL NEWS. This journal has completed its twenty-first volume with the December number for this year. For 1910, 484 pages and 14 plates were issued.

The usual meetings of the Section have been held, with an average attendance of nine persons.

Two members and two associates have been elected. The additions to the collection have been numerous. Mr. Morgan Hebard presented 1,047 specimens of Orthoptera and 3,605 specimens of the same order were purchased by the Academy. In all 5,957 insects were added to the collections.

One hundred and fifty boxes have been acquired to accommodate this growth. The safety and rearrangement of the collection has had the usual care, and with the improvement in cases and boxes the danger from museum pests has been greatly decreased.

The entire exotic series of Orthoptera, the North American Forficulidæ, Blattidæ, Mantidæ, Phasmidæ and Gryllidæ have been rearranged, together with the duplicate Hymenoptera, the collection of galls and the Dipterous family Stratiomyidæ.

A large part of the Micro-lepidoptera has been relaxed and mounted and nearly the entire series of North American Rhopalocera has been rearranged. Much of the Hemiptera has been recently studied and named by a specialist. The incorporation of the additions to the collection has taken much time, and the Section is indebted to those students not directly responsible for the work.

Mr. Rehn has had charge of the Orthoptera and Dr. Calvert has continued to care for the large and valuable collection of Odonata. Mr. E. T. Cresson is working on the arrangement of parts of the collection of Hymenoptera.

The Conservator represented the Academy at the First International Entomological Congress, held in Brussels, Belgium, last August.

This meeting demonstrated the great importance of entomology from a practical or economic standpoint, particularly that branch of economic entomology relating to the dissemination of disease by insects and the carriage of germ diseases to man.

The following persons were elected officers to serve for the ensuing year:

Director............Philip Laurent.
Vice-Director............H. W. Wenzel.
Treasurer............E. T. Cresson.
Conservator............Henry Skinner.
Recorder............Henry Skinner.
Secretary............E. T. Cresson, Jr.
Publication Committee............E. T. Cresson,
E. T. Cresson, Jr.

Botanical Section.

Five double wooden cases, which had to be moved from the north room owing to the change of windows on Race Street, were transferred to the local herbarium, the plants contained in them being moved into new dust- and insect-proof metal cases. But little work has been done on the arrangement of the herbarium owing to the remodelling of the building, though the preparation and mounting of specimens has gone on with but little interruption.

Some important additions have been made to the collections during the year. The Conservator spent about a month in Jamaica and brought back a collection of more than 850 sheets. Mr. Joseph Crawford spent about the same length of time in Panama and Jamaica, adding about 800 sheets, and more than 100 sheets from Jamaica and Cuba have been received in exchange from the New York Botanical Garden. On the Academy's expedition to Arizona and New Mexico, in the latter part of the year, Dr. Pilsbry collected nearly 800 sheets of plants, and 640 sheets, principally from Nevada and California, have been purchased by the Section from Mr. A. A. Heller. Other collections, aggregating about 400 sheets, have been received from B. H. Smith, Dr. C. D. Fretz, Witmer Stone and Charles S. Williamson.

The work in the local herbarium has been carried on with greater effect than during any previous year, the 3,511 sheets added by the members of the Philadelphia Botanical Club having been mounted and distributed by Mr. Samuel S. Van Pelt. Much valuable work, especially in studying some of the more complex groups, has been done by Mr. Bayard Long.

During the year a small printing outfit was added to the equipment of the herbarium, resulting in the saving of much time and labor in label writing, besides insuring uniformity in style and size of labels. Acknowledgment is here made of the continued assistance in the herbarium during the year of Miss Ada Allen.

At the annual meeting of the Section, held on December 6, the following were elected as officers for the year:

Director..........Benjamin H. Smith.
Vice-Director..........Joseph Crawford.
Secretary and Recorder..........Charles S. Williamson.
Treasurer and Conservator..........Stewardson Brown.

Respectfully submitted,
Stewardson Brown,
Conservator.

Mineralogical and Geological Section.

The Section has this year held five meetings, besides meeting once (May 17) in conjunction with the Academy. Communications were made by Mr. S. L. Schumo, with his own photographic illustrations, on pot-holes at the Falls of Schuylkill; by Prof. Chester A. Reeds, on the geology of the Arbuckle Mountains, Oklahoma; by Dr. Edgar T. Wherry, on copper deposits of Franklin and Adams Counties, Pa., besides various shorter communications and discussions.

There were seven field excursions of the Section, with an average attendance of about twenty-five. The excursions visited: (1) The crystalline rocks, old Paleozoic rocks and a trap dike near Lafayette, Marble Hall and Spring Mill, Montgomery County; (2) The crystalline rocks south of West Chester; (3) The New Red and crystalline rocks near Langhorne, Bucks County; (4) The crystalline rocks between Newtown Square and Wallingford, Delaware County; (5) The minerals and fossils near Mullica Hill, N. J.; (6) The crystalline rocks near Paoli and Castle Rock, Delaware County; (7) The New Red rocks near the Buckingham Mountain fault, in Bucks County.

The membership of the Section has increased by one associate member.

The following officers of the Section have been elected for the year 1911:

Director	Benjamin Smith Lyman.
Vice-Director	Frank J. Keeley.
Recorder and Secretary	S. L. Schumo.
Treasurer	William B. Davis.
Conservator	George Vaux, Jr.

Respectfully submitted by order of the Section.

Benjamin Smith Lyman,
Director.

Ornithological Section.

As was the case last year, work in the Ornithological department has been seriously handicapped by the absence of Mr. Rehn in the West during three months and the general curatorial work that has devolved upon the Conservator. Nevertheless, much progress has been made in the arrangement of the collection. All of the remaining mounted birds, with the exception of the humming-birds, have been identified and labelled, practically completing this important piece of work.

In the study collection all of the families of Passerine birds from the thrushes to the crows, comprising some 450 drawers of skins, have been reidentified and rearranged, while all the species represented in the collection have been checked off in Sharpe's *Hand List of Birds,* so that it will soon be possible to see at a glance exactly what species the Academy possesses in each family.

Labels have also been placed on all the drawers as far as the Turdidæ.

Twelve metal cases were procured during the year, part of which were used in the rearrangment of the Passeres, while the others were allotted to the type specimens, which were carefully examined and rearranged systematically.

Among the important accessions of the past year may be mentioned the local collection of Mr. F. Guy Meyers, a valuable series of Chihuahuan birds presented by Dr. William E. Hughes, and a series of Costa Rican birds obtained by purchase.

The Delaware Valley Ornithological Club, Spencer Baird Ornithological Club and Pennsylvania Audubon Society have held their meetings at the Academy during the year.

The Conservator is indebted to Mr. J. A. G. Rehn for valuable assistance in cataloguing and for preparing the labels for the mounted birds, and to Mr. E. J. F. Marx, of the Delaware Valley Club, who spent several veeks as voluntary assistant in rearranging portions of the collection.

At the annual meeting the following officers were elected.

Director....................Spencer Trotter, M.D.
Vice-Director....................George Spencer Morris.
Recorder....................Stewardson Brown.
Secretary....................William A. Shryock.
Conservator and Treasurer....................Witmer Stone.

Witmer Stone,
Conservator.

The annual election of Officers, Councillors and Members of the Committee on Accounts to serve during 1910 was held, with the following result:

President....................Samuel G. Dixon, M.D., LL.D.
Vice-Presidents....................Edwin G. Conklin, Ph.D., Sc.D.
John Cadwalader.
Recording Secretary....................Edward J. Nolan, M.D.
Corresponding Secretary....................J. Percy Moore, Ph.D.
Treasurer....................George Vaux, Jr.
Librarian....................Edward J. Nolan, M.D.
Curators....................Samuel G. Dixon, M.D., LL.D.,
Henry A. Pilsbry, Sc.D.,
Witmer Stone,
Henry Tucker, M.D.
Councillors to serve three years..Thomas H. Fenton, M.D.,
Edwin S. Dixon,
Henry Skinner, M.D.,
Robert G. LeConte, M.D.

Councillor for unexpired term of one year	William E. Hughes, M.D.
Committee on Accounts	Charles Morris,
	Samuel N. Rhoads,
	John G. Rothermel,
	Thomas H. Montgomery, Ph.D.,
	Frank J. Keeley.

COUNCIL FOR 1911.

Ex-Officio.—Samuel G. Dixon, M.D., LL.D., Edwin G. Conklin, Ph.D., John Cadwalader, Edward J. Nolan, M.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry A. Pilsbry, Sc.D., Witmer Stone and Henry Tucker, M.D.

To serve three years.—Thomas H. Fenton, M.D., Edwin S. Dixon, Henry Skinner, M.D., Robert G. LeConte, M.D.

To serve two years.—Philip P. Calvert, Ph.D., Thomas Biddle, M.D., Frederick Prime Frank J. Keeley.

To serve one year.—Charles B. Penrose, M.D., Charles Morris, Spencer Trotter, M.D., William E. Hughes, M.D.

Curator of Mollusca	Henry A. Pilsbry, Sc.D.
Assistant Librarian	William J. Fox.
Assistants to Curators	Henry Skinner, M.D.,
	Stewardson Brown,
	J. Percy Moore, Ph.D.,
	Edward Vanatta,
	Henry W. Fowler,
	James A. G. Rehn,
	Ezra T. Cresson, Jr.
Aid in Archæology	Harriet Newell Wardle.
Aid in Herbarium	Ada Allen.
Assistant in Library	Furman Sheppard Wilde.
Taxidermist	David N. McCadden.
Janitors	Charles Clappier,
	Daniel Heckler,
	James Tague,
	Jacob Aebley,
	Adam E. Heckler.

STANDING COMMITTEES.

FINANCE.—John Cadwalader, E. S. Dixon, Effingham B. Morris, William D. Winsor and the Treasurer.

PUBLICATIONS.—Henry Skinner, M.D., Witmer Stone, Henry A. Pilsbry, William J. Fox, Edward J. Nolan, M.D.

LIBRARY.—Thomas H. Fenton, M.D., George Vaux, Jr., Henry Tucker, M.D., Frank J. Keeley and Thomas Biddle, M.D.

INSTRUCTION AND LECTURES.—Henry A. Pilsbry, Sc.D., Charles Morris, Witmer Stone, Henry Tucker, M.D., George Spencer Morris.

COMMITTEE OF COUNCIL ON BY-LAWS.—Thomas Fenton, M.D., John Cadwalader, Charles B. Penrose, M.D., Witmer Stone.

ELECTIONS DURING 1910.

MEMBERS.

January 18.—Hamilton D. Carpenter.

February 15.—Merkel H. Jacobs, Ph.D., E. Waterman Dwight Edward Anthony Spitzka, M.D.

April 19.—John B. Henderson, Jr.

May 17.—Edgar Madison Ledyard.

November 15.—Robert Adams, Jr.

CORRESPONDENTS.

November 15.—Edward B. Poulton, D.Sc., A.M., of Oxford; Thomas Hunt Morgan, Ph.D., of New York; Leland Ossian Howard, Ph.D., of Washington.

ADDITIONS TO THE MUSEUM, 1910.

Mammals.

O. H. Brown. Hoary Bat (*Lasiurus cinerus*), Cape May, N. J.

Robert D. Carson. Dormouse Lemur (*Microcebus myoxinus*).

F. W. Cassedy. Albino Grey Squirrel (*Sciurus carolinensis*), Cape May, N. J.

Benjamin Chew. Mounted head of Asiatic Ibex (*Capra sibirica*), Thian Shan Mountains, Chinese Turkestan.

J. H. Ferriss. Skin and skull of Coues's Deer (*Odocoileus couesi*), Santa Catalina Mountains, Arizona.

J. Habisreitinger. Albino Mink skin (*Lutreola vison*).

Dr. J. Percy Moore. Seven specimens of White-footed Mouse (*Peromyscus leucopus fusus*), Martha's Vineyard, Mass.

Purchased. Pygmy Sperm Whale (*Kogia breviceps*), Sea Isle City, N. J. Skin and skull of Beaver (*Castor canadensis*).

Mrs. Charles Schäffer. Albino Streator's Chickaree (*Sciurus hudsonicus streatori*), Glacier, B. C.

Charles S. Wells. Skull of Red Fox (*Vulpes fulvus*).

Zoological Society of Philadelphia. Specimens prepared as follows: Mounted: Potto (*Perodicticus potto*): skin and skull; two white-throated Monkeys (*Cercopithecus albigularis*), Moloney's Monkey (*Cercopithecus moloneyi*), Woolly Monkey (*Lagothrix* sp.), Black-backed Jackal (*Canis mesomelas*), White-whiskered Paradoxure (*Paradoxurus leucomystax*), two individuals of brown phase of Black Bear (*Ursus americanus*), California Sea-lion (*Zalophus californianus*), Kangaroo Rat (*Dipodomys elator*), American Porcupine (*Erethizon dorsatum*), Bridled Wallaby (*Onychogale frenata*): skin and skeleton; Lion "Prince" (*Felis leo*), European Brown Bear (*Ursus arctos*), Sing-sing Antelope (*Kobus unctuosus*): skull; Reddish Macaque (*Macacus rufescens*).

Birds.

Edw. E. Armstrong. Two Lapland Longspur (*Calcarius lapponicus*), Illinois.

Dr. William E. Hughes. Collection of Chihuahuan birds. Meyers collection of Pennsylvania and Virginia birds.

Dr. James V. Ingham. Ten skins of Trinidad Humming-birds.

Wm. H. Patterson. Skin of Mynah (*Mainatus intermedius*).

Purchased. Collection of Costa Rican birds. One long-tailed Duck (*Harelda hyemalis*) and two black Duck (*Anas rubripes*), Sea Isle City, N. J.

Mrs. Charles Roberts. Two Ptarmigan (*Lagopus lagopus*), Alaska. One Great-horned Owl (*Bubo virginianus*).

Mrs. J. D. Winsor. Black-throated Blue Warbler (*Dendroica cærulescens*).

David H. Wright. Short-eared Owl (*Asio accipitrinus*).

Zoological Society of Philadelphia. Skeleton of Single-wattled Cassowary (*Casuarius unappendiculatus*). Jobi Island Cassowary (*Casuarius unappendiculatus occipitalis*), mounted.

Reptiles and Amphibians.

Jacob Aebly. Tree-toad (*Hyla versicolor*), Philadelphia.

O. H. Brown. Spade-foot Toad (*Scaphiopus holbrooki*), Cold Spring, Cape May County, N. J.

H. W. Fowler. Jar of Frogs, Toads and Salamanders (*Elaphe* and *Natrix sipedon*), three mud turtles (*Kinosterum pensylvanicum*), Big Bohemia Creek, Md. Several species of *Hyla*, Holmesburg, Philadelphia.

J. B. Hutcher. Tadpole, Patagonia.

J. W. Holman. Opaque Salamander (*Ambystoma opacum*), Ocean County, N. J.

C. J. Hunt. Green Snake (*Liopeltis vernalis*), Chicago, Ill. Swamp Tree-toad (*Pseudacris triseriatus*), Riverside, Ill.

Hebard-Rehn Expedition 1910. Eighty-one reptiles and amphibians, western United States.

H. L. Mather, Jr. Numerous collections of reptiles and amphibians, Pennsylvania.

H. L. Mather and Edw. Carr, Jr. Several Salamanders.

H. A. Pilsbry. One Box-tortoise (*Terrepene* sp.), Arizona.

Pilsbry Expedition 1910. Sixty-five reptiles and amphibians, Southwestern United States.

H. Porter and H. W. Fowler. Jar of amphibians, Newark, Del.

Louis H. Schmidt. Mounted Leather-back Turtle (*Dermochelys coriaceus*), Portland, Me.

L. S. Snyder. Collection of Salamanders and Toads, Montgomery County, Pa.

C. H. Stall. Copperhead Snake (*Agkistrodon contortrix*) and Hellbender (*Cryptobranchus alleganiensis*), Newton Hamilton, Pa.

Mrs. Linda Sullivan. *Hyla squirella*, from head of Florida lettuce.

James Tague. Five-legged Frog (*Rana clamata*), Philadelphia.

E. G. Vanatta. Two Lizards and one Toad, Bermuda.

William Welsh. Red-bellied Turtle (*Pseudemys rubriventris*), May's Landing, N. J.

Fishes.

R. M. Abbott and H. W. Fowler. Collection of fishes, Lake Hopatcong, N. J.

Jacob Aebley. Disarticulated skull of *Anarrhichas lupus*, Maine.

Cornell University. Collection of Cyprinoids (in exchange).

Frank Ericson. Two young Dolphins (*Coryphæna hippurus*), Sea Isle City, N. J.

R. B. Farley. Sting-ray (*Dasyatis say*), Barnegat, N. J.

H. W. Fowler. Collection of several hundred fishes from Big Bohemia Creek, Md. Also a collection from Delaware County, Pa., and Manasquan, N. J. Several fishes from Bustleton, Philadelphia. Collection of young fishes from Burlington, N. J. One hundred fishes, Wycombe, Pa.

H. W. Fowler and H. L. Mather, Jr. Local collections of fishes. Collection of fishes from Neshaminy Creek. Jar of fishes, Claymont, Del. Small collection of fishes from Carcroft, Del.

W. J. Fox. *Raja ocellata*, two *Phycis chuss*, one *Merluccius bilinearis*, two

Astroscopus guttatus, young *Albacora thynnus*, *Lobotes surinamensis* from Sea Isle City, N. J. Mandible of grouper from Townsend's Inlet, N. J.

B. W. GRIFFITHS and H. W. FOWLER. Collection of fishes, Elmer, N. J.

H. WALKER HAND. *Sciænops ocellatus*, Cape May, N. J.

F. J. KEELEY. Trigger Fish (*Balistes carolinensis*), Great Egg Harbor, N. J.

T. D. KEIM. Small collection of fishes, northern New Jersey and vicinity of New York City. Three jars of fishes from Long Island Sound.

T. D. KEIM and H. W. FOWLER. Small collection of fishes, Burlington Island, N. J. Eight jars of fishes from Delaware.

E. J. F. MARX and H. W. FOWLER. Three jars of fishes, Easton, Pa.

H. L. MATHER, JR. Seven jars of fishes, Newton Hamilton, Pa. Jar of fishes from Philadelphia and three jars of fishes from Altoona, Pa.

D. N. MCCADDEN. *Rachycentron* and *Echeneis*, Ocean City, N. J. Sole (*Achirus fasciatus*), Ocean City, N. J. Also collection of fishes from same place.

DR. R. J. PHILLIPS. Collection of fishes, Corson's Inlet, N. J. Also *Paralepis* from same locality.

DR. R. J. PHILLIPS and H. W. FOWLER. Collection of fishes, Corson's Inlet, N. J. Four jars of fishes from Wilmington, Del.

PILSBRY EXPEDITION 1910. Three species of fishes, Arizona.

H. PORTER and H. W. FOWLER. Jar of fishes, Newark, Del.

E. G. VANATTA. Three fishes, Bermuda.

INSECTS.

STEWARDSON BROWN. Three Lepidoptera, Jamaica.

P. P. CALVERT. Twenty-one Neuroptera, Costa Rica.

T. D. A. COCKERELL. Two Coccidæ, Trinidad.

EXCHANGE. Seventy Orthoptera, Georgia and Florida; four Lepidoptera, New Mexico.

E. T. CRESSON, JR. Seventy-nine Diptera, United States.

H. W. FOWLER. Five Orthoptera, Delaware.

G. M. GREENE. Seventeen Orthoptera, Pennsylvania; two Coleoptera, New Jersey.

FORDYCE GRINNELL, JR. Forty-six Orthoptera, California.

F. HAIMBACH. Five Lepidoptera, Massachusetts.

H. S. HARBECK. Two Hymenoptera, New Jersey.

MORGAN HEBARD. Four hundred and seventy-eight Orthoptera, North Carolina; four hundred and sixty-seven Orthoptera, Sapucay, Paraguay; one hundred and two Orthoptera, Manitoba.

MORGAN HEBARD and J. A. G. REHN. Twenty-five insects, Virginia and North Carolina.

FRANK M. JONES. Fifty-three Orthoptera, Mississippi.

JOSEPH MCFARLAND. One hundred and fifty insects, United States.

A. DE WINKELRIED BERTONI. Thirty-two Orthoptera, Paraguay.

L. C. PHELEY. Sixteen Orthoptera, Kentucky.

W. D. PIERCE. Sixteen Strepsiptera, Kentucky.

G. R. PILATE. Two hundred Coleoptera, California.

H. A. PILSBRY. Seven Coleoptera, Arizona; five Orthoptera, Arizona and New Mexico.

PURCHASED. Two thousand five hundred and six Orthoptera, Africa and Peru; five hundred and ninety-one Orthoptera, Trinidad and Venezuela; three hundred and fifty Orthoptera, Jalisco, Mexico; one hundred and fifty-eight Orthoptera, Natal.

MRS. CHARLES SCHÄFFER. Eleven Lepidoptera, Canada.

C. SCHROTTKY. Twenty-one Orthoptera, Paraguay.

HENRY SKINNER. Six Lepidoptera, British Columbia; one Coleoptera, Pennsylvania; three Lepidoptera, Alaska.

E. A. SMYTH, JR. Two Lepidoptera, Central America.

WITMER STONE. Eleven insects, Massachusetts.

LANCASTER THOMAS. Five hundred Lepidoptera, North Carolina.

E. P. VAN DUZEE. One Hemiptera, Florida.

W. H. WHEELER. Five Hymenoptera, Nova Scotia.

Five thousand nine hundred and fifty-seven specimens.

RECENT MOLLUSCA.

R. M. ABBOTT and H. W. FOWLER. Ten trays of fresh-water shells from Lake Hopatcong, N. J.

BENJAMIN ALBERTSON. Two species of shells from Nantucket, Mass.

JOHN A. ALLEN. Nineteen species of shells from Tahiti and Ohio.

J. L. and A. L. BAILY, JR. Sixty trays of shells from Europe.

DR. F. BAKER. Seven species of marine shells from the west coast of America.

DR. AMOS P. BROWN. Four hundred and seventy-seven trays of Jamaica shells.

FRANCIS H. BROWN. Three species of fresh-water shells from Canada.

STEWARDSON BROWN. *Planorbis* from Norwood, Jamaica.

OWEN BRYANT. *Paludestrina* from Bermuda.

G. W. CAFFREY. *Helix* from Spain.

A. W. CLIME. Fourteen specimens of *Unio* from Arkansas.

C. H. CONNER. Nine trays of land and fresh-water shells from Pennsylvania.

C. M. COOKE. Thirty-two trays of *Lepachatina* from the Hawaiian Isles.

DR. W. H. DALL. Six trays of shells from Africa and North America.

L. E. DANIELS and J. H. FERRISS. Fifty-eight trays of shells from Arizona.

PROF. C. A. DAVIS. Two sets of *Paludestrina* from Bermuda.

H. K. DEISHER. Five species of land and fresh-water shells from Kurtztown, Pa.

J. H. FERRISS. One hundred and forty-one trays of land shells from Arizona.

H. W. FOWLER. Thirty-five trays of shells from Pennsylvania and Maryland.

MORGAN HEBARD. Twenty-three species of land and fresh-water shells from Florida.

J. B. HENDERSON, JR. Five species of land shells from Hamilton County, N. Y.

Y. HIRASE. Forty-three species of land shells from Corea, Japan and China.

H. V.'IHERING. Forty-one trays of fresh-water shells from South America.

SAMUEL R. JACOBS. Eight species of shells from Ireland and Pennsylvania.

T. D. KEIM. Twelve trays of shells from Delaware and Connecticut.

C. A. KOFOID. *Helix aspersa* Müll from Berkeley, Cal.

J. G. MALONE. Sixteen species of West Coast shells.

H. T. MATHER, JR. Six species of fresh-water shells from Hamilton County, Pa.

CLARENCE B. MOORE. Three hundred and thirty-five trays of shells from Florida.

Stanley B. Moore. *Ariolimax columbianus* Gld. from Pinole, Cal.

Dr. A. E. Ortmann. Fourteen species of *Unios* from western Pennsylvania.

W. H. Over. Seventeen trays of land and fresh-water shells from South Dakota.

Patagonian Expedition. One hundred and thirty-five trays of South American shells.

Major A. J. Peile, R. A. Fifteen species of shells from Bermuda and Africa.

Dr. H. A. Pilsbry. Two hundred and five trays of shells from Arizona and Eastern States.

Purchased. One thousand seven hundred and eighty-one trays of shells.

J. A. G. Rehn. Three species of land shells from Western States.

S. N. Rhoads. Forty-eight trays of shells from England.

S. Raymond Roberts. *Polygyra thyroides* Say from Mont Clair, N. J.

C. T. Simpson. Two shells from Porto Rico.

Dr. H. Skinner. Nine species of land shells from Italy and Dalmatia.

Dr. V. Sterki. Three species of shells from Indiana and Ohio.

Witmer Stone. Seventy-three trays of shells from the Atlantic coast of United States.

E. G. Vanatta. Two hundred and ten trays of shells from Bermuda.

Bryant Walker. Nine trays of American fresh-water shells.

Miss H. N. Wardle. Five species of land shells from Mexico.

H. W. Wenzel. *Campeloma decisum* Say. Pocono, Pa.

H. W. Winkley. Three trays of New England shells.

R. T. Young. Twenty-two species of shells from Devil's Lake, N. D.

Invertebrates (other than Insects and Mollusks).

W. J. Becker. *Estheria californica*, Pacific Grove, Cal.

Dr. A. P. Brown. *Peripatus*, Jamaica.

W. T. Knecht. *Balanus eburneus*.

J. G. Malone. Echinoderm and Balanus, Alaska.

H. L. Mather, Jr. Several Crayfish (*Cambarus*).

D. N. McCadden. Isopod from rock bass, Ocean City, N. J.

Thomas O. Mitchell. Barnacles from turtle, Atlantic City, N. J.

J. Percy Moore. Sixty-nine bottles of scaled Polychæta, including cotypes of nine species, from deep water off California.

Wm. V. Morgan. Bryozoan, Bermuda.

W. H. Over. *Estheria morsei* Date, South Dakota.

H. A. Pilsbry. Myriapod, Ventnor, N. J., and two Scorpions, Arizona.

Princeton Patagonian Expedition. Three trays of Brachiopods.

Purchased. Fifteen trays of Terebratulina, Atlantic Ocean.

Charles E. Ronaldson. Shells of King-crab (*Limulus*), Buzzard's Bay, Mass.

Witmer Stone. Fourteen trays of invertebrates, New Jersey and Pennsylvania.

United States Fish Commission. Collection of invertebrates made on the Albatross Hawaiian Expedition.

E. G. Vanatta. Six jars of invertebrates, Bermuda.

Wm. T. Wright. *Pectinatella magnifica*, St. David's, Pa.

Fossils Vertebrate.

Exchange with J. F. Mouldy. Collection of Moa bones, New Zealand.

Invertebrate Fossils.

H. K. Deisher. Slab of brachiopods, Berks County, Pa. Several slabs of dendrites. Twenty-nine trays of fossils, United States. Twenty-two specimens of fossils, Pennsylvania and Missouri.

Dr. Henry Fox. Twenty-nine trays of fossils, Jericho and New Egypt, N. J.; twenty-nine trays of Miocene fossils from New Jersey.

Wm. Imes. Fossils brachiopods and mollusks, Juniata County, Pa.

H. K. Deisher. Thirty trays of fossils from Clarion County, Pa.

Dr. J. Percy Moore. Cretaceous fossils from Martha's Vineyard, Mass.

Minerals.

Mrs. M. Brinkman. Collection of minerals.

H. K. Deisher. Collection of minerals, Berks County, Pa.

George E. Eiwe. Hexagonal volcanic rock.

Wm. Imes. Quartz crystals, Juniata County, Pa.

Spencer Penrose. Jillsanite, Ashley Valley, Utah.

C. E. Ronaldson. Garnets, Maine.

Estate of Lancaster Thomas. Collection of minerals and crystal models.

Mrs. William S. Yarnall. Collection of minerals.

William S. Vaux Collection. Twenty specimens purchased.

Ethnology and Archæology.

Charles M. Burns. Two specimen of Cingalese Script.

Arthur W. Clime. Thirty-seven specimens of modern work in stone, including an engraved sandstone gorget, small "celts" of chest, spear and arrowheads of quartz, flint, jasper, chest and glass flaked with stone and bone tools.

William Imes. Several arrowheads, Juniata County, Pa.

Dr. Fernando Salagaren (through H. N. Wardle). Two ceremonial coppers, Oaxaca, Mex.

Mrs. M. T. S. Schaeffer. Embroidered bag and wood carving made by Ainu of Japan.

Dr. Raymond Spear, U. S. N. Collection of Samoan implements, tapa clothes, etc.

H. Newell Wardle. Basket made by Thicket Indians, Sitka, Alaska. Thirty-six ancient potsherds, rain coat, ten obsidian and terra cotta objects, Mexico.

Plants.

Charles C. Bachman. Three specimens.

Edwin B. Bartram. Forty-five specimens.

G. William Bassett. Two specimens.

O. H. Brown. One specimen.

Stewardson Brown. Two hundred and ninety local and eight hundred and fifty Jamaica plants.

Joel J. Carter. Nineteen specimens.

Mrs. H. C. Chapman. Collection of Bar Harbor plants.

Joseph Crawford. Eight hundred Jamaica and Panama plants.

Dr. John W. Eckfeldt. Four specimens.

William Findlay. Four specimens.

Dr. C. D. Fretz. Fifty specimens of Cratægus.

J. H. Grove. Fifty specimens.

R. Heber Howe, Jr. Three Lichens in exchange.

Dr. Ida A. Keller. Forty-five specimens.

Dr. A. F. K. Krout. One specimen.

Henry A. Lang. Eight specimens.

Frank Leaming. Cedar log, Cape May Court House, N. J.

Bayard Long. Eighteen hundred and ninety-nine specimens.

New York Botanical Garden. Thirty-eight Jamaica and eighty-two Cuban plants, in exchange.

Francis W. Pennell. Five specimens.

Harold W. Pretz. One hundred and fifty-three specimens.

Benjamin H. Smith. Sixty-eight specimens.

Witmer Stone. Eight hundred and ninety-three specimens.

E. G. Vanatta. Fourteen specimens.

Samuel S. Van Pelt. Forty-one specimens.

Westtown School. Two specimens.

Charles S. Williamson. Seventy-six specimens.

Capt. J. H. Workman. Specimen of Tuckahoe (*Pachyma cocos*).

Academy's Expedition to Arizona and New Mexico (Dr. H. A. Pilsbry). Seven hundred and eighty-three specimens.

Botanical Section, Purchased. Seven hundred and forty specimens of Nevada and California plants.

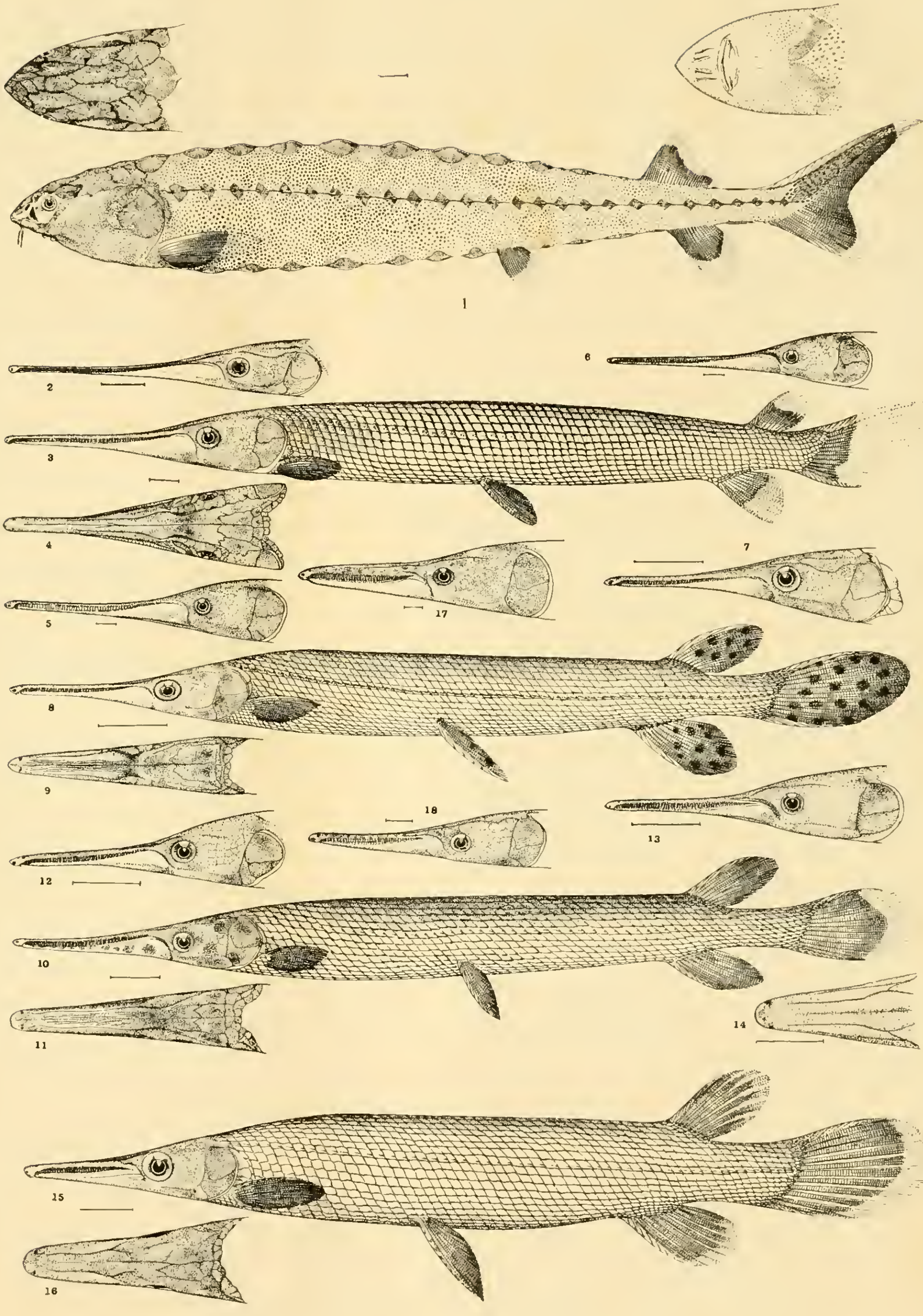
George Welder. Twelve slabs of fossil plants, Bucks County, Pa.

INDEX TO GENERA, SPECIES, ETC., DESCRIBED AND REFERRED TO IN THE PROCEEDINGS FOR 1910.

Species described as new are indicated by heavy-faced, synonyms by italic numerals.

GENERAL INDEX.

1910.



FOWLER ON GANOIDS.