PROCEEDINGS

OF THE

Academy of Natural Sciences

OF

PHILADELPHIA

VOLUME LX

1908

PHILADELPHIA :
THE ACADEMY OF NATURAL SCIENCES
LOGAN SQUARE
1908-1909

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA,
MARCH 3, 1909.

I hereby certify that printed copies of the PROCEEDINGS for 1908 have been mailed as follows :—

Pages	1–32	mailed	April	21, 1908.
"	33–64	"	June	9, 1908.
"	65–112, 129–144	"	July	24, 1908.
"	113–128, 145–156	"	July	27, 1908.
"	157–364	"	October	8, 1908.
"	365–412	"	October	14, 1908.
"	413–444	"	October	31, 1908.
"	445–492	"	January	4, 1909.
"	493–508	"	January	7, 1909.
"	509–540	"	January	28, 1909.
"	541–588	"	February	2, 1909.
"	589–624	"	March	3, 1909.

EDWARD J. NOLAN, M.D.,
Recording Secretary.

PUBLICATION COMMITTEE:

CONTENTS.

For Announcements, Reports, etc., see General Index.

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1908.

JANUARY 7.

The President, SAMUEL G. DIXON, M.D., in the Chair.

One hundred and six persons present.

The Hayden Memorial Geological Medal[1] was presented to Charles D. Walcott, LL.D. The presentation address was made by Dr. Persifor Frazer and responded to by the recipient of the award. A reception was tendered Dr. Walcott at the close of the formal proceedings.

The following Standing Committees were appointed by the Council to serve during the ensuing year:

FINANCE.—John Cadwalader, Edwin S. Dixon, Effingham B. Morris, Horatio C. Wood, M.D., and George Vaux, Jr., Treasurer.

PUBLICATIONS.—Henry Skinner, M.D., Henry A. Pilsbry, Sc.D., Witmer Stone, Philip P. Calvert, Ph.D., and Edward J. Nolan, M.D., Editor and Treasurer.

LIBRARY.—Dr. C. Newlin Peirce, Henry Tucker, M.D., Thomas Biddle, M.D., Benjamin Sharp, M.D., and George Vaux, Jr.

[1] For an illustration of the remodelled Hayden Medal see Report of Recording Secretary, PROCEEDINGS, 1907, p. 564.

INSTRUCTION.—Benjamin Smith Lyman, Henry A. Pilsbry, Sc.D., Charles Morris, Philip P. Calvert, Ph.D., and Dr. C. Newlin Peirce.

COMMITTEE OF COUNCIL ON BY-LAWS.—Arthur E. Brown, Sc.D., Thos. H. Fenton, M.D., John Cadwalader and Chas. B. Penrose, M.D.

The President is, *ex officio*, a member of all Standing Committees.

JANUARY 21.

The President, SAMUEL G. DIXON, M.D., in the Chair.

Ninety-seven persons present.

The deaths of Jacob Reese, March 25, 1907, and of Miss Adeline Tryon, January 20, 1908, members, were reported.

Dr. CASEY A. WOOD made an illustrated communication on the eyes and eyesight of birds. (No abstract.)

Dr. William J. Sinclair was elected a member.

The following was ordered to be printed:

HOW FULGUR AND SYCOTYPUS EAT OYSTERS, MUSSELS AND CLAMS.

BY HAROLD SELLERS COLTON.

Since observations on the habits of Prosobranch mollusks are fragmentary and few, I embraced an opportunity of studying *Fulgur carica*, *Fulgur perversa* and *Sycotypus canaliculatus* under conditions as nearly natural as one can hope to have in a laboratory located far from the sea. Most of the observations were carried out in the Vivarium of the University of Pennsylvania; these were supplemented by studies on fresh material under more natural conditions at the Fisheries Laboratory at Woods Hole.[1]

The individuals studied in Philadelphia had been in captivity a long time. All had been there a year and many several years. The *Fulgur carica* had come from Woods Hole and the Jersey coast. *F. perversa* I had brought up from Clearwater, Florida, two years and a half before. Of these latter none had died a natural death during that time.

The salt water aquarium in which they were confined was about five feet wide and eleven feet long. There was three feet of water over the greater part, but a shallow beach at one end.

On the beach I was accustomed to place oysters that I kept as a stock to feed the animals in this tank. Every week I chopped up an oyster or two and distributed the juice and fragments all over the tank. This stimulated the Fulgurs and Sycotypi to activity and to make frequent raids on the living oysters on the beach. This led me to inquire into the kind of food, the amount of food, and method of feeding of these gasteropods.

There is but one actual observation on the manner of feeding of these mollusks that I have been able to discover. Stimpson (1860), in speaking of *Sycotypus*, said: "In eating (it) applies end of proboscis to the clam's foot, and with a sudden jerk of the lingual ribbon inward and sidelong takes a strip of flesh."

The "impression" that most persons hold with reference to the manner of eating and the habits of the *Sycotypus* and *Fulgur* is expressed by Herrick (1906): "Since this animal is a great pest to the oystermen and clam-diggers, ... it is of some interest . . . . to know . . . .

[1] I am deeply indebted to the United States Commissioner of Fisheries for the use of a table at the Woods Hole Laboratory, to Dr. F. B. Sumner, the Director, for many favors, and particularly Dr. E. G. Conklin for reading the manuscript of this paper and for many helpful suggestions.

how this gasteropod accomplishes its destructive work of boring through the shells of oysters and clams and rasping out their soft contents by means of the file-like tongue." Although this is in the introduction, he does not mention again how *Sycotypus* bores through shells and had only the "impression" that they did bore.

Ingersoll (1884) has given the most detailed description of the food and the manner of taking it that I have been able to discover. "The food of the conch (*Fulgur* or *Sycotypus*)," says he, "being mainly the flesh of other mollusks, its method of killing them is one of brute strength, since it is unprovided with the silicious, file-like tongue by means of which the small drills set at naught the shelly armor of their victims. The conch is a greater savage than that. Seizing upon the unfortunate oyster, unable to run away, he envelops its shell in the concave under surface of his foot, and by just such muscular action as you would employ in grasping an object in the palm of your fist, crushes the shell into fragments and feasts at leisure on the flesh thus exposed. One planter thought one Winkle (*Fulgur* and *Sycotypus*) was capable of killing a bushel of oysters in a single hour. They do not confine themselves to oysters altogether, of course; any mollusk or other animal sluggish or weak enough to be broken up suffers from their predacity. I was told in New Jersey by an intelligent man that a conch would even pull a razor clam out of its burrow and devour it. If this be true the soft shell clam also falls a victim to the same marauder. The Quahog is generally safe."

I quote this because my observations and experiments unfortunately contradict so many of these interesting statements.

My experiments as to the kind of food were restricted to live Lamellibranchs, because I never was able to observe them eat chopped oyster or chopped meat. Chopped oyster certainly stimulates them and perhaps they will eat it. I cannot tell. Table I gives the results of my studies at Woods Hole and Philadelphia. (x) indicates that the particular bivalve was fed to the conch and eaten; (o) indicates that it was fed to the conch and not eaten; and (–) means that the particular form was not supplied with the indicated food.

Table I.

	Sycotypus.	*F. carica.*	*F. perversa.*
Mya	x	x	–
Venus	0	x	x
Ensis	–	x	–
Modiola	0	x	–
Mytilus	x	x	–
Ostrea	x	x	x

At Woods Hole *Sycotypus* and *F. carica* were found only at places where *Ensis* (razor clams) were abundant. I could not find them on any other beach. Although I did not observe *Sycotypus* eating *Ensis*, I think there is every reason to suppose that they do.

The experiments on the amount of food are too few to be definite. The results, such as they are, are expressed in Table II. (x) indicates present but not eaten. (o) indicates not present.

TABLE II.

No.	Conch.	Days.	*Ostrea.*	*Mya.*	*Venus.*	*Mytilus.*	*Modiola.*
4	*Sycotypus*............	10	x	13	x	7	x
4	*F. carica*..............	10	x	x	2	3	1
3	*F. perversa*..........	42	7	0	0	0	0
4	*F. carica*..............	42	0	0	0	0	0
2	*Sycotypus*............	42	4	0	0	0	0
1	*Sycotypus*............	2	4	0	0	0	0

Very often one individual would eat a couple of clams or oysters in a day, but as a rule the meals were far apart.

Notwithstanding most persons' "impressions," it is highly improbable that these mollusks ever bore through Lamellibranch shells. I have never seen a hole that would fit their proboscis, nor does the wearing of the teeth on the odontophore indicate that they were worn down against a hard substance. Plate I, figs. 3–4 show the median tooth of *Urosalphinx* which bores rapidly through the shells of mussels. The former shows a tooth before being worn and the latter a tooth worn down. These teeth compared with a similar series, Plate I, figs. 1 and 2, showing *F. carica*, suggest that there are two methods of wear. In *Urosalphinx* the teeth are worn evenly off so that a straight line will join the tops. The large teeth are worn level with the short ones. In *Fulgur*, however, the teeth are broken off in almost any way. Examinations of the radulæ of *Nassa obsoleta*, *Nassa trivittata*, *Lunatia* and *Purpura lapillus* seem to substantiate the view. But with the exception of *Purpura* and perhaps *Nassa obsoleta*, too little is known how they take their food to render any general conclusions tenable. In the case of these last two, *Purpura*, which has a radula worn like *Urosalphinx*, has been observed to bore (Wilcox, 1905); and *Nassa*, with wear such as I have described for *Fulgur*, has never been seen to bore, but will crawl between the valves of *Mya*, wedging the valves apart, and devour the flesh (Dimon, 1905).

The other method of attack (Ingersoll, 1884) is by breaking the shell. As described by Ingersoll this is utterly impossible. However, both *F. perversa* and *F. carica* do injure the shell of *Venus mercenaria* (Quahog); and, although they leave marks on the shell of *Mytilus* (mussel) and perhaps *Ostrea*, the shell of *Mya* (soft shell clam) is left without a scratch.

In the case of *Sycotypus* eating oysters, I have been able to watch the whole process from the beginning to the end without interruption, so I will take this as my first example. It will be an account of the behavior of a single individual.

The *Sycotypus* had not been fed for a month or so and was buried in the gravel. To stimulate, I added some very finely chopped-up oyster to the aquarium. When it started to crawl out of the gravel, a few minutes after I added the oyster juice, I placed some live oysters in the aquarium with it. It attacked one of the oysters five minutes after I placed them with it. Fifty minutes afterward it left the empty shell. Going a foot to another oyster, it began to attack it twenty minutes after it left the first one.

The *Sycotypus* crawled on top of the oyster, which closed its valves. The conch waited two minutes when the oyster opened its valves (Plate II, fig. 7). Rotating its shell on the axis of the columella through an angle of 70°, it thrust its own shell between the valves of the oyster and introduced its proboscis between the shells (Plate II, fig. 8). Forty minutes later it left the empty shell.

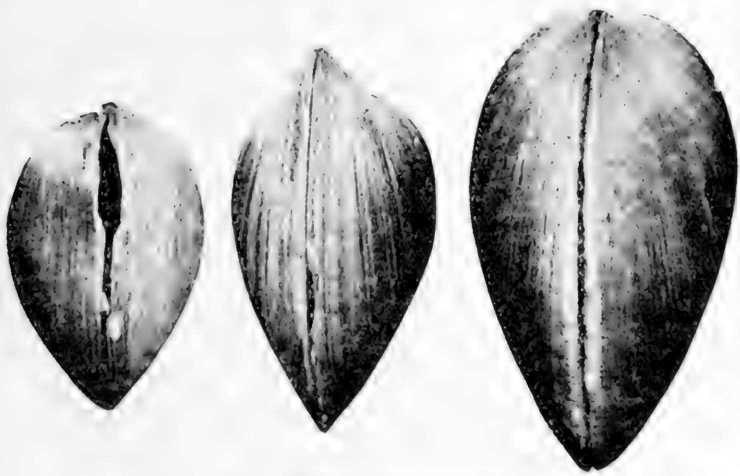
Sycotypus does not wedge the shells of *Mya* apart, because it can get at the soft parts without doing so, since the valves gap slightly (Plates II and III, figs. 11, 12). To test this I introduced an oyster that had had three-quarters of an inch broken from the margins of both valves on the end away from the hinge so that the valves appeared to gap. I found that *Sycotypus* attacked this one in the same manner as it attacked *Mya* and did not wedge the shells apart (Plate I, fig. 6).

Fulgur eating *Venus* is a much more complicated case. The conch (*Fulgur perversa* or *F. carica*) grasps the *Venus* in the hollow of its foot (Plate IV, fig. 13), bringing the margin of the *Venus* shell against its own shell margin. By contracting the columellar muscle it forces the margins of the shells together, which results in a small fragment being chipped from the shell of *Venus*. This is repeated many times and, finally, the crack between the valves is enlarged to a width of 3 mm. or more (text fig.).

The proboscis is normally about 5 mm. to 8 mm. in diameter There are three ways in which it may get at the animal. First, it may flatten out its proboscis so that it will go through the crack; secondly, it may pour in a secretion between the valves which kills the clam, and, thirdly, it may wedge its shell between the valves of the *Venus*. By contracting its columellar muscle it may actually wedge the valves apart. *Venus* is much more sensitive to mechanical stimuli than is *Ostrea*. *Venus* never opens its valves of itself when it is in the grasp of a *Fulgur*, while *Ostrea*, after the first shock, opens wide its valves as if no danger were near.

Fulgur and *Sycotypus* often break their own shell when opening oysters and clams, and this accounts no doubt for the irregular growth lines seen on their shells.

This method of inserting the margin of a gasteropod between the valves of a Lamellibranch has been noticed before. Francois (1890)



Quahog shell clipped by *Fulgur*.

briefly reports that *Murex fortispinna* has a special tooth on the margin of its aperture for the purpose of inserting between the valves of *Arca*. It may be that this manner of attacking the soft parts of bivalves is a very common habit of Prosobranch mollusks.

All writers recognize *Fulgur* and *Sycotypus* as pests to the oyster men. How many oysters will be destroyed will depend on the average number eaten in a given time. Although I have found them to eat two oysters one day and two the next, there follows a long rest period where the individual remains buried in the sand—sometimes for days, sometimes for months.

Notwithstanding that Ingersoll (1884) says, "It is needless to say that they do not burrow at all," I find that they are buried about 65 per cent. of the time, the tip end of the black siphon alone projecting above the sand—5 mm.—a most inconspicuous object.

The following table gives the records of the activity of nine individuals for a period of six weeks. It indicates the periods of rest and activity expressed in days. Plate V shows these periods of rest and activity distributed in space.

TABLE III.

Gasteropod.	Days active.	Days buried.	Days quiet.	Days of food.
Sycotypus No. 2	21	16	3	2
" No. 10	2	38	0	1
F. carica No. 3	9	25	6	0
" No. 4	5	34	1	0
" No. 5	11	0	14	0
" No. 6	10	4	26	0
F. perversa No. 1	7	29	4	1
" No. 7	10	30	0	2
" No. 8	7	33	0	1

These experiments were carried on in Philadelphia and so were not under perfectly natural conditions. They show how far apart the meal times are. During these experiments *F. carica* never ate. If these observations reflect at all the normal habits of the individual, they cannot, I think, be a very serious oyster pest.

Sycotypus and *Fulgur* do not always react to their food in the same manner, but they react to different Lamellibranchs in a way best suited to getting at the soft parts of the animals. Therefore the behavior is adaptive (Jennings, 1906, 1907).

Another question is, are these organisms intelligent? Jennings (1906) defines intelligence as a modification of behavior in accordance with experience. The usual way to test this is by habit formation (Jennings, 1907). "(1) The organism must be presented with a problem to be solved. (2) The organism must 'try' to solve the problem in several different ways. (3) It must be able to solve the problem in but one or a few ways."

In accordance with these criteria I presented the mollusks with a simple maze problem with oysters as "bait." Although without food for a week, they buried themselves in the sand and did not move again. At the end of two weeks I discontinued the experiment. To show the normal behavior of these animals I plotted their movements for a period of six weeks. This gave no results except those embodied in the earlier part of this paper. The diagrams show, however, how very sluggish these mollusks are. It is probably impossible by any of the ordinary methods to determine the intelligence of *Sycotypus* and *Fulgur*. The solution of this problem awaits some ingenious future investigator.

Summary.

1. *Fulgur* and *Sycotypus* are very hardy and live well in captivity.
2. *Fulgur* probably attacks any Lamellibranch.
3. *Sycotypus* will attack any except *Venus*.
4. Oysters are eaten in less than an hour. Clams in from an hour to an hour and a half. Quahogs from seven hours to three days.
5. They do not bore shells with the radula.
6. They open shells of oysters by wedging their own shell between the valves, and tear out the flesh with their radula. They probably treat Quahogs in the same way.
7. Some shells are injured in the process, depending on the amount of gap and the sensitiveness of the organism to mechanical stimuli.
8. Their meals are far between.
9. They spend their time between meals buried in the sand.
10. They may not be as serious a pest to the oystermen as previously reported.
11. Their behavior is adaptive. As yet we have no proof that these animals are intelligent.

Literature.

1895. Cooke. *Cambridge Nat Hist.*, Vol. III, p. 60.
1905. Dimon, A. C. *Cold Spring Harbor Monographs*, V, pp. 31–36.
1890. Francois. *Arch. Exp. G.*, (2), IX, p. 240.
1870. Gould. *Invertebrata of Mass.*, 2d. ed., by W. G. Binney.
1906. Herrick, J. C. Mechanism of the Odontophoral apparatus in Sycotypus canaliculatus, *Am. Nat.*, Vol. XL, p. 707.
1884. Ingersoll, E. *Fisheries Industries of the U. S.*, Section I, p. 694.
1906. Jennings, H. S. *Behavior of the Lower Organisms*, p. 334.
1907. Jennings, H. S. Behavior of the Starfish Asterias forreri, *U. of Cal. Pub. in Zool.*, Vol. IV, No. 2, p. 155.
1860. Stimpson. *Check List*, p. 6.
1882. Tryon, G. W. *Structural and Systematic Conchology*, p. 137.
1905. Wilcox, M. A. Biology of Acmæa testudinalis, *Am. Nat.*, May, 1905, p. 325.

Description of Plates I–V.

Figs. 1 and 2 were drawn with the aid of a camera lucida and magnified about 72 diameters.

Figs. 3 and 4 were drawn with a camera lucida and magnified about 270 times.

The succeeding figures were drawn free-hand from living animals with the exception of figs. 7 and 8, which are semi-diagrammatic. They are ¾ natural size.

PLATE I.—Fig. 1.—Median tooth of *Fulgur carica* (unused).

Fig. 2.—Median tooth of *Fulgur carica* (worn).

Fig. 3.—Median tooth of *Urosalphinx* (unworn).

Fig. 4.—Median tooth of *Urosalphinx* (worn).

Fig. 5. *Sycotypus* eating an oyster viewed from above.

Fig. 6.—*Sycotypus* eating an oyster viewed from side. The oyster had had the end toward the conch broken for about ¾ inch.

PLATE II.—Fig. 7.—*Sycotypus* on top of oyster (semi-diagrammatic).

Fig. 8.—The same a few seconds afterward, showing the margin of the *Sycotypus* shell wedging apart the shells of the oyster.

Fig. 9.—*Sycotypus* wedging apart the valves of an oyster.

PLATE III.—Fig. 10.—*Sycotypus* in search of food.

Fig. 11.—*Sycotypus* eating *Mya*.

PLATE IV.—Fig. 12.—*Sycotypus* eating *Mya*.

Fig. 13.—*F. carica* eating *Venus*, showing how it holds the shell.

PLATE V.—Diagrams illustrating the wanderings of *F. perversa*, *F. carica* and *S. canaliculatus* during a period of six weeks. Each square of the diagram represents one square foot. Each of the diagrams represent an aquarium of salt water five feet by eleven feet. The plottings were made daily. The Roman numerals indicate the identification number of the individual welks. Arabic numerals indicate days at one spot. (o) means an oyster eaten. (B) indicates that the individual was buried.

February 4.

Dr. William P. Wilson in the Chair.

Thirty persons present.

The Publication Committee reported the reception of a paper entitled "Acrididæ (Orthoptera) from São Paulo, Brazil, with descriptions of one New Genus and three New Species," by James A. G. Rehn (January 27).

Witmer Stone made a communication on the geographical distribution of plants and animals in Southern New Jersey. (No abstract.)

February 18.

Arthur Erwin Brown, Sc.D., Vice-President, in the Chair.

Ninety persons present.

The reception of a paper entitled "Remarks on the Fossil Cetacean Rhabdosteus latiradix Cope," by Frederick W. True (February 18), was reported by the Publication Committee.

Philip P. Calvert, Ph.D., made a communication on the general results of nine years' study of the dragon-flies of Mexico and Central America for the *Biologia Centrali Americana*. (No abstract.)

Burton Chance, M.D., was elected a member.

The following were ordered to be published:

ACRIDIDÆ (ORTHOPTERA) FROM SÃO PAULO, BRAZIL, WITH DESCRIPTIONS OF ONE NEW GENUS AND THREE NEW SPECIES.

BY JAMES A. G. REHN.

The material treated in the following paper represents the Pyrgomorphinæ and Locustinæ of a collection of Orthoptera made at several localities in the State of São Paulo, Brazil, by Mr. Adolph Hempel, and presented to the Academy by the author.

The Acridinæ belonging to this collection has already been treated, in conjunction with other South American material of that subfamily, in a paper in these Proceedings.[1]

PYRGOMORPHINÆ.

OMMEXECHA Serville.

Ommexecha servillei Blanchard.

1837. *Ommexecha Servillei* Blanchard, Ann. Soc. Entom. France, V, p. 613, Pl. XXII, figs. 2 and 3. [Province of Corrientes, Argentina.]

São Paulo. September 13 and 19, 1900. (Hempel.) Three ♂, three ♀.

Reboucas. September 26, 1900. (Hempel.) One ♂, one ♀.

Previous records for this species are Porto Allegre, Rio Grande do Sul (Karsch), Sierra Geral, Santa Catharina (Karsch), São Paulo (Bruner), Matto Grosso (Karsch), Brazil, Asuncion and San Bernardino, Paraguay (Bruner).

LOCUSTINÆ.

TROPINOTUS Serville.

Tropinotus affinis Bruner.

1906. *Tropinotus affinis* Bruner, Proc. U. S. Nat. Mus., XXX, p. 646. [Sapucay, Paraguay.]

Jundiahy. April 17, 1898; September 10, 1899. (Schrottky.) Two ♂, two ♀.

The bowed lateral carinæ of the pronotum appear to be the chief diagnostic character of this species, unless this is also shared by *T. scabripes* Stål, which has not been examined.

[1] *Proc. Acad. Nat. Sci. Phila.*, 1906, pp. 10–50.

ELÆOCHLORA Stål.

Elæochlora arcuata n. sp.

Types: ♂ and ♀; Jundiahy, State of São Paulo, Brazil. March 1, 1899 (♂). (Schrottky.) [A. N. S. Phila.]

This peculiar species belongs to the section of the genus containing *E. trilineata* and *viridicata* (Serville) and *humilis* and *pulchella* Rehn. as well as the rather aberrant *picticollis* (Gerstaecker). It is readily separated from any of these species by the well elevated and longitudinally arcuate median carina of the pronotum, the tubercles of the pronotum also being blunter and fewer than in the allied species. The male can also be immediately separated from the above species, except *picticollis*, by the short acute tegmina.

Size rather large; form of the female quite robust, of the male slen-

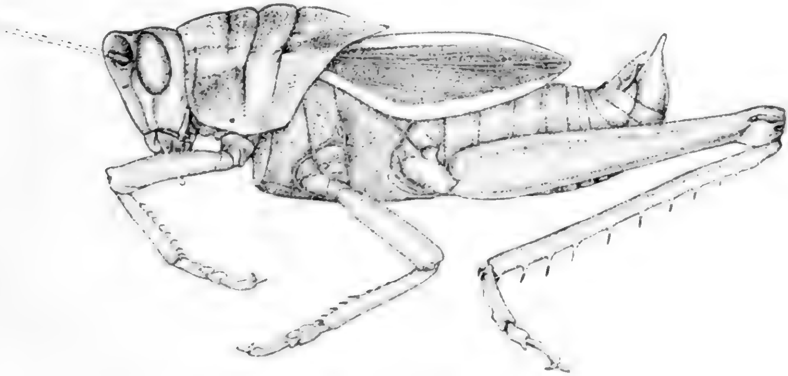


Fig. 1.—*Elæochlora arcuata* n. sp. Lateral view of male type. (× 2½.)

derer. Head with the occiput rounded; fastigium subhorizontal, very slightly excavated, longer than broad, the apex slightly acute-angulate, the apical margins slightly arcuate in the male; angle of the fastigium when viewed from the lateral aspect narrowly rounded into the moderately (♀) or considerably (♂) retreating face; frontal costa very much narrowed at its junction with the fastigium, slightly but regularly expanding ventrad to the clypeus, sulcate except in the very narrow dorsal portion; eyes of the male elliptical, oval, of the female ovate; antennæ not complete. Pronotum rugoso-punctate, with the prozona tectate, the metazona with the disk flattened and the carina considerably elevated, the outline of the carina when viewed from the lateral aspect being very slightly arcuate in the female, very considerably so in the male; cephalic margin obtuse-angulate, slightly more marked in the male than in the female; caudal angle acute-angulate, the apex sharp and the margins slightly arcuato-emarginate; lateral shoulders marked on the metazona, a continuation descending obliquely ventro-cephalad on the prozonal portion of the lateral lobes prozona of the disk with accessory lateral shoulders, which are less marked than the primary ones, converging from the principal transverse sulcus to the cephalic margin, all the lateral shoulders more marked in the male than in the female; transverse sulci three in number, all cutting the median ridge, but only the caudal one doing so deeply; greatest median width of the pronotal disk contained about twice in the length; lateral lobes of the pronotum with the ventral margin obtuse-angulate. Tegmina of the male exceeding the length of the pronotum by about half the length of the head, of the female about equal to the length of the metazona and half of the prozona; shape of the male tegmina sublanceolate, of the female tegmina sub-rhomboid, the greatest width of the male tegmina contained two and a half times in their length, that of the female tegmina contained once and two-thirds in their length. Wings much smaller than the tegmina, not functional in either sex. Prosternal spine erect, conical; inter-space between the mesosternal lobes very slightly transverse, the angles of the lobes broadly rounded; interspace between the meta-sternal lobes distinctly arcuate transverse. Abdomen compressed in both sexes, distinctly carinate dorsad in the male; supra-anal plate of the male acute-angulate, distinctly sulcate mesad, the sulcus narrowed meso-caudad; cerci of the male very small, simple, styliform; subgenital plate compressed, produced, rostrate, the apex elevated and slender. Cephalic and median limbs moderately robust in the male, rather weak in the female. Caudal femora about one and one-third (♀) or one and two-thirds (♂) the length of the pronotum, rather slender, tapering, no appreciable pregenicular constriction, dorso-median carina sparsely serrato-dentate, pattern of the pagina rather irregular and not deeply impressed; caudal tibiæ about equal to the femora in length, armed on the external margin with ten to twelve spines, on the internal with nine to ten spines, those of the internal margin longer than those on the external; tarsi distinctly depressed.

General color olive-green becoming brownish on some areas and brighter green on others. ♂. Face dull oil green, genæ and occiput of the general color aside from a dull broad subequal medio-longitudinal bar of russet on the vertex and occiput, bordered laterad by poorly defined blackish areas; eyes burnt umber. Pronotum very dull olive-green dorsad, the median carina and angles marked obscurely with burnt sienna; lateral lobes with considerable parrot green mesad, the cephalic and ventral margins narrowly and the caudal margins rather broadly margined with ochraceous-buff, the marginal color blending into the general color. Tegmina blackish, broadly margined, except toward the apex where the paler color narrows until completely absent at the very apex, with ochraceous-buff, principal veins of the median portion of the tegmina apple green. Limbs distinctly brownish, the caudal tibiæ and tarsi vinaceous-cinnamon, tibial spines wholly black on the internal margin, tipped with black on the external margin. ♀. Head bice-green with a very pale ochraceous-buff occipital and fastigial band as in the male, which band, however, has the lateral defining bars poorly indicated; eyes vandyke brown; antennæ pansy purple with the proximal joint of the color of the head. Pronotum generally more oil green than olive-green; median carina marked with a bar of madder brown which narrows caudad and is poorly outlined cephalad; ventral and caudal margins of the lateral lobes with very faint and poorly defined light margins. Tegmina oil green with a pale margin similar to the male, in addition to which the green area is outlined by a heavy pencilling of black, quite distinct on all but the ventro-caudal portion, while the sutural margin has a very fine black edging to its proximal half; principal veins of the green area apple green. Limbs oil green tending toward apple green, caudal tarsi marked with maroon purple dorsad, caudal tibiæ with the spines as in the male.

Measurements.

	♂	♀
Length of body,	29.2 mm.	52 mm.
Length of pronotum,	11.1 "	18.6 "
Median width of disk of pronotum,	5.5 "	8.2 "
Length of tegmen,	12.8 "	13.8 "
Greatest width of tegmen,	5.4 "	8 "
Length of caudal femur,	17.9 "	24.2 "

A paratypic female has also been examined. It differs from the female type only in the tegmina being more produced and nearer to the type seen in the male.

CHROMACRIS Walker.

Chromacris miles (Drury).

Jundiahy. (Schrottky). One ♂.

This individual has the lighter color of the wings rich yellow.

Chromacris nuptialis (Gerstaecker).

1873. *Romalca nuptialis* Gerstaecker, Stett. Entom. Zeit., XXXIV, p. 185. [Salto Grande,[2] Brazil.]

Jundiahy. January 20, 1899 (♀). (Schrottky.) One ♂, one ♀.

The markings of the tegminal veins in this species remind one of the similar pattern noticed in the otherwise very different *C. icterus*.

ZONIOPODA Stål.

Zoniopoda tarsata (Serville).

Jundiahy. January 28, 1899. (Schrottky.) One ♂.

This specimen agrees fully with the original description and two Rio Grande do Sul specimens determined as *tarsata*, received from the late Dr. Saussure.

LEPTYSMA Stål.

Leptysma gracilis Bruner.[3]

1906. [*Leptysma*] *gracilis* Bruner, Proc. U. S. Nat. Mus., XXX, p. 658. [São Paulo, Brazil.]

São Paulo. September 5–19, 1900. (Hempel.) Six ♂, four ♀.

This series shows an appreciable amount of variation in the form of the fastigium, some having the angle more acute than others.

Leptysma filiformis (Serville).

São Paulo. September 1 and 7, 1900. (Hempel.) Three ♀.

PARACORNOPS Giglio-Tos.

Paracornops longipenne (De Geer)?

1773. *Acrydium longipenne* DeGeer, Mém. d'Hist. Ins., III, p. 501, Pl. 42, fig. 9. [Surinam.]

São Paulo. September 14, 1900. (Hempel.) Five ♂, one ♀.

We have followed Bruner[4] in considering this form the same as DeGeer's species, the correctness of which association can be determined definitely only by the examination of Surinam material.

The specimens in hand are brownish instead of greenish as described by DeGeer, but as far as can be determined from his figure they do not differ structurally, and in dimensions they fully agree with those given by him.

---

[2] One of two localities, Salto Grande, Minas Geraes or Salto Grande, São Paulo, probably the latter.

[3] The five females from Sapucay, Paraguay, recorded by the author as *L. filiformis* (*Proc. Acad. Nat. Sci. Phila.*, 1907, p. 180) are found on re-examination to be this species. The absence of male individuals accounts for the error in determination.

[4] *Proc. U. S. Nat. Mus.*, XXX, p. 662.

OMALOTETTIX Bruner.

Omalotettix signatipes Bruner.

São Paulo. September 1 to 14, 1900. (Hempel.) Nine ♀.

These specimens are uniformly, though slightly, smaller than Chapada, Brazil, and Sapucay, Paraguay, females, but in no other respect do they appear to differ from topotypes.

HOMALOSAPARUS[5] n. gen.

A member of the *Xiphiolæ* and related to *Saparus* Giglio-Tos and *Xiphiola* Bolivar, differing from the former in the less compressed general form, in the form of the frontal costa, the less produced head, the less compressed pronotum, the more rounded tegmina, the more robust limbs and the produced subgenital plate; differing from *Xiphiola* n the more compressed form, in the absence of distinct lateral angles to the pronotum, the absence of any costal projection between the antennæ, in the broader tegmina, in the narrower interspace between the mesosternal lobes and in the produced subgenital plate and slender cerci.

Vertex ascending; fastigium rectangulate; frontal costa not projecting between the antennæ, becoming obsolete ventrad of the ocellus; face declivent; eyes acute ovoid, hardly projecting; antennæ heavy, depressed, very slightly expanded proximad. Pronotum rugoso-punctate; dorsal transverse sulci three in number; median carina distinct; caudal angle of the disk subrectangulate; lateral angles without carinæ. Tegmina exceeding the apex of the abdomen, rather broad, greatest width in the distal third; intercalary vein absent. Prosternal spine erect, slender, apex blunt; interspace between the mesosternal lobes very distinctly longer than broad; interspace between the metasternal lobes very narrow. Subgenital plate of the male produced, acuminate, keeled. Caudal femora moderately inflated; caudal tibiæ with nine spines on the lateral margins.

Type.—*H. canonicus* n. sp.

Homalosaparus canonicus n. sp.

Type: ♂; São Paulo, Brazil. September 13, 1900. (Hempel.) [A. N. S. Phila.]

Size medium; form distinctly compressed; surface ruguloso-punctate. Head with the occiput regularly ascending to the interocular region which, with the fastigium, is subhorizontal; interocular region slightly more than twice the width of the interantennal portion of the frontal costa; fastigium broadly trigonal, the apex with a short, distinct, median, longitudinal sulcus; angle of the fastigium and vertex, when seen from the lateral aspect, rounded rectangulate, the facial line being

[5] Ὁμαλός, resembling, and *Saparus*, a generic name.

subperpendicular to a short distance ventrad of the insertion of the antennæ, then considerably declivent; lateral foveolæ indistinct, punctate; frontal costa slightly constricted dorsad and obsolete from a point ventrad of the ocellus where it is slightly narrowed, entire length impresso-punctate; eyes acute dorsad, strongly elongate-ovoid

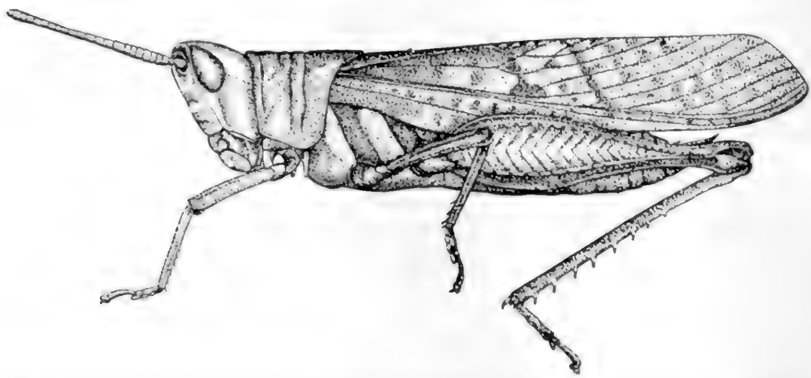


Fig. 2.—*Homalosaparus canonicus* n. gen. and sp. Lateral view of type. (× 2½.)

and somewhat longer than the infraocular portion of the genæ, when viewed from the dorsum the eyes are seen to be very slightly prominent; antennæ about as long as the head and pronotum together, heavy, distinctly depressed, very slightly expanded proximad and with a very slight expanded distal clavation. Pronotum about half again as long as the dorsal surface of the head; cephalic margin subtruncate with an extremely slight median emargination, caudal margin subrectangulate, apex finely angulate; median carina low, distinct, severed three times; lateral shoulders distinct on the metazona, rounded and descending ventro-cephalad on the prozona; lateral lobes about as deep on their greatest dorsal length, ventral margin rotundato-emarginate cephalad, arcuate caudad. Tegmina exceeding the tips of the caudal femora by about the length of the head; greatest width at about three-fourths the length from the proximal extremity and contained about four and a half times in the tegminal length; costal margin with a very considerable rounded lobe, distad of which the margin is straight to the point of greatest width and arcuate thence to the apex, sutural margin straight except for a slight proximal arcuation, apical region ob-

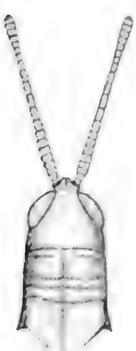


Fig. 3.—*Homalosaparus canonicus* n. gen. and sp. Dorsal view of head and pronotum. (× 2½.)

liquely truncate with the apex rounded rectangulate. Wings fully developed. Prosternal spine erect, rather slender, hardly tapering, bluntly pointed. Interspace between the mesosternal lobes broad cephalad, sharply narrowed to about a third the cephalic width, then slightly and regularly expanded with the caudal angles of the lobes rounded, the whole shape of the interspace being like a letter X with the upper portion abnormally expanded and the lower portion drawn out; interspace between the metasternal lobes narrow, inverted, cuneiform. Abdomen moderately compressed; supra-anal plate produced subequal in width in the proximal half, distinctly narrowed mesad and thence arcuate to the rather blunt apex; cerci slender, subequal in the proximal half, roundly emarginate on the dorsal margin in the distal half, the apex blunt, the distal fourth seen to be distinctly arcuate mesad when viewed from the dorsum; subgenital plate acute scaphiform, the apex acute-angulate, and the lateral portions of the plate distinctly constricted proximad, ventral aspect with a distinct median keel. Cephalic and median limbs rather slender. Caudal femora about two-thirds the length of the tegmina, the greatest width contained about four times in the length, dorsal carinæ serrato-dentate, pattern of the paginæ well impressed, genicular lobes acute; caudal tibiæ slightly shorter than the femora, lateral margin with nine spines one of which is quite small and apical, internal margin with ten spines, one apical; caudal tarsi comparatively short and with the pulvilli large.

General color prout's brown, tawny-olive ventrad and tending toward seal brown on the dorsum of the head, disk of the pronotum and proximal portion of the tegmina. Head with the face washed with walnut brown, several pale bars crossing between the labrum and median ocellus; labrum ochre; sides of the head ventro-caudad of the eyes washed with seal brown; eyes russet; antennæ wood brown dorsad, vandyke brown ventrad with the tip blackish. Pronotum slightly touched laterad with walnut brown. Tegmina sprinkled rather sparingly with small subquadrate maculations of seal brown; angle of the anal field rather pale. Wings transparent, tinted with pale brownish. Caudal femora with an obscure pregenicular annulus of seal brown, tubercles on the carinæ and pattern of the paginæ blackish; caudal tibiæ with the spines maize yellow with seal brown tips.

Measurements.

Length of body,	28.2 mm.
Length of pronotum,	6 "
Greatest caudal width of pronotum,	4 "
Length of tegmen,	24.8 "
Length of caudal femur,	15.8 "

A series of five paratypic males have also been examined, taken from the first to nineteenth of September, 1900. In size they show some little variation, and in color there is a tendency in some specimens to a more grayish coloration than in others, while in one specimen the color pattern is much more contrasted than in the type. Pale bars on the lateral angles of the pronotum are sometimes present, the ventral half of the eye also being suffused with seal brown in some specimens, while the small tegminal maculations frequently show a tendency to associate in oblique transverse bars well defined or much interrupted and from one to three in number.

SCHISTOCERCA Stål.

Schistocerca gratissima n. sp.

Schistocerca lineata (Stoll)? according to Bruner, Proc. U. S. Nat. Mus., XXX, pp. 675, 676 (1906).[6]

Type: ♂; São Paulo, Brazil. September 14, 1900. (Hempel.) [Acad. Nat. Sci. Phila.]

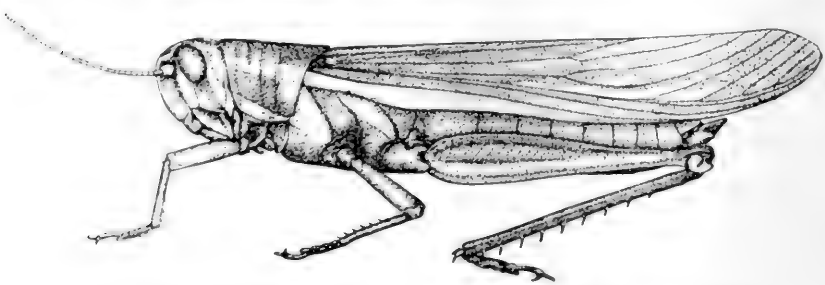


Fig. 4.—*Schistocerca gratissima* n. sp. Lateral view of type. (× 1½.)

Allied to *S. pallens* (Thunberg) but differing in the shorter, blunter fastigium, the lesser space between the eyes, the broader and more truly elliptical eye, the more arcuate facial outline when viewed laterad and the anomalous pink and green coloration.

Size large; form rather slender. Head with the occiput considerably elevated and rounded, descending regularly to the fastigium and rounding into the frontal costa; interspace between the eyes slightly exceeding the greatest width of the fastigium; fastigium about as long as broad, considerably excavated; frontal costa slightly constricted

[6] We do not consider the resemblance of Stoll's figure of *Gryllus* (*Locusta*) *lineatus* (*Natuurl. Afbeeld. Besch. Springh.*, Pl. XV (B, fig. 57) close enough to specimens of this species to consider them the same. While in one or two points resemblance exists, in a number of others the discrepancies are very considerable. Stoll's figure appears to us to be a true *Locusta* (*Acridium* of authors).

dorsad, thence of a uniform width to the clypeus, deeply sulcate from between the antennæ to near the clypeus; facial outline when viewed from the lateral aspect slightly arcuate; eyes elliptical oval, distinctly longer than the infraocular sulcus; antennæ somewhat exceeding the length of the head and pronotum together. Pronotum rounded dorsad, hardly constricted, not tectate, disk of the metazona slightly flattened; cephalic margin of the disk very slightly angulate with a hardly appreciable median emargination, caudal margin of the disk nearly rectangulate, the apex very broadly rounded, median carina present but not high, cut by three transverse sulci, prozona and metazona subequal in length, the width of the metazona slightly greater than its length, lateral angles not apparent on the prozona, well rounded on the metazona; lateral lobes considerably longer than deep, narrowing ventrad, ventral margin truncate on the caudal half, obliquely emarginate on the cephalic half. Tegmina exceeding the apex of the abdomen by a distance about equal to the length of the pronotum; costal margin considerably arcuate in the distal third; apex broadly rounded. Prosternal spine stout, acute, very considerably retrorse; interspace between the mesosternal lobes longitudinal, subcuneate, the interspace cephalad being nearly as wide as the lobes; metasternal lobes contiguous. Abdomen somewhat compressed; cerci of moderate length, the apex somewhat narrower than the base, subtruncate; subgenital plate moderately produced, the apex rather deeply divided. Caudal femora about reaching to the apex of the abdomen, rather slender, medio-dorsal carina serrate, paginæ with the pattern distinctly but not very deeply impressed; caudal tibiæ with the spines quite long, nine in number on the external and eleven on the internal margins.

Fig. 5.—*Schistocerca gratissima* n. sp. Dorsal view of head and pronotum of type. (× 1½.)

General colors oil green, liver brown and salmon-buff. Head with the face, an infraocular bar and the fastigium and occiput green, remainder salmon-buff; a poorly defined medio-longitudinal occipital pale band present, bordered laterad by poorly defined darker areas; eyes burnt umber; antennæ dull pinkish. Pronotum with the dorsum green with a subequal median bar of vinaceous-rufous; lateral lobes vinaceous-pink with a broad oblique bar of green. Mesothoracic and metathoracic epimera green, mesothoracic and metathoracic episterna and ventral portions of the thorax pinkish. Tegmina with a costal bar of primrose yellow extending over almost the whole of the costal half of the costal field, the greater portion of the margin of this pale area being narrowly edged with maroon, remainder of the tegmina liver brown, the principal veins maroon, several pale areas, caused by the coloration of adventitious veins, distributed over the median portion of the tegmen; anal field with a rather broad longitudinal band of vinaceous-cinnamon. Wings slightly infuscate. Cephalic and median limbs buffy washed dorsad with greenish. Caudal femora with the dorsal half oil green, the ventral half salmon-buff; the division along the middle of the paginæ being indicated by a slightly blackish area, genicular arches chestnut; caudal tibiæ and tarsi pomegranate purple, the spines maize yellow tipped with black.

Measurements.

Length of body,	49.5 mm.
Length of pronotum,	9.5 "
Greatest dorsal width of pronotum,	6 "
Length of tegmen,	46.2 "
Length of caudal femur,	25 "

Two paratypic males in the Academy Collection and one of the same sex from Surinam (V–IX; Fruhstorfer) in the Hebard Collection have been examined. This series shows a considerable amount of variation in size and some in color. One São Paulo male is about equal to the type in size, the other two specimens being appreciably smaller. The additional São Paulo individuals agree fully with the type in color, while the Surinam male has the greens much deeper, almost french green, and the pink shades almost replaced by yellowish-white, sometimes greenish-yellow, the purplish color of the caudal tibiæ being weaker and replaced on the ventral surface by oil greenish.

DICHROPLUS Stål.

Dichroplus brasiliensis Bruner.

1906. *Dichroplus brasiliensis* Bruner, Proc. U.S. Nat. Mus., XXX, pp. 678, 682. [Victoria, Brazil.]

Espirito Santo, Brazil. [Hebard Collection.] One ♀.

São Paulo. September 14, 1900. (Hempel.) One ♀.

The pale bars mentioned in the original description are but faintly indicated in these specimens.

SCOTUSSA Giglio-Tos.

Scotussa brasiliensis Bruner.

1906. [*Scotussa*] *brasiliensis* Bruner, Proc. U. S. Nat. Mus., XXX, p. 689. [São Paulo, Brazil.]

São Paulo. September 7–19, 1900. (Hempel.) Six ♂, four ♀.

These specimens agree fully with the original description except in the number of external tibial spines. In three of the males both tibiæ bear eight spines, and another male has eight on one tibiæ and nine on the other. In consequence the presence of nine spines cannot be considered diagnostic.

REMARKS ON THE FOSSIL CETACEAN RHABDOSTEUS LATIRADIX Cope.

BY FREDERICK W. TRUE.

The genus and species *Rhabdosteus latiradix* were first described by Cope in 1867,[1] and were based on a rostrum from Charles County, Md., near the Patuxent River, collected by James T. Thomas. Three teeth were also "with much probability" assigned to the species. Cope remarked: "Joseph T. Thomas, the discoverer of this cetacean, tells me that he has seen portions of the muzzle between two and three feet long."

No further original information regarding the species appears to have been published until 1890, when Cope published figures of the type specimen, as restored, and of a tooth. He remarked, however, that the posterior parts of the maxillary and premaxillary bones "were restored from a different specimen from that represented in the rest of the figures."[2] This "different specimen" was figured by Mr. Case, in 1904, together with still another rostrum[3] and the three teeth.

From an examination of the three beaks, which were very kindly placed in my hands for study by the authorities of the Philadelphia Academy of Natural Sciences and Mr. Witmer Stone, it appears probable that three species are represented. The rostrum figured by Mr. Case in Pl. 15, fig. 1, is the same as that described by Leidy, in 1869, as probably belonging to *Priscodelphinus grandævus*.[4] I have remarked in a previous paper that the reasons for identifying the rostrum with that species are unsatisfactory;[5] but, however that may be, the rostrum certainly does not belong to the same species as the one called *Rhabdosteus latiradix* by Cope, nor is it likely that it represents the same genus.

The "different specimen" mentioned by Cope in 1890, and figured by Mr. Case in Pl. 15, fig. 2, does not, in my opinion, belong to the species *latiradix*, nor is it at all probable that it belongs to the genus *Rhabdosteus*.

[1] *Proc. Acad. Nat. Sci. Phila.*, 1867, pp. 132 and 145.
[2] *Amer. Nat.*, 1890, p. 607, fig. 4.
[3] *Rep. Maryland Geol. Surv.*, Miocene, 1904, Pl. 15.
[4] *Journ. Acad. Nat. Sci. Phila.*, Ser. 2, Vol. 7, 1869, p. 434.
[5] *Smithsonian Misc. Colls.*, Quart. Issue, 50, Pt. 4, No. 1782, p. 451, January 27, 1908.

Leaving out of consideration for the moment the rostrum originally assigned to *Priscodelphinus grandævus* (Case's Pl. 15, fig. 1), I would remark that the restoration of neither of the other two beaks appears to me satisfactory, and that the figure published by Cope in 1890 is even less so. As regards the latter, by adding a portion from the second beak to the posterior end of the type, Cope has, in my opinion, produced a figure which does not represent any species which has actually existed, and, furthermore, as the portion added is itself incorrect, the erroneousness of the figure is compounded. It should also be remarked that in the side view (Cope's fig. 4 (1*a*)) the alveoli are much smaller than in the restoration of the type itself.

Cope's note on the genus *Rhabdosteus*, published in 1890, is as follows:

"The muzzle reaches an extraordinary elongation, and for the greater part of its length forms an edentulous cylinder, which resembles the beak of the sword-fishes. The few teeth which remain at the base of the muzzle are like those of *Platanista*, with roots compressed so as to be longitudinal, and crowns compressed so as to be transverse, to the axis of the skull. The *R. latiradix* Cope is not uncommon in the Miocene beds of Maryland. Its skeleton is unknown. The nearest approach to *Rhabdosteus* is made by the genus *Stenodelphis*."

After repeatedly examining the type specimen (Pl. VI), I am satisfied that this characterization is only partially correct.

The alveoli, as restored, are horizontal. They are nine in number, about equal in size, and situated in advance of the depression in the palate in which a lozenge-shaped area of the vomer usually appears. Hence, they are hardly likely to represent the posterior end of the series. That the alveoli should be horizontal in the midde of the series is improbable. No known cetacean has such a conformation, and on anatomical grounds it appears unlikely to occur. The lower (or inner) margin of the alveoli and the lower half of the various septa are alone preserved, and this only on one side of the jaw. No distinct trace of the upper (or outer) margin of the alveoli and septa can be seen on the long rod-like superior portions of the maxillæ. The narrow inferior strip of the maxilla, which bears the incomplete alveoli and septa (already mentioned), has been placed outside the larger piece, which forms the proximal end of the palate, and parallel with it. Such a combination could be justified only on the ground that the maxilla had split lengthwise, and that the outer and inner pieces represent two parts of one and the same bone. This is improbable, as the inferior surface of the larger piece is convex, while that of the smaller piece is nearly plane. The smaller piece is, in my opinion, much more likely to have been anterior to the larger piece originally and in line with it, though this would bring the rather large alveoli farther forward than might be expected. If the superior, rod-like portion of the maxilla were turned outward on its axis, so as to bring the alveoli nearly or quite to a vertical position, a space would apparently be left between the premaxilla and maxilla. It is not reasonable to suppose that any such space existed originally.

In view of the circumstances mentioned above, I think it is unlikely that the real form of the rostrum can be determined until additional specimens have been collected, or at least until the type specimen has been taken to pieces, so that all the surfaces of the component bones can be examined.

It should be remarked that at the anterior end of the small piece of the maxilla which bears the alveoli there is a space of 19 mm., in which it is obvious that no alveoli existed, and between this and the first alveolus which is traceable is another space of about 25 mm., in which additional alveoli may or may not have existed. In any case, the fragment in question bears the end of the series of alveoli, and, if it is properly oriented, the anterior end. As the fragment bearing the alveoli is much shorter than the rod-like portions of the maxillæ above it, this confirms to some extent Cope's assertion that the muzzle "in the greater part of its length forms an edentulous cylinder."

Measurements of the type-beak of Rhabdosteus latiradix Cope.

Total length of beak, as restored,	440 mm.
Greatest breadth of the same, as restored,	39 "
Length of longest piece of premaxilla preserved,	330 "
Length of longest piece of maxilla preserved,	277 "
Breadth of premaxilla at posterior end,	11 "
Breadth of premaxilla at anterior end	7 "
Breadth of portion of maxilla above the alveoli at posterior end,	9 "
Breadth of alveoli at anterior end,	7 "
Greatest breadth of palate between alveoli, as restored,	21 "
Length of the palatal portion of the left maxilla, which contains the alveoli,	166 "
Breadth of the same at the anterior end,	4 "
Breadth of the same at the posterior end,	4 "
Length of larger palatal fragment (left), which is internal to the preceding in the restoration,	193 "
Breadth of the same at the anterior end,	5 "
Breadth of the same at the posterior end,	16 "
Length occupied by nine alveoli,	103 "
Antero-posterior breadth of largest septum between alveoli,	5 "
Antero-posterior breadth of largest alveolus,	7 "

The "different specimen" mentioned by Cope, and figured by Mr. Case,[6] consists of two pairs of slender elongated bones, of which the outer pair represents the superior rostral portion of the maxillæ, and the inner pair the superior rostral portion of the premaxillæ. The maxillæ diverge at both anterior and posterior ends, while the premaxillæ diverge at the anterior end and converge at the posterior end. At the latter point, in the median line, is inserted a piece of bone which may represent a portion of the vomer or mesethmoid.

After examining this specimen, I am of the opinion that it is not properly put together, especially as a space is left between the maxillæ and premaxillæ proximally. The small fragment inserted between the premaxillæ does not belong in that position. It is unsymmetrical and probably represents some portion of the maxilla.

Traces of several alveoli are visible on the under side of the maxillæ, at the proximal end. That these bones are acuminate at this end is due to the fact that both the inner and outer edges are abraded. The bones should be turned outward somewhat on their axes, so that the lower free border, which is now directed outward, would be directed downward. This would bring the maxillæ into such a position that the upper surface would be horizontal proximally, very much as in *Inia*.

The two inner bones are probably premaxillæ, although at the anterior end the inner surface is plane or slightly convex rather than concave. At the middle, the inner wall is concave, with traces of a continuous longitudinal ridge. If they are really premaxillæ, they should be transposed, that on the right side being placed on the left and *vice versa*. At the same time they should be given a quarter turn on their axes, so as to make horizontal the inner surfaces which are now vertical. This would also cause the bones to diverge at the posterior end, as they do in *Inia* and most other Odontoceti, leaving space for the prenarial triangle. Their shape would then correspond closely to that of the same bones in *Inia*, except that the sides near the proximal end would be somewhat more nearly vertical.

The specimen probably represents a genus allied to *Inia*, but it is impossible without more material to determine its relationships accurately. It does not agree with any European genus of which the rostrum has been figured, nor with any American genus of which the rostrum is available for comparison.

---

[6] *Rep. Maryland Geol. Surv.*, Miocene, Pl. 15, fig. 2.

Fig. 1.—Rostrum of *Priscodelphinus* sp.? from the Miocene of Shiloh, N. J. Superior surface. (½ nat. size.)

The third rostrum (text fig. 1), which is that mentioned by Leidy in 1869 under *Priscodelphinus* (or *Tretosphys*) *grandævus*,[7] and also figured by Mr. Case,[8] has, as already mentioned, no close relationship with the other two. It may for the present be considered as representing a species of *Priscodelphinus*, although, as explained in a previous paper,[9] the reasons for referring it to that genus are not satisfactory.

The principal peculiarities of the rostrum are that the premaxillæ are much depressed, but not narrowed, anteriorly, that the anterior alveoli are larger than the posterior ones and directed forward, and that the external free border of the maxillæ is rounded (see text figs. 2 and 3).

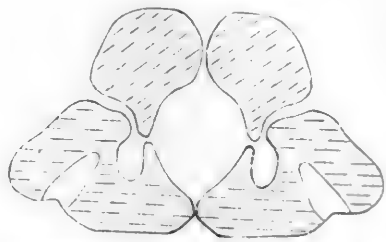


Fig. 2.—Transverse section of the same at the posterior end. (Nat. size.)

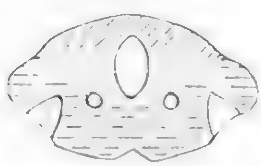


Fig. 3.—Transverse section of the same at the anterior end. (Nat. size.) In figs. 2 and 3 the maxillæ are indicated by horizontal lines and the premaxillæ by oblique lines

The three teeth which were provisionally referred to *Rhabdosteus* by Cope are preserved in the Academy of Natural Sciences of Philadelphia, and were examined by me in 1907. Very good figures of the largest one were published by Cope

[7] *Journ. Acad. Nat. Sci. Phila.*, Ser. 2, Vol. 7, 1869, p. 434.
[8] *Rep. Maryland Geol. Surv.*, Miocene, Pl. 15, fig. 1.
[9] *Smithsonian Misc. Colls.*, Quarterly Issue, 50, Pt. 4, No. 1782, p. 451, January 27, 1908.

in 1890.[10] This tooth and one other are blackish in color, while the third tooth is yellowish. The last mentioned is 21 mm. long, and that figured by Cope 23 mm.

As mentioned by Cope, both crown and root are compressed, the former at right angles to the latter.[11] This form of tooth occurs in *Stenodelphis* and in some genera of *Delphinidæ*. The crown is slightly recurved. The base of the crown is somewhat convex, both internally and externally, and is marked off from the root by a distinct constriction, due in part, no doubt, to wear.

Teeth similar to these in size and form, from Baltringen, Würtemberg, Germany, were described and figured by Dr. J. Probst in 1886,[12] under the name of *Schizodelphis canaliculatus* H. von Meyer. This species is considered identical with *S. sulcatus* by Dr. Abel, but the teeth of the latter, figured by Dal Piaz,[13] are certainly different, as regards the shape of the crown and the direction of its compression, from those figured by Probst. Even with allowance for variation, it seems to me probable that they may represent two different species of the genus *Schizodelphis*. The principal difference between the teeth assigned to *Rhabdosteus* and those figured by Probst is that the crown is shorter in the former.

On the whole, it seems probable that the teeth described by Cope belong to the genus *Schizodelphis*, but this is not a sufficient reason for considering *Rhabdosteus* synonymous with *Schizodelphis*, especially in view of the fact that it is uncertain whether the teeth have any direct connection with the type rostrum of *Rhabdosteus*. The most that can be said is that the alveoli of *Rhabdosteus* indicate that the teeth had flattened roots of the same size as those of the teeth which Cope assigned to that genus.

Explanation of Plate VI.

Plate VI.—Fig. 1.—Type specimen of *Rhabdosteus latiradix* Cope. Superior surface. Scale $\frac{1}{25}$.

Fig. 2.—The same. Left side. Scale $\frac{1}{25}$.

Fig. 3.—The same. Inferior surface. Scale $\frac{1}{25}$.

[10] *Amer. Nat.*, 1890, p. 607, fig. 4 (2, 2*a*, 2*b*).

[11] That the anterior and posterior surfaces of the crown are flat is not due to wear.

[12] *Jahreshefte Ver. Vaterländ. Naturkunde Württemberg*, 42, 1886, Pl. 3, figs. 11–14.

[13] *Palæont. Ital.*, 9, Pl. 31, figs. 6–28.

March 3.

Arthur Erwin Brown, Sc.D., Vice-President, in the Chair.

Sixty-four persons present.

The reception of a paper entitled "New Land and Fresh-water Mollusca of the Japanese Empire," by H. A. Pilsbry and Y. Hirase (February 28), was reported.

Dr. John W. Harshberger made a communication on his dendrological studies in Italy, with special reference to the influence of vegetation on the building up of the islands on which Venice is placed, and on the condition of the timber foundations of the Campanile as revealed at the time of its fall. (No abstract.)

March 17.

Arthur Erwin Brown, Sc.D., Vice-President, in the Chair.

Fifty-nine persons present.

The Publication Committee reported the reception of a paper entitled "New Land Shells from the Chinese Empire—I," by H. A. Pilsbry and Y. Hirase (March 11).

E. G. Conklin, Ph.D., made a communication on some phenomena and causes of heredity. (No abstract.)

The following were ordered to be published:

NEW LAND AND FRESH-WATER MOLLUSCA OF THE JAPANESE EMPIRE.

BY H. A. PILSBRY AND Y. HIRASE.

Among other new forms noticed below, the first *Pisidium* from Japan is described. It is from the island of Yesso, where the palæarctic element is much better represented than in other parts of the Empire.

FORMOSAN SPECIES.

Cyclophorus formosaensis Nevill.

This is apparently confined, in its typical form, to northern Formosa. Numerous specimens from Hōōzan, Ensuiko, Sammaipo and Hotawa —places all in the interior below the middle of the island—differ by having a strong keel at the periphery, and may be known as *C. f. interioris* n. subsp., Sammaipo being type locality. It is this form which we formerly listed as *C. turgidus* Pfr. from Hotawa (*Proc. Acad. Nat. Sci. Phila.*, 1905, p. 722). It differs from *C. turgidus* in the very much smaller central nipple or mucro on the inside of the operculum. The shells are practically indistinguishable. Our former opinion that *C. formosaensis* is a variety of *C. turgidus* must be retracted. We doubt whether *C. turgidus* occurs in Formosa. The species of this group of Cyclophori stand very close, and their differences are not of much importance, yet the areas occupied by the several slightly differentiated races are mainly different.

Cyclophorus friesianus Mlldff.

This species has been found at Tapanii, Formosa, the specimens agreeing well with the original description except by their smaller size, alt. 19, diam. 22 mm. It differs from *C. formosaensis interioris* only in having numerous low spiral ridges above and below the peripheral keels. The operculum is like that of *formosaensis*, evenly convex inside with a very small central nipple.

SPECIES OF JAPAN AND THE RYUKYU ISLANDS.

Cyclotus tanegashimanus n. sp.

Shell very similar to *C. campanulatus* Marts., but if specimens of the same size are compared, *tanegashimanus* is seen to have the umbilicus a trifle larger and the aperture just perceptibly smaller; the lip is less expanded. The operculum is *distinctly convex externally*, and *much* *more deeply concave inside*, than that of *C. campanulatus*. The edge is bevelled and flat between projecting outer and inner laminæ.

Alt. 8.5, diam. 12.2 mm.; whorls $4\frac{1}{2}$.
" 7.1 " 10 " " $4\frac{1}{2}$.

Tanega-shima, Ōsumi. Types No. 94,711 A. N. S. P., from No. 54*b* of Mr. Hirase's collection.

The Cycloti of this group, represented in Japan by *C. campanulatus*, and in China by *C. stenomphalus* and its allies, are very similar in shape and color. The form described above is well distinguished by its externally convex operculum, that of *C. campanulatus* being flat outside and much less concave within.

Spiropoma yakushimanum n. sp.

The shell is depressed, very openly umbilicate, solid, yellowish-olivaceous, somewhat brownish on the last whorl, the cuticle much paler or usually wanting on the inner whorls. Surface glossy where unworn, marked with growth-lines and very indistinct traces of spiral striæ. Whorls fully $4\frac{1}{2}$, quite convex, the first one projecting a little; last whorl tubular, very convex at the base, deeply descending in front. Aperture oblique, longer than wide. Peristome contracted, being thickened within and shortly built forward; obtuse, whitish. It is thickened in the posterior angle, but usually has a small notch there. The columellar margin recedes rather conspicuously. The short parietal margin is thick and straight.

Alt. 7.3, diam. 12.5, alt. of aperture including peristome 5.3, width 4.7 mm.

Alt. 6.3, diam. 11.5 mm.

The operculum is conic, composed of $7\frac{1}{2}$ flat whorls separated by a narrow ledge with raised outer edge, producing a narrow spiral channel along the suture; summit obtuse.

Yaku-shima, Ōsumi. Types No. 94,716 A. N. S. P., from No. 1,447 of Mr. Hirase's collection.

Compared with *S. japonicum* (A. Ad.), this form differs in the more descending last whorl, the deeper umbilicus and more excised or receding columellar lip. The aperture is longer than wide in *yakushimanum*, nearly round in *japonicum*. It is perhaps more closely related to *S. nakadai* of Tanega-shima, a smaller shell with an operculum of fewer whorls, but having an aperture much as in *S. yakushimanum*.

Diplommatina gotoensis n. sp.

Closely related to *D. cassa*, but with longer conical spire, rapidly tapering and conic above the penultimate whorl, which is the largest;

pale reddish or yellowish-corneous; very finely and evenly striate throughout. Constriction in the middle in front. Last whorl smaller, only moderately ascending to the aperture. Aperture subcircular, the outer lip reflexed, duplicate, the two laminæ close together, a narrow opaque whitish streak just behind the reflection; indistinctly angular at the base of the columellar lip. Parietal callus thin with low, thread-like edge, not very distinct, and rising to the middle of the front of the penultimate whorl. Columellar lamella horizontal, thin, rather long. Palatal plica quite short and situated wholly to the left of the parietal callus. Inside, the columellar lamella is evenly high and thin throughout. Internal parietal lamella low and rather long.

Length 3, diam. 1.5 mm.; whorls 6½.
" 2.7, " 1.3 " " 6½.

Goto, Hizen. Types No. 84,905 A. N. S. P., from No. 604*b* of Mr. Hirase's collection.

This species resembles *D. nipponensis* Mlldff. in shape and sculpture, but differs by the position of the constriction, which is median in *gotoensis*, above the termination of the outer lip in *nipponensis*. In the latter species the palatal plica lies under the parietal callus. *D. cassa* is a more cylindric species, the cone of the spire shorter. *D. kyushuensis* Pils. and Hir., a widely distributed species in Kyushu, is closely related to *D. gotoensis*, but it has a palatal plica about twice as long, and the columellar lamella is much stronger near its inner termination than near the aperture, while in *D. gotoensis* it is about equally strong throughout.

Eulota (Plectotropis) lepidophora scutifera P. and H., n. subsp.

The shell closely resembles *E. lepidophora tenuis* Gude, but differs by its more convex whorls and consequently deeper sutures. The periphery is often a little less angular than in *tenuis*. Surface, when unworn, copiously covered with triangular cuticular scales.

Alt. 4.3, diam. 8.7 mm.; whorls 5½.
" 4, " 7.3 " " 5¼.

Iheyajima, Ryukyu group. Types No. 94,705 A. N. S. P., from No. 1,290*b* of Mr. Hirase's collection.

Eulota (Aegista) celsa P. and H., n. sp.

The shell is convexly conic, deeply umbilicate, the umbilicus cylindric, well-like, the periphery obtusely angular. Surface lusterless, chestnut brown, finely but not strongly striate on the upper surface, the striæ indistinct at the base; on the last part of the last whorl near the aperture the striæ are partially interrupted into long granules. The spire has convex outlines and an obtuse apex. Whorls 6⅓, convex, very slowly widening, the last one very slowly and slightly descending, indistinctly angular at the periphery in front, becoming rounded on the last half. The aperture is quite oblique, very much larger than the umbilicus. Peristome thin; outer margin only very slightly expanded; basal margin deeply arcuate, slightly expanded; columellar margin broadly, triangularly dilated. The terminations of the lip are widely separated, parietal callus very thin.

Alt. 10.5, diam. 12 mm.; alt. and width of aperture 6 mm.; width of umbilicus 3 mm.

South Nishigo, Uzen. Type No. 94,740 A. N. S. P., from No. 1,438 of Mr. Hirase's collection.

This peculiar *Aegista* has some superficial resemblance to *Trishoplita hilgendorfi* Kob. It is closely related to *E. eminens* P. and H., but differs in being larger, stronger, with less scaly sculpture, and a little less strongly angular. It is quite possible that intermediate provinces between Shima and Uzen will be found to have connecting links between *E. eminens* and *E. celsa*; yet at present they seem to be sufficiently distinct.

The type specimen is higher than others in the type lot. The lower ones have less convex outlines, the spire being less convexly conic; the last two whorls have sculpture of long granules in places; and the umbilicus is much wider than in the type. Alt. 9, diam. 13.8 mm.; aperture 6 x 6 mm.; umbilicus 3.5 mm. wide (*celsus*, lofty).

Ena reiniana vasta n. subsp.

Shell very large, cylindric. The cuticle is glossy, yellowish brown, and copiously granulose except on 3 or 4 earliest whorls; but many old shells have lost the cuticle and sculpture in part or wholly. Whorls 8 to 9½.

Length	37.5,	diam.	above	aperture	11	mm.
"	35	"	"	"	10.8	"
"	32.5	"	"	"	11.2	"

S. Nishigō, Uzen. Types No. 94,686 A. N. S. P., from No. 1,439 of Mr. Hirase's collection.

This is the largest of the Japanese Bulimini. It is larger than *Ena reiniana omiensis*, and copiously granular when unworn.

Ena reiniana ugoensis n. subsp.

Shell very short and obese, reddish on the spire, whitish on the last whorl, under a thin yellow cuticle; granulation only weakly developed. Whorls 7½.

Length	26,	diam. above aperture 10,	length of aperture 10	mm.
"	23,	" " " 10,	" " 9.2	"

Kitaura (Cape of Ojika), Ugo. Types No. 94,738 A. N. S. P., from No. 1,444 of Mr. Hirase's collection.

The obese shape, length about 2½ times the diameter, is the chief character of this local race.

Pythia pachyodon n. sp.

This species of the *scarabæus* group is nearly uniform blackish olive, but with a blackish band below the suture and sometimes with more or less brown suffusion. The surface is rather finely wrinkle-striate, with some widely spaced spiral lines. Spire angular on both sides, with whitish streaks in front of the angle. Whorls 10. Base perforate or umbilicate. Aperture with two stout parietal teeth and a strong columellar lamella. Teeth in the outer margin irregular, three larger, with two or three minute ones.

Length 30.6, greatest diam. 18.5, antero-posterior diam. 13.5 mm.; length of aperture 18.5 mm.

Loochoo (Okinawa) and Ōshima, in the Ryukyu Islands. Types No. 87,537 A. N. S. P., from Mr. Hirase.

Pythia ægialitis n. sp.

The shell is similar to *P. pachyodon*, but is copiously mottled with dark brown on a pale corneous-yellowish ground; the markings sometimes partially obscured when the surface is superficially worn. Teeth of the inner margin as in *P. pachyodon*; three teeth in the outer lip.

Length 25.3, greatest diam. 15.6, antero-posterior diam. 11, length of aperture 16.7 mm.

Loochoo (Okinawa) and Ōshima, Ryukyu Islands.

The specimens from Ōshima are somewhat longer and comparatively less wide than those from Loochoo Island.

While closely related to the *P. scarabæus* group, which is composed of very poorly characterized species, yet the two Ryukyuan forms do not exactly agree with any of them, and it may be well to have definite designations for them.

Besides these forms, *P. cecillei* Phil. has been found by Mr. Hirase at Hirado, Hizen, and *P. nana* Bavay was described from specimens taken at Loochoo.

Pisidium japonicum n. sp. Fig. 1.

The shell is subglobose, rounded-oval, with large, very wide, moderately projecting rounded beaks; surface glossy, very finely, irregularly striate; cuticle light yellow; valves very convex, not very inequipartite.

both ends rounded, the posterior shorter and wider. Hinge very short, the lateral teeth short and wide, rather near together, stout but low,

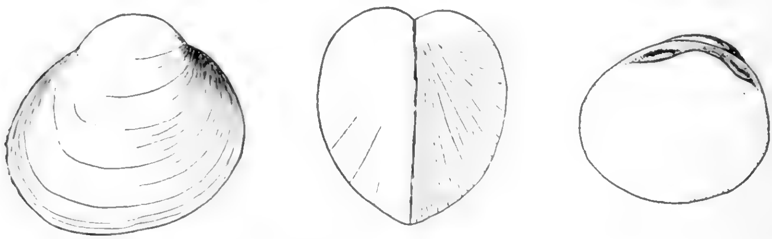


Fig. 1.—*Pisidium japonicum*, lateral, posterior and interior views.

only the anterior one projecting above the level of the valve. Cardinal teeth minute, almost obsolete, narrow, very low and somewhat elongate.

Length 2.37, alt. 2.16, diam. 1.87 mm.

Akkeshi, Kushiro, Yesso. Types No. 94,744 A. N. S. P., from No. 181 of Mr. Hirase's collection.

This is the first *Pisidium* to be described from Japan. It is a very small species, unusually globose, with very large full beaks.

NEW LAND SHELLS OF THE CHINESE EMPIRE—I.

BY H. A. PILSBRY AND Y. HIRASE.

The following species were collected by Mr. Nakada in the course of several months' work, chiefly in the north. A more ample report will be published later. Working chiefly in the densely populated northeastern provinces and not far from the coast, the number of species taken was naturally not great, though some, such as *Vallonia patens* Reinh., *Eulota? munieriana* Cr. & Deb., etc., are forms hitherto but little known. Around Soochow and Hangchow a fauna richer in *Clausiliæ*, Helices and *Cyclophoridæ* was encountered, most of the species in this region being among those described by Père Heude and earlier naturalists.

DIPLOMMATINIDÆ.

Diplommatina hangchowensis n. sp. Fig. 1.

The shell is short, cylindric, the summit shortly conic, base rounded; corneous or pale brownish, somewhat translucent, the upper part whitish or pale red. Whorls 5½, very convex. The first whorl is smooth; following whorls are very finely and delicately rib-striate; on the penultimate whorl the ribs are much weaker, and the last whorl is smooth. In back view the penultimate whorl is largest, the last whorl much smaller and quite glossy, ascending a little near its end, and constricted in front, above the columella. A short palatal plica shows through, just left of the parietal callus. The aperture is nearly circular. The peristome is expanded and thickened, with a flat face and inconspicuous inner rim; at the base of the columella it is very indistinctly angular; it is interrupted above, the margins joined by a thin parietal callus, with thin adnate edge. Columellar lamella well developed.

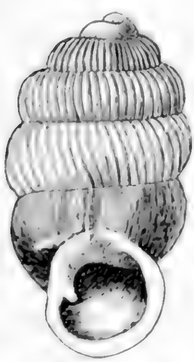


Fig. 1.—*Diplommatina hangchowensis.*

Length 2.4, diam. 1.3 mm., alt. of aperture 0.95 mm.

Hangchow, province of Che-kiang, China. Types No. 94,748 A. N. S. P., from No. 1,479*a* of Mr. Hirase's collection.

This species of the section *Sinica* is smaller than *D. paxillus* Gredler, and differs by its smooth last whorl and very short palatal plica. It is more related to *D. hungerfordiana* of Formosa, which differs in shape. *D. schmackeri* Mlldff. is unlike *hangchowensis* by the shape of the aperture.

A variety also from Hangchow may be called *D. hangchowensis granum.* It is larger, length 2.7, diam. 1.5 mm., with 6 whorls and pale reddish-corneous color. The cone of the spire is longer than in *D. hangchowensis.*

HYDROCENIDÆ.

The genus *Georissa* is represented by six species in China: *G. bachmanni* Gredl., *G. sinensis* Hde., *G. nivea* Hde., *G. sulcata* Mlldff., *hungerfordiana* Mlldff., and *G. heudei* P. & H. In all of these except *sinensis* and *heudei* the glossy, flat operculum is retracted some distance in the aperture, This is the normal condition in *Georissa.*

In *G. sinensis* and *G. heudei* the thick, calcareous operculum lodges at the edge of the peristome, as in *Bithynia*, being larger than in *Georissa* proper. We propose to signalize this feature by the erection of a new subgenus *Georissopsis*, the type being *G. heudei.*

Georissa (Georissopsis) heudei n. sp. Fig. 2.

The shell is minutely perforate or subperforate, conic, higher than wide, gray, more or less reddish in places, sculptured with very fine, close spiral striæ, usually in large part lost by erosion. There are 3½ to 3¾ whorls, the first corneous and glossy, the rest very convex, separated by deep sutures. The aperture is subvertical, broadly semicircular, the outer margin very convex, inner margin nearly straight; the basal margin is very broadly rounded, the upper end narrowly rounded. The peristome is thin, acute; the inner lip is built forward, standing free from the whorl except for a short space near the posterior end, leaving an umbilical area.

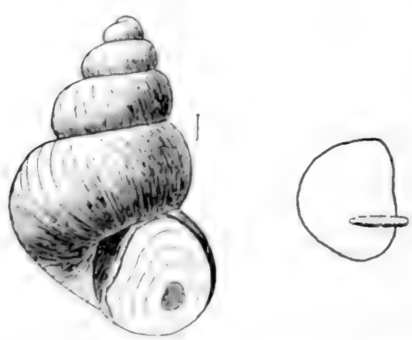


Fig. 2.—*G. heudei* and outline of operculum, interior view.

Length 3.4, diam. 2.1 mm.

The operculum lodges at the lip-edge. It is between triangular and semicircular in shape, calcareous, thick, white, with a dark nuclear dot *nearer the outer border;* around this it has concentric growth-lines. The inner face is concave. Near the lower third a stout rib arises about the middle of the width, running to the columellar border where it projects as a short point.

Hangchow, province Che-kiang, China. Types No. 94,745 A. N. S. P., from No. 1,477 of Mr. Hirase's collection.

This species is very similar to *G. sinensis* (Hde.) in characters of the shell, but it differs in the operculum, which is figured as with subcentral nucleus in *G. sinensis,* while in *G. heudei* the nucleus is near the outer border. We have no reason to doubt the accuracy of Heude's figure. It was drawn by Rathouis, whose faithful drawings have probably never been surpassed. Unfortunately Père Heude, who described *G. sinensis* as a *Realia,* did not describe the operculum, merely saying that "l'opercule est celui du genre."

Some specimens from Changyang, received as *G. sinensis,* are much smaller than Père Heude's type. They have a dark, subcentral nuclear dot.

G. heudei occurred at Hangchow with the much smaller *G. bachmanni* Gredl.

HELICIDÆ.

Eulota læva P. and H., n. sp.

The shell is *sinistral,* depressed-globose with conic spire, narrowly half-covered umbilicate, thin, light corneous-yellow. Surface glossy, smooth to the eye, but under a lens it is seen to have very weak, faint growth-lines, the last two whorls *densely, minutely granular,* the granu-

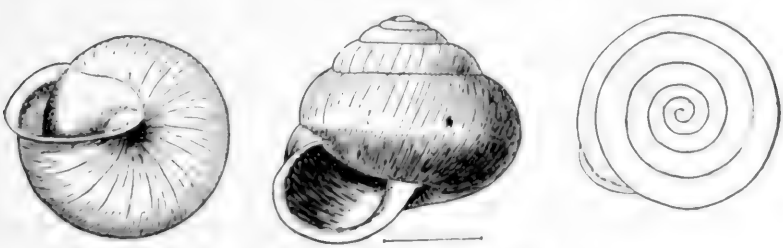


Fig. 3.—*E. læva*, basal, front and dorsal views.

lation weak on the upper surface, more distinct on the base; there are also some weak traces of a few coarse, impressed spirals on the last whorl. The spire is conic with slightly convex outlines and obtuse apex. Whorls 5½, slowly increasing convex, the last descending a little to the aperture and indistinctly angular in front, the base very convex. The aperture is quite oblique, the upper and baso-columellar margins about equally arcuate, the outer arc more strongly curved. The peristome is thin, narrowly but well expanded, the baso-columellar margin reflexed, somewhat dilated towards the columellar insertion.

Alt. 12.5, diam. 13.8 mm.; aperture 7.5 mm. high, 8 wide.

Hangchow, province Che-kiang, China. Type No. 94,739, A. N. S. P., from No. 1,475 of Mr. Hirase's collection.

This is a more compact shell than *Eulota fortunei* and quite different in sculpture. The generic position is uncertain, until the soft anatomy can be examined. It may belong to the section *Eulotella*, or it may be a *Ganesella*. The minute granulation is like some species of the *G. japonica* group. We do not know of any sinistral *Ganesella*, but there are many sinistral species of *Eulota*.

Dead and bleached shells which have lost the cuticle do not show the granulation described above. The largest example seen measures, alt. 12, diam. 16.5 mm. It is a dead shell.

Eulota (Plectotropis) scitula P. and H., n. sp. Fig. 4.

The shell is rather narrowly umbilicate, conic above, convex below, strongly angular at the periphery; uniform chestnut brown. The surface is rather dull, finely closely and rather weakly marked with growth-striæ, which in quite fresh, unworn shells bear short adnate cuticular threads on the base, giving it a sparsely scaly appearance. The last two whorls have also a very close, fine sculpture of beautifully even spiral

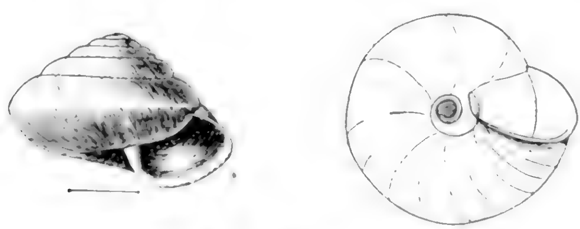


Fig. 4.—*Eulota (Plectotropis) scitula.*

striæ. The outlines of the conic spire are nearly straight. Whorls $6\frac{1}{3}$, slowly increasing, moderately convex, the last descending very little or not at all in front, convex beneath. The aperture is strongly oblique, rounded lunate. Peristome thin, narrowly but distinctly expanded, the basocolumellar margins a little reflexed, dilated towards the columellar insertion; ends widely separated, joined by a thin film.

Alt. 6.5, diam. 9.2 mm.; aperture alt. 4, width 4.6 mm.; umbilicus 1.7 mm. wide.

Alt. 6.5, diam. 9 mm.

Hangchow, province Che-kiang, China. Types No. 94,741 A. N. S. P., from No. 1,471 of Mr. Hirase's collection.

A small, beautifully sculptured shell, which we are unable to identify with any of Père Heude's species from the lower Yangtse valley. It has some resemblance to *E. inornata* and belongs to a group of thin, dull species with the shell spirally engraved, cuticular scales small or wanting, and usually with no peripheral fringe. Other species of this group are *E. osbecki, inornata, hachijoensis, fulvicans, lautsi, micra, perplexa, inrinensis, hebes*, etc.

Chloritis impotens P. and H., n. sp. Fig. 5.

Shell depressed-globose, narrowly umbilicate, thin and fragile, corneous-brown. The surface has a somewhat silky sheen, and under the lens is seen to be densely set with small granules, which are long in the direction of growth-lines, and arranged in oblique, forwardly descending rows, though this arrangement is not everywhere visible, being in part or wholly lost near the mouth. This granular sculpture extends almost to the apex, only the initial half whorl or less being smoothish, though not glossy. On the last two whorls the granules

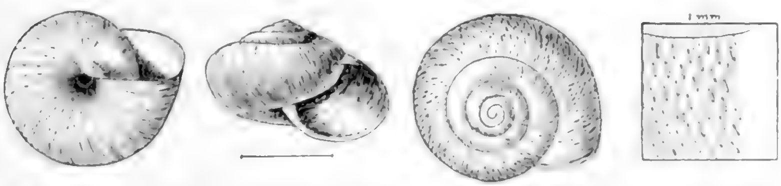


Fig. 5.—*C. impotens*, basal, front and dorsal views, and sculpture of last whorl below suture.

bear short cuticular appendages in fresh, unworn shells, such as are often present in *Ægista* and *Plectotropis*. The spire is low-conic. Whorls 5, convex, at first slowly increasing, the last one abruptly becoming much wider, about twice the width of the preceding, not noticeably descending in front, rounded at the periphery. The aperture is rounded-lunate, moderately oblique. Peristome thin throughout, the outer and basal margins very slightly expanded, columellar margin broadly, triangularly dilated, half covering the umbilicus.

Alt. 8.7, diam. 12.6 mm.; alt. aperture 6.5, width 7.5 mm.

Chifoo, province Pe-chili, China. Types No. 94,742 A. N. S. P., from No. 1,468 of Mr. Hirase's collection.

A thin, fragile shell, with large aperture and densely, minutely granose-scaly sculpture. In fully adult shells the granulation is more or less worn from the apical and early whorls, and on the last whorl the long granules appear to be glossy, but hardly if at all raised above the dull surface. The generic position of this snail is uncertain, but it has the shell characters of *Trichochloritis* rather than of any group known anatomically to belong to *Eulota*.

PUPILLIDÆ.

Hypselostoma (Boysidia) hangchowensis P. and H., n. sp.

The shell is high-conic, with obtuse apex and convex base, minutely perforate, with a long curved umbilical rimation, dark brown. The spire is straightly conic, composed of 5½ convex whorls. The last whorl ascends slowly to the aperture, its latter part being straightened and built forward to the level of the ventral face of the shell. There is no crest or marked constriction behind the lip. The aperture is truncate-oval, the upper margin straight. Peristome thin, well expanded, continuous; with a shallow dent outside at the upper third of the outer lip. The angular and parietal lamellæ are concrescent into one stout straight lamella reaching to the margin, wider in the middle of its length, where it shows traces of its dual composition. The columellar lamella is strong, slopes obliquely downward as it enters, and the outer end reaches to, but not upon, the expansion of the lip. There are two short palatal plicæ, the lower one somewhat more deeply placed.

Fig. 6.—*H. hangchowensis.*

Alt. 2.9, diam. 1.8 mm.; largest axis of aperture 1.3 mm.

Hangchow, province Che-kiang, China. Type No. 94,743 A. N. S. P., from Mr. Hirase.

Compared with *H. (Boysidia) hunana* Gredler, this is a much smaller shell, with only two palatal plicæ instead of three, and the angulo-parietal lamella is less distinctly bifid, as seen in an obliquely basal view. It is not closely related to other described species.

H. hangchowensis was found with *Bifidaria (Bensonella) plicidens* (Bens.), a species not before reported from China, but found in the Ryukyu Islands, as well as in subhimalayan India.

H. hunana as described and figured by Gredler has the last whorl built forward, carrying the aperture free from the preceding whorl. We have not seen this form; the specimens of *hunana* before us, while agreeing with Gredler's description in other characters, do not have the last whorl free in front, though the peristome is continuous. They are like Père Heude's figures of *hunana*. Dr. von Möllendorff has unnecessarily altered the name *hunana* to *hunanensis*.

We share with Gredler the opinion that *Boysidia* is a section or subgenus of *Hypselostoma* rather than a distinct genus.

April 7.

Arthur Erwin Brown, Sc.D., in the Chair.

Thirty-seven persons present.

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

"Description of a new Species of Squaloid Shark," by Chiyomatsu Ishikawa, Ph.D. (March 18, 1908).

"Notes on *Succinea ovalis* Say and *S. obliqua* Say," by H. A. Pilsbry (March 21).

"Animal Names and Anatomical Terms of the Goshute Indians," by Ralph V. Chamberlain (March 28).

"Notes on Sharks," by Henry W. Fowler (March 28).

"Generic Types of Nearctic Reptilia and Amphibia," by Arthur Erwin Brown (April 7).

The death of Henry Clifton Sorby, a correspondent, March 9, was reported.

Dr. Henry W. Cattell made a communication on Trypanosomiasis in man and animals. (No abstract.)

April 21.

Arthur Erwin Brown, Sc.D., in the Chair.

Twenty-eight persons present.

The Publication Committee reported that papers under the following titles had been presented for publication:

"On the Classification of Scalpilliform Barnacles," by Henry A. Pilsbry (April 21).

The death of James M. Ridings, a member, March 7, was announced.

Mr. Harold Sellers Colton made a communication on Charles Wilson Peale and the Philadelphia Museum. (No abstract.)

Henry H. Donaldson, M.D., was elected a member.

The following were ordered to be printed:

NOTES ON SUCCINEA OVALIS Say AND S. OBLIQUA Say.

BY HENRY A. PILSBRY.

Since Gould's publication on the Succineas of Massachusetts in 1841, there has been more or less confusion as to the identity of *Succinea ovalis* Say. The facts in the case were pointed out by Dr. Binney in 1851, but unfortunately a faulty manner of correcting Gould's mistake was adopted, resulting in two errors of nomenclature in place of one. Some years ago the writer rectified the current usage, restoring Say's name *ovalis* to its original significance. This correction has been accepted by many recent writers, but there are a few conspicuous exceptions; hence it seems necessary, in the interest of uniform nomenclature, to demonstrate the status of *S. ovalis* by giving its history somewhat fully.

Observations on the mantle-markings of *Succinea*, made in New York several years ago, also find place here. These color markings are shown to be highly variable among individuals of a single colony, yet the general pattern differs to a greater or less extent in different species. The subject is worth further investigation, both from the standpoint of variation and also systematically, as an aid in distinguishing species in this difficult genus.

Succinea ovalis Say.

The actual type or types of *Succinea ovalis* Say are no longer in existence; but three specimens labelled and mounted on a card by Say are extant, representing what he subsequently considered to be *S. ovalis*. The original description must have been drawn from immature individuals, the measurements, "length nine-twentieths of an inch, aperture seven-twentieths," being only about two-thirds to three-fourths the ordinary size attained around Philadelphia. *The proportion of aperture to length given by Say agrees with specimens I have measured, but with no other Succinea of this region.* This common Philadelphian snail, still living in Fairmount Park, is indistinguishable from what Lea subsequently described from Newport, R. I., as *S. totteniana*.

In the *Tableau Systématique de la Famille des Limaçons*, p. 26 (1821), Férussac records *Succinea ovalis* Say as communicated to him by Say, and figured on plate XIA, fig. 1 of the *Histoire*, etc., which was issued in 1822. The two figures given represent the form now commonly known as "*S. totteniana*" (but properly called *S. ovalis* Say), and still found around Philadelphia. These figures agree perfectly with the specimens labelled by Say in the collection of the Academy. On the same plate Férussac figures larger forms ("*S. obliqua*" of authors) as varieties of *S. putris* (figs. 7, 8). He also figures large *ovalis* (*totteniana*) from "the islands Miquelon and Saint Pierre, near Newfoundland" (fig. 9).

The species *S. ovalis* was therefore very well figured by Férussac, from author's specimens, prior to Say's description of *S. obliqua*; and there was but scant excuse for mistaking it, except that but few American workers possessed the large and expensive *Histoire naturelle générale et particulière des Mollusques terrestres et fluviatiles.*

Beck, 1837, and other early European writers accepted the species, referring to Férussac's figures.

Succinea ovalis was correctly recognized also by various early American writers for the form later known as *totteniana*. See DeKay's *New York Fauna, Mollusca*, p. 53, Pl. 4, figs. 51, 52. It was Gould who by error shifted the names, in the first edition of the *Invertebrata of Massachusetts* (1841). He recognized three Succineas in that State:

S. ovalis, fig. 125 [= *S. retusa* Lea].

S. campestris, fig. 126 [= *S. ovalis* Say = *totteniana* Lea].

S. avara, fig. 127 [correctly identified].

Gould subsequently recognized his two mistakes, and finding that the names *S. ovalis* Say, *obliqua* Say and *campestris* Gould, not Say, all applied to one species, he proposed to retain the name *obliqua* for it, and to use "*S. ovalis* Gld. not Say" for *S. retusa*, the snail he had figured in error as Say's *ovalis*.

DeKay, C. B. Adams and Sager, who used Gould's work, were in some measure misled, especially in regard to *S. campestris*. DeKay (1843), as mentioned above, correctly identified *S. ovalis*.

In 1851 Dr. Amos Binney lucidly discussed the American Succineas in Vol. II of the *Terrestrial Mollusks*, pp. 63, 64. His exposition of the history of *S. ovalis* Say leaves little to be desired, and may well be quoted here:

"*Succinea ovalis* Say.—This species, diffused universally in the middle and northern States of the Union, is that which is described in the works of Messrs. Gould, Mighels, Kirtland and Sager as *Succinea campestris* Say. It varies much in size, and in the divergence of the last whorl from the axis of the shell, and this last variation when strongly developed constitutes *Succinea obliqua* Say. *Succinea ovalis* of Messrs. Gould, Adams, Mighels and Sager is *not* the *ovalis* of Say, but a species which was unknown to him. As, however, the *ovalis* of Gould is that now most commonly known under the name of *Succinea ovalis*, we propose to retain it, and to apply to Mr. Say's species his second name, *obliqua*."

Fig. 1.—Tablet bearing *Succinea ovalis*, mounted and labelled by Thomas Say. Nat. size.

Fig. 2.—Say's tablet of *Succinea obliqua*. Nat. size.

The tablet of three specimens of *S. ovalis* labelled by Say is photographed, fig. 1. A series of modern specimens from Fairmount Park is shown, fig. 3. These show a considerable amount of variation in contour, some being as long as Say's types of *S. obliqua*, shown in fig. 2. Philadelphian examples do not attain a large size, rarely exceeding 16 or 18 mm. in length. It is a region of crystalline metamorphic rock, deficient in lime, where the land shells generally run under the size usual in New York or the West. The color is yellowish green, and the shell very thin.

This type of shell is widely distributed, from Ontario to the mountains of North Carolina and west to Minnesota and Missouri.

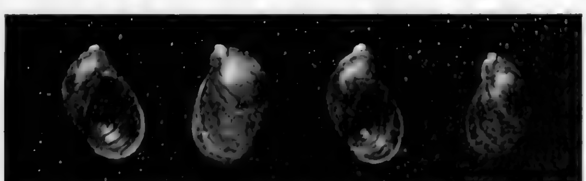


Fig. 3.—*Succinea ovalis* Say. Fairmount Park, Philadelphia. Nat. size.

In the examples of *S. ovalis* taken at Chittenango Falls the upper part of the spire in living animals is whitish with a papery appearance, the last whorl is pale buff, becoming olivaceous and dusky over the lung. This is in some examples more or less obscured by a gray network, marked with some black blotches, but in others there is a pattern of black streaks very much like that of *S. ovalis chittenangensis*. See Pl. VII, figs. 9, 10, 11, (No. 90,084, 90,085 A. N. S. P.)

Succinea obliqua Say, 1824, also was described from Philadelphia, two cotypes mounted on the cards used by Say, and inscribed with his autograph label, being still preserved. They are photographed in fig. 2. These specimens have the spire longer than in *ovalis*, the suture more oblique, but are otherwise very similar. They are greenish-yellow, though not quite so green as *ovalis*, and the abundant series of other Philadelphian specimens before me leaves no doubt that they intergrade perfectly with Philadelphian *ovalis*. It will not, I think, be possible to use the name *obliqua* in a varietal or subspecific sense, though it might be used to indicate the elongate phase or form which the species often assumes, if a name for that be desired.[1] It must be understood, however, that the longer phase occurs with the shorter typical *ovalis*, and is fully connected therewith by intermediate individuals in the same colonies.

The synonyms of *S. ovalis*, and early references thereto discussed above, here follow:

Succinea ovalis Say, Journ. A. N. S. Phila. I, 1817, p. 15. Férussac, Tabl. Syst., 1821, p. 26; Hist. Nat. Moll. Terr., Pl. XIA, fig. 1 (not *S. ovalis* Gould).

Succinea obliqua Say, Major Long's Second Exped., II, 1824, 260, Pl. 15, fig. 7. DeKay, New York Fauna, Moll., p. 53, Pl. 4, fig. 53. Binney, Terrestr. Moll., II, p. 69.

Succinea campestris Gould, Invert. of Mass., 1841, p. 195, fig. 126. DeKay, New York Fauna, Moll., p. 53, Pl. 4, fig. 54 (not *S. campestris* Say).

Succinea totteniana Lea, Proc. Am. Philos. Soc., II, 1841, p. 32.

Succinea ovalis optima n. subsp. Fig. 4.

In many localities from New York to Minnesota and Iowa a form much more robust than typical *ovalis* is found. The shell has coarser wrinkle sculpture, and yellow predominates rather than green. The contour is about that of the larger examples of *ovalis* (such as those Say called *S. obliqua*), but varies to nearly or quite as broad as typical *ovalis*. The suture is deep, and at the last whorl oblique. The largest specimens I have seen are from the type locality, Crugers Valley, near Upper Red Hook, Duchess Co., N. Y., collected by Mr. W. S. Teator. Two of them measure:

[1] *S. greeri* Tryon has been quoted as a synonym of *S. obliqua*, but it is certainly distinct from that species.

Length	26,	diam.	16,	length of aperture		18	mm.	
"	25	"	13.5	"	"	17.5	"	

This size is not often reached. In the middle West a length of 20 mm. is near the maximum, and the size of some individuals which seem to be adult is not greater than the largest of the typical form of *S. ovalis*.

Fig. 4.—*Succinea ovalis optima.* Nat. size.

This large race is what has commonly been called *S. obliqua* Say, but the true *obliqua* is merely the longer phase of typical *ovalis*, and the name is not fairly applicable to the form above described. I have not examined the living animal of this race.

I picked up a single bleached specimen of *S. o. optima* on the beach at Galveston, Texas, in 1886. It had probably floated there, as I do not think it exists in the Austroriparian zone.

Succinea ovalis chittenangoensis n. subsp. Pl. VII, figs. 1 to 8.

The shell is yellow or pinkish-yellow, much lengthened, with a longer spire than any other race of *S. ovalis*; suture deep; whorls $3\frac{1}{2}$, the last rather flattened above, not so convex there as in *S. ovalis* or *S. o. optima*. Aperture very oblique, relatively small.

Length	22.5	diam.	11.5,	length of aperture		14	mm.	(No. 90,087).
"	23.3	"	11.3	"	"	14	"	(No. 90,081).
"	21	"	11.3	"	"	13	"	(No. 90,079).
"	19	"	10.5	"	"	12	"	(No. 90,083).

Cotypes from a sloping weed-covered talus near the foot of Chittenango Falls, Madison Co., N. Y., No. 90,087, 90,081 and 90,079, A. N. S. P., collected August 27, 1905, by Messrs. Henderson, Walker, Clapp and Pilsbry.

A very large series was taken, associated with a few *S. ovalis*, from which they are easily separated by the characters given above. I have seen this form from nowhere else. The locality is on the Onondaga limestone (coniferous).

In the living animal the mantle as seen through the shell is pale yellow with a slight olive tint, olive over the lung; the apex is more or less ruddy. This ground is profusely striped and blotched with black on the last 1½ whorls, as shown in figs. 1 to 5. Over the kidney the black blotches are interrupted and the ground tint is lighter, making a light streak across the whorl, partially seen in figs. 2 and 5 at the right upper portion of the last whorl. Very exceptionally the black blotches are almost absent, as in figs. 6, 7, 8. Fig. 8 represents the least marked individual seen, and probably to be regarded as a case of partial albinism. The lower edge (collar) of the mantle is gray peppered with white dots. The foot is pale yellowish, back and flanks gray with slate tesselation, tentacles slate. The posterior end of the foot is somewhat blackish above. All figures of plate VII were drawn from living animals. In alcohol the black and gray pigment remains, but

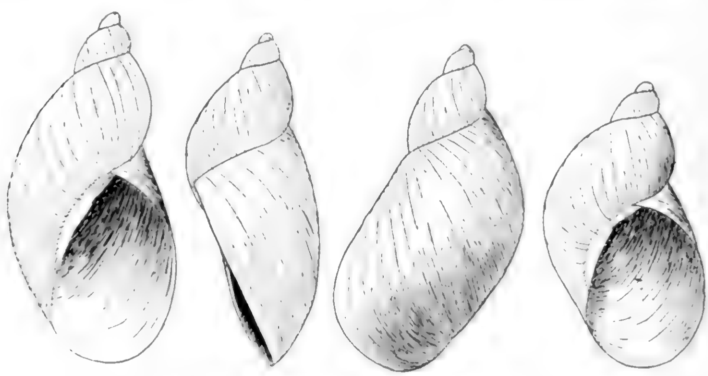


Fig. 5.—*S. ovalis chittenangoensis.* × 2.

the yellow tint is fugitive. The pattern of pigmentation of the lung has clearly been influenced by a tendency of the markings to follow veins; but in many specimens this tendency has been lost to a great extent.

Summary. (1) *Succinea ovalis* Say was based upon Philadelphian specimens of the form subsequently described as *S. totteniana* Lea. It was well figured by Férussac from examples sent by Say, as early as 1822. The proportion of aperture to length given by Say applies to no other *Succinea* of the region about Philadelphia. (2) *Succinea ovalis* Gould, 1841, is a totally different species, which was described as *S. retusa* by Lea in 1837. The true identity of *S. ovalis* was recognized by Dr. Binney in 1851. (3) *Succinea obliqua* Say, 1824, was based upon elongate specimens of *S. ovalis* Say, also from Philadelphia. It is an absolute synonym of *S. ovalis*. (4) *S. totteniana* Lea and Binney is absolutely identical with the typical *S. ovalis* Say.

Explanation of Plate VII.

Figs. 1–8—*Succinea ovalis chittenangoensis* n. subsp. 1, 2, No. 90,081 A. N. S. P.; 3, No. 90,079; 4, 5, No. 90,080; 6, No. 90,083; 7, 8, No. 90,082.

Figs. 9–11—*Succinea ovalis* Say, Chittenango Falls. 9, 10, No. 90,085; 11, No. 90,084.

NOTES ON SHARKS.

BY HENRY W. FOWLER.

The species included in this paper are based on material contained in the collection of the Academy of Natural Sciences of Philadelphia, unless otherwise stated.

HEXANCHIDÆ.

Hexanchus griseus (Gmelin).

A dried skin without data.

Heptranchias cinereus (Gmelin).

Head $6\frac{2}{5}$ to $6\frac{1}{2}$; depth 10 to $10\frac{3}{4}$; snout 3 in head; eye 4 to $4\frac{1}{2}$; length of mouth $2\frac{1}{4}$ to $2\frac{1}{3}$; interorbital space $3\frac{1}{6}$ to $3\frac{3}{4}$; front margin of first dorsal $2\frac{3}{5}$ to $2\frac{2}{3}$; front margin of anal $3\frac{5}{6}$ to $4\frac{2}{7}$; least depth of caudal peduncle 4; front margin of lower caudal lobe 2 to $2\frac{1}{5}$; length $32\frac{1}{2}$ to $35\frac{1}{2}$ inches. Two examples from Italy (C. L. Bonaparte, No. 245).

Also 2 dried skins without data, the larger $44\frac{1}{2}$ inches long.

HETERODONTIDÆ.

Heterodontus japonicus (Duméril).

Head $5\frac{1}{4}$; depth $7\frac{1}{4}$; depth of head $1\frac{3}{5}$ in its length; width of head $1\frac{1}{5}$; height of first dorsal $1\frac{2}{7}$; height of second dorsal $1\frac{1}{2}$; height of anal $1\frac{3}{5}$; lower caudal lobe $1\frac{2}{7}$; pectoral $4\frac{3}{5}$; tail $4\frac{1}{5}$ in length of body; width of pectoral $1\frac{1}{2}$ in its length. Color in alcohol deep brown with obscure scattered brown spots on trunk, which are however rather sparse. Length 28 inches. No data.

Also jaw of another, from Japan in 1891 (Frederick Stearns).

SCYLIORHINIDÆ.

Poroderma stellare (Linnæus).

Head $7\frac{2}{7}$ to $8\frac{1}{6}$; depth $8\frac{2}{5}$ to 14; snout $2\frac{1}{5}$ to $2\frac{2}{3}$ in head; eye $3\frac{2}{5}$ to $4\frac{3}{4}$; width of mouth 2 to $2\frac{2}{3}$; interorbital space $2\frac{1}{6}$ to $2\frac{2}{3}$; first dorsal $1\frac{1}{3}$ to $1\frac{7}{8}$; second dorsal $1\frac{7}{8}$ to $2\frac{1}{8}$; anal $1\frac{3}{5}$ to $2\frac{1}{4}$; caudal from origin of lower lobe $3\frac{2}{5}$ to $4\frac{1}{4}$ in rest of body; length 6 to 18 inches. Eleven examples. Italy (Bonaparte). Also 2 dried skins, Nos. $\frac{89}{T}$ and $\frac{83}{T}$, with same data.

Two other dried skins without data.

This genus must now be known by the above name, as Dr. Gill's specification of *Catulus stellaris* Smith as the type of *Catulus*[1] is not admissible. Under *Catulus* three species are included by Smith, viz.: *Squalus canicula* Linn., *Scyl. marmoratum* Bennett, and *C. edwardii* Smith. The first of these is here considered as the type, thus allowing it to fall a synonym of *Scyliorhinus* Blainville. The type of *Poroderma* Smith may be considered its first species, *Squalus africanum* Gmelin.

Galeus melastomus Rafinesque.

Head $6\frac{1}{15}$ to 7; depth 10 to $14\frac{7}{8}$; snout 2 to $2\frac{1}{8}$ in head; eye $3\frac{3}{4}$ to $4\frac{2}{3}$; width of mouth $1\frac{9}{10}$ to $2\frac{1}{5}$; interorbital space 2 to $2\frac{2}{3}$; first dorsal $1\frac{3}{5}$ to $2\frac{1}{2}$; second dorsal $1\frac{7}{8}$ to $2\frac{3}{5}$; base of anal 1 to $1\frac{3}{7}$; caudal from origin of lower lobe $2\frac{1}{2}$ to $3\frac{3}{5}$ in rest of body; length 7 to $18\frac{7}{8}$ inches. Ten examples. Italy (Bonaparte, No. 253).

Also 3 dried skins without data.

The above generic name may be adopted for this genus, as Rafinesque includes but two species. They are *G. melastomus* and *Squalus uyato*, of which the first may be considered the type. If his intention was to have made *S. galeus* Linnæus his type he certainly has missed the opportunity, as that species is not even mentioned, and the inference may be only surmised by reference to his *Ind. It. Sicil.*, 1810. *Pristiurus* Bonaparte is thus superseded by *Galeus* Rafinesque.

HEMISCYLLIIDÆ.

Chiloscyllium indicum (Gmelin).

Three examples from Padang (C. H. Harrison, Jr., and H. M. Hiller), Sumatra. Color when fresh in arrack more or less uniform dull brown, lower surface of head, abdomen, and bases of pectorals and ventrals dirty cream-white. The largest 21 inches long. The youngest with very distinct markings. One specimen now in Stanford University.

Orectolobus japonicus (Regan).

One example without data. The Japanese material called *O. barbatus* by Jordan and Fowler[2] is this species.

GINGLYMOSTOMIDÆ.

Ginglymostoma cirratum (Gmelin).

One from St. Martin's (R. E. Van Rijgersma), W. I. Three other dried skins, and one alcoholic, may have the same data. They are all

---

[1] *Ann. Lyc. Nat. Hist. N. Y.*, 1861, p. 41.
[2] *Proc. U. S. Nat. Mus.*, XXVI, 1903, p. 606.

uniformly brown and without spots. The largest is but a little over 2 feet in length. The St. Martin's example shows: Head $5\frac{1}{2}$; width of head about 1 in its length; snout $1\frac{5}{6}$; eye 8; width of mouth about 3; interorbital space $1\frac{2}{3}$; buccal cirrus 6; front margin of first dorsal about $1\frac{1}{5}$; of second dorsal $1\frac{2}{5}$; of anal $1\frac{2}{3}$; pectoral $1\frac{1}{6}$; ventral $1\frac{3}{5}$; least depth of caudal peduncle $4\frac{2}{5}$; length about 23 inches.

Two other examples, probably the *Squalus punctatus* Schneider, one evidently from St. Martin's (Rijgersma), W. I., and the other from Tortugas (James Roosevelt), Fla. Both are rather sparsely spotted with deep brown. Head $5\frac{4}{5}$; depth $7\frac{2}{5}$ to 8; snout $1\frac{7}{8}$ to 2 in head; width of mouth $2\frac{1}{5}$ to $3\frac{1}{2}$; interorbital space $1\frac{2}{5}$ to $1\frac{3}{5}$; front margin of first dorsal $1\frac{2}{5}$ to $1\frac{2}{3}$; of second dorsal $1\frac{3}{4}$ to $1\frac{7}{8}$; of anal 2; least depth of caudal peduncle $4\frac{1}{2}$ to 5; pectoral $1\frac{1}{8}$ to $1\frac{1}{5}$; ventral $1\frac{5}{6}$ to 2; length $12\frac{1}{2}$ to $14\frac{3}{8}$ inches.

In the preliminary account of this genus by Müller and Henle[3] no species is mentioned, though Drs. Jordan and Gilbert have designated *Squalus cirratus* Gmelin[4] as its type. Müller and Henle's next account includes species.[5] Dr. Gill designates "*Type* Ginglymostoma concolor,"[6] which may be assumed to be congeneric with the species of the present group, though somewhat confusing as *Nebrius* Rüppell (its type *N. concolor* Rüppell) was admitted to *Ginglymostoma* by Dr. Gill himself.

CARCHARIIDÆ.

Carcharias littoralis (Mitchill).

Head 5; depth $8\frac{3}{4}$; length of first dorsal 2 in head; of second dorsal $2\frac{1}{4}$; of anal $2\frac{1}{3}$; of lower caudal lobe $2\frac{1}{3}$; pectoral $1\frac{2}{3}$; tail $12\frac{1}{2}$ in length of body; entire length $44\frac{1}{2}$ inches. Nantucket (B. Sharp), Mass.

Head of a large example from Sea Isle City (W. J. Fox), and jaws from Townsend's Inlet (J. D. Casey), N. J., latter wrongly confused by me with *Lamna cornubica*.[7] Also 3 other pairs of jaws without data.

ALOPIIDÆ.

Alopias vulpes (Gmelin).

Head $8\frac{2}{5}$; depth $8\frac{2}{5}$; width of head $1\frac{3}{5}$ in its length; depth of head $1\frac{1}{4}$; snout about $3\frac{1}{4}$; eye about 6; width of mouth 3; interorbital space $2\frac{2}{3}$;

[3] *Wiegm. Arch.*, 1837, p. 396.
[4] *Bull. U. S. Nat. Mus.*, No. 16, 1882, p. 18.
[5] *Syst. Besch. Plag.*, 1838, p. 23.
[6] *Ann. Lyc. Nat. Hist. N. Y.*, 1861, p. 40.
[7] *Rep. N. J. State Mus.*, 1905, p. 56.

front margin of first dorsal $1\frac{3}{7}$; least depth of caudal peduncle $2\frac{3}{5}$; ventral $1\frac{9}{10}$; about 38 series of teeth in upper jaw and 28 in lower; pectoral reaching $\frac{1}{5}$ to ventral, and its greatest width 2 in its length. Color in alcohol dull gray-brown, more or less uniform, lower surface of trunk and head, also of pectoral and ventral, a little paler. Dorsals and caudal like back. Iris pale slaty-gray. Length 49 inches. Newport, R. I. J. C. Dunn.

Also a large dried skin (Bonaparte $\frac{40}{T}$), probably from Italy?

LAMNIDÆ.

Isurus oxyrinchus Rafinesque.

Jaws of a large example, evidently this species, without data. Possibly from Italy?

Lamna cornubica (Gmelin).

Head about 5; depth about $6\frac{1}{3}$; snout about $2\frac{2}{5}$ in head; eye $7\frac{3}{4}$; width of head about 3; gape of mouth $2\frac{5}{7}$; interorbital space $3\frac{3}{4}$; height of first dorsal $2\frac{2}{5}$; length of second dorsal $4\frac{3}{7}$; of anal $4\frac{1}{5}$; least depth of caudal peduncle 9; greatest width of caudal peduncle $4\frac{1}{4}$; front margin of lower caudal lobe $1\frac{1}{2}$; pectoral $1\frac{1}{4}$; ventral 3. Color in alcohol dull gray-brown on upper surface of body, and pale or whitish below, line of demarcation along side of caudal peduncle sharply defined. Dorsal and upper surface of caudal like back, lower pale like belly, though with more or less grayish. Upper surface of pectoral like back, lower paler like belly. Ventral and anal pale, slightly with grayish. Iris pale olive-gray, eyeball whitish. Teeth whitish. Length $27\frac{1}{2}$ inches. Italy (Bonaparte).

CETORHINIDÆ.

Cetorhinus maximus (Gunner).

Although there is no example in the collection, a large dried mounted skin, said to have been taken in Monterey Bay, Cal., was exhibited in Philadelphia several years ago, and was examined by Mr. Witmer Stone and myself.

GALEORHINIDÆ.

Cynais canis (Mitchill).

Nantucket (Sharp), Mass.; Newport (J. Leidy and S. Powel), R. I.; Sea Isle City (Fox), Atlantic City (C. W. Buvinger, G. W. Tryon, Jr.), and Great Egg Harbor Bay (Leidy), N. J.; E. Coast U. S. (Smiths. Inst.); Italy (Bonaparte).

Mustelus mustelus (Linnæus).

(*M. equestris* Bonaparte, Icon. Faun. Ital., Pesc. III, pt. 2, vii, 1834, descr., Pl., fig. 2, mari d'Italia.)

Head $6\frac{1}{2}$; depth about 9; width of head $1\frac{4}{7}$ in its length; depth of head at posterior margin of eye $2\frac{1}{2}$; snout measured to eye $2\frac{2}{5}$; eye $5\frac{2}{5}$; width of mouth $2\frac{3}{4}$; interorbital space $2\frac{3}{4}$; width of internasal space $6\frac{1}{2}$; front margin of first dorsal $1\frac{1}{6}$; of second dorsal $1\frac{1}{5}$; of anal $2\frac{2}{7}$; least depth of caudal peduncle $6\frac{3}{5}$; front margin of lower caudal lobe $2\frac{1}{10}$; upper margin of pectoral $1\frac{1}{10}$; front margin of ventral 2.

Body very elongate, depressed in front, sides well compressed, and tapering posteriorly into a long slender caudal, greatest depth about origin of first dorsal. Edges of body rather slightly convex or depressed, a very obsolete or slight median ridge down back most pronounced on upper surface of caudal peduncle, and down postventral and postanal regions a well-developed deep median groove. Caudal peduncle slender, compressed, and its least depth about $1\frac{3}{5}$ in its length.

Head well depressed, profiles tapering similarly, and as viewed above rather elongate with somewhat attenuately convergent margins though tip rounded. Snout broadly depressed, edge rather trenchant, and its length but a trifle less than its width. Eye elongate, large, laterally superior, and placed about midway in length of head. Mouth rather broad, symphysis of mandible slightly in front of anterior margin of eye, and rami would nearly form a right angle. Lips thin and hardly developed. At angle of mouth externally a rather long fleshy fold forming a well-developed flap projecting posteriorly, and though groove distinct posteriorly around it, it extends but very little along outer margin anteriorly. About 55 series of blunt tubercles or pavement-like teeth in each jaw. Buccal folds rather narrow. Tongue large, broad, its surface minutely asperous, and edges all free and sharp. Nostrils large, well separated on each side of snout below, near last third in length of latter measured to eye, and each with a well-developed flap. Interorbital space broad, well depressed, and but very slightly convex.

Gill-openings 5, last 2 over base of pectoral, and third deepest or about 2 in interorbital space. Spiracle small, distinct, and placed behind eye a space equal to about $\frac{1}{3}$ its horizontal diameter.

Body covered everywhere with minute shagreen denticles of uniform size.

Origin of first dorsal much closer to origin of pectoral than that of ventral or a little nearer tip of snout than origin of second dorsal, its apex forming nearly over its posterior basal margin, and a long slender point projecting behind equal in length to width of mouth. Origin of second dorsal a little nearer posterior basal margin of first dorsal than origin of upper lobe of caudal, base of fin like that of first dorsal well elevated and fleshy, and fin otherwise similar with posterior point about equal to eye horizontally. Caudal long and slender, origin of upper lobe begins a little behind that of lower, and its distal expansion about $3\frac{1}{2}$ in its own length. Lower caudal lobe a little elevated below, and length of its base about $1\frac{1}{2}$ in entire length of upper. Anal inserted a little behind middle of base of second dorsal, or a little nearer origin of lower caudal lobe than tip of depressed ventral, and similar to second dorsal, only smaller, posterior point equal to horizontal eye-diameter. Pectoral large, upper margin rather evenly convex, reaching $\frac{3}{5}$ to origin of ventral, and its posterior margin slightly concave. Ventral inserted about midway between origin of ventral and that of anal, rather broad, and its lower margin a little concave. Clasper small, about half length of posterior point.

Color in alcohol dull uniform gray-brown above, merging into grayish-white tint uniformly over lower surface of body. Upper fins like back or with grayish, both pectoral and ventral paler below. Iris pale brassy and pupil slaty.

Length about 26 inches.

No. 617, A. N. S. P., cotype of *M. equestris* Bonaparte. Italy (Bonaparte, No. 248). From Dr. T. B. Wilson.

Also Nos. 618 to 620, with same data. They show: Head $5\frac{3}{7}$ to $6\frac{1}{5}$; depth $8\frac{1}{2}$ to $10\frac{1}{5}$; width of head $1\frac{4}{7}$ to $1\frac{3}{4}$ in its length; snout 2 to $2\frac{1}{4}$; eye $4\frac{1}{3}$ to $6\frac{1}{5}$; width of mouth $3\frac{2}{7}$ to $3\frac{1}{2}$; interorbital space $2\frac{1}{2}$ to $2\frac{3}{5}$; front edge of first dorsal $1\frac{4}{7}$ to $1\frac{2}{3}$; front edge of anal $1\frac{2}{7}$ to $2\frac{2}{3}$; pectoral 1 to $1\frac{3}{5}$; length $10\frac{1}{2}$ to $21\frac{3}{4}$ inches. The smallest example is uniform on the back, like the larger ones, and is without any spots or markings. My confusion of these examples with *Galeorhinus galeus*[8] was due to the original labels being evidently wrongly placed. I have verified this by an examination of Bonaparte's original catalogue, where they are also wrongly entered in the latter's own handwriting.

Mustelus mento Cope. Fig. 1.

(Proc. Am. Philos Soc. Phila., XVII, 1877, p. 47, Pacific Ocean at Pecasmayo, Peru.)

Head about 5; depth $7\frac{2}{3}$; width of head $1\frac{2}{3}$ in its length; snout $2\frac{1}{5}$; eye $5\frac{1}{2}$; width of mouth $3\frac{2}{3}$; interorbital space $2\frac{3}{5}$; front margin of

[8] *Proc. Acad. Nat. Sci. Phila.*, 1901, p. 332, Pl. 13, fig. 4 (anatomy).

first dorsal $1\frac{9}{10}$; front margin of second dorsal $2\frac{2}{7}$; front margin of anal about 3; front margin of lower caudal lobe $2\frac{1}{2}$; least depth of caudal peduncle $6\frac{1}{4}$; pectoral $1\frac{3}{7}$; ventral $2\frac{9}{10}$. Body rather well compressed, back elevated, edges rather rounded or convex, a very slight median keel down back and a slight median depression down postventral and postanal regions. Caudal peduncle slender, well compressed, and its least depth about $\frac{3}{7}$ its length. Head broad, depressed, profiles similar, and when viewed above rather narrowly convergent

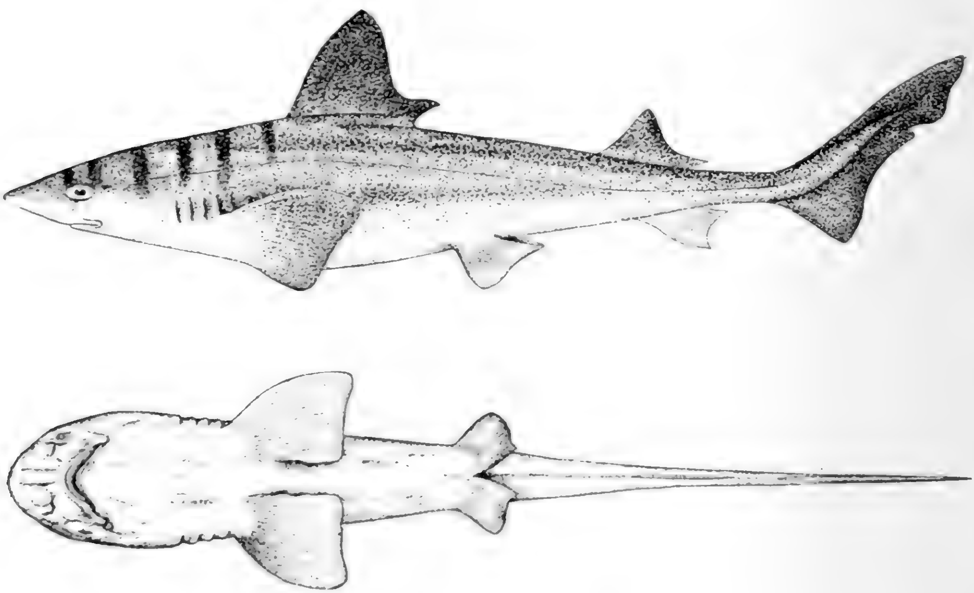


Fig. 1.—*Mustelus mento* Cope. (Type.)

with rounded tip. Edges of snout rather trenchant, and its length equal to its greatest width. Eye elongate, and its center a trifle posterior in length of head. Mouth moderately broad, symphysis falling but a trifle before front of eye, and rami would form a right angle. Lips thin and little free. At each corner of mouth a pointed flap, free behind and with a rather long outer fold. Teeth pavement-like, in about 50 series. Upper buccal fold papillose, with a slightly ragged margin, not entire as stated previously, and narrow. Lower buccal fold entire. Tongue rather pointed, its upper surface very finely asperous, and margins free. Nostrils large, inferior, well separated, about last third in snout measured to eye, and each with a well-developed flap. Interorbital space convex. Body everywhere minutely roughened. Origin of first dorsal nearly midway between tip of snout and origin of second dorsal, apex of fin falling about midway in its length, and posterior pointed flap equals eye horizontally. Origin of second dorsal a little nearer that of first dorsal than last caudal vertebra. Anal with its apex about opposite its posterior basal margin. Upper lobe of caudal begins a little after that of lower, and its distal expansion about $2\frac{4}{7}$ in its length. Lower caudal lobe a little elevated in front, and its height about $3\frac{2}{5}$ in its length. Pectoral reaches $\frac{3}{5}$ to ventral. Ventral inserted a trifle nearer origin of pectoral than posterior basal margin of anal, and reaching a trifle more than half-way to anal. Color in alcohol with under surfaces of pectorals and ventrals grayish, otherwise fins of more or less uniform tint of back. Iris pale yellowish-brown, pupil dusky. Length $12\frac{1}{4}$ inches. No. 21,104, A. N. S. P., type of *M. mento* Cope. Pacific Ocean at Pecasmayo, Peru (J. Orton). Coll. of 1876–77. From Cope.

Triakis felis (Ayres).

Santa Barbara (U. S. F. C.), Cal.

I adopt *Mustelus felis* Ayres for this species, as his name has evident priority. His paper[9] was read December 4, 1854, which is in the signature dated December 25. This was received by the Academy of Natural Sciences of Philadelphia on February 6, 1855.[10] *T. semifasciatus* Girard occurs in No. 6 of the same volume,[10] which was elsewhere[11] not acknowledged as having been received until February 20, 1855, and therefore this date may be accepted for its publication.

Galeorhinus galeus (Linnæus).

Head $5\frac{4}{7}$; depth about $8\frac{1}{5}$; snout about $2\frac{1}{8}$ in head; eye 5; length of mandible 3; width of mouth $2\frac{1}{5}$; tip of snout to mandible $2\frac{2}{7}$; interorbital space $2\frac{5}{7}$; front margin of first dorsal $1\frac{9}{10}$; of second dorsal $3\frac{5}{7}$; of anal $4\frac{2}{3}$; least depth of caudal peduncle about 5; pectoral $1\frac{2}{5}$; ventral $3\frac{2}{3}$; length $17\frac{3}{4}$ inches. Italy (Bonaparte, No. 254). The other three examples are all smaller, the smallest 9 inches long and showing the attachment of the placenta still in good preservation. These were confused as *Galeus mustelus* by me, as already explained.

Also a dried skin, without data, 44 inches long.

[9] In *Proc. Cal. Acad. Sci.*, I.
[10] See *Proc. Acad. Nat. Sci. Phila.*, VII, p. xxii, in donations to the library.
[11] *New York Lyc. Nat. Hist.*

Galeorhinus zyopterus Jordan and Gilbert.

(Bull. U. S. Nat. Mus., XVI, 1883, p. 871, evidently based on *G. galeus* Jordan and Gilbert, Proc. U. S. Nat. Mus., III, 1880, p. 42, San Pedro, California; Jordan and Gilbert, *l.c.*, p. 458, San Francisco, Cal.)

Head $5\frac{2}{7}$; depth 11?; width of head $1\frac{3}{5}$ in its length; depth of head at posterior margin of eye about $2\frac{3}{4}$; snout $2\frac{1}{5}$; eye $4\frac{1}{2}$; width of mouth at corners $2\frac{1}{3}$; interorbital space $2\frac{1}{5}$; front margin of first dorsal 2; of second dorsal about 2; of lower caudal lobe $1\frac{3}{5}$; least depth of caudal peduncle 5; upper margin of pectoral $1\frac{1}{3}$; front margin of ventral about 5.

Body elongate, slender, depressed anteriorly and tapering back from head. Down middle of back, also middle of postventral and postanal regions, a longitudinal groove. Caudal peduncle slender, its least depth about $2\frac{1}{2}$ in its length.

Head broadly depressed, about equally so above and below, and as viewed from above profile rather elongately convergent with rounded tip. Snout well depressed, its edge but slightly trenchant, and space between its own tip and front of mouth equal to width of latter. Eye large, elongate, lateral and its center falling a trifle posterior in length of head. Nictitating membrane large, well developed, and with a deep pocket between itself and eye. Rami of mandible would nearly form a right angle, though symphysis not quite extended forward till opposite front rim of eye. Teeth pointed, mostly tricuspid, and directed towards side of mouth, with outer cusp of each of lateral teeth best developed. About 44? series of teeth in upper jaw. Buccal folds rather well developed and papillose. Tongue large, broad, flattened, rounded in front, and its edge free. Nostrils rather large, well separated or internasal space about half width of mouth, each with a small fleshy point, and placed about last $\frac{2}{7}$ in snout measured to front of eye. Interorbital space broad, a little convex, and depressed medianly.

Gill-openings 5, last 2 over base of pectoral, and third and fourth largest or about $1\frac{3}{5}$ in eye horizontally.

Body covered everywhere with simple shagreen points of moderately small and uniform size.

Origin of first dorsal a little nearer that of second than tip of snout, forming a rather rounded lobe with its apex just before posterior basal margin of fin, and point of latter equals eye horizontally. Origin of second dorsal nearer that of first than end of last caudal vertebra by a space equal to width between outer edges of nostrils, apex of fin forming about over middle of its length, and its posterior point about $1\frac{1}{3}$ in eye horizontally. Origin of anal a trifle after that of second dorsal, its apex forming about first third in its length and its posterior point $1\frac{2}{7}$ in eye horizontally. Origin of lower caudal lobe a little in advance of that of upper, and height of fin at this point about $2\frac{2}{5}$ in length of its base. Upper caudal lobe broad, its expansion at end nearly equal to width of mouth or about $3\frac{2}{3}$ in its length. Pectoral broad, larger than first dorsal, and reaching $\frac{4}{7}$ to ventral, with posterior margin a little incised. Ventral inserted a little nearer origin of first dorsal than that of anal, and reaching $\frac{3}{7}$ to origin of latter. Clasper equals posterior anal point.

Color in alcohol deep gray-brown on back, becoming paler gray on sides, and lower surface whitish. Upper surface of snout pale brownish. Teeth all whitish. Iris livid grayish and pupil slaty. Nictitating membrane pale like side of head. Dorsals pale brownish, upper or outer portion of lobe dusky to blackish and posterior point becoming very pale to whitish. Caudal pale brownish, end of upper lobe and notch behind lower dusky to blackish, fin otherwise more or less pale. Pectoral dusky or blackish above, pale to grayish below. Ventral and anal whitish like lower surface of body.

Length $12\frac{3}{4}$ inches.

No. 582, A. N. S. P., cotype of *G. zyopterus* Jordan and Gilbert. San Francisco, California (U. S. F. C. No. 27,190).

Galeocerdo tigrinus Müller and Henle.

Head $6\frac{1}{6}$; depth $11\frac{5}{6}$; width of head $1\frac{2}{5}$ in its length; snout 3; width of mouth $2\frac{1}{10}$; space between tip of snout and front of mouth 4; interorbital space $1\frac{2}{3}$; pectoral $1\frac{1}{4}$; base of ventral $4\frac{1}{3}$; caudal nearly 2 in rest of body. Body broad, depressed, and trunk rather slender posteriorly. Caudal peduncle broad, and side from below second dorsal bluntly keeled till opposite middle of lower elongate caudal lobe. Head large, very broad, depressed. Snout broad, rounded. Length of preoral region about $\frac{2}{3}$ width of mouth. Eye anteriorly lateral, with nictitating membrane. Mouth large, beginning well before eye, and gape extends one diameter behind latter. Corner of mouth with long outer fold. Teeth about $\frac{18}{18}$, broad, compressed, directed laterally, finely serrated along margins, and with five small cusps externally. Tongue broad, not free. Lips rather thin. Nostrils lateral, with small flaps, and nearer front edge of snout than front of mouth. Interorbital space convex. Anterior gill-openings large, third largest, and last two over base of pectoral. Peritoneum silvery. Shagreen very fine. First dorsal inserted opposite posterior basal edge of pectoral, with sharp point behind, and height of fin a little less than base. Second dorsal inserted about midway between caudal pits and origin of ventral. A narrow median low keel along back between dorsals. Anal small, inserted below first third of base of second dorsal, its margin deeply concave, and with a sharp point posteriorly. Lower caudal lobe about $2\frac{4}{5}$ in upper. Caudal notch near tip. Pectoral falcate, margin concave and reaching posteriorly below posterior base of dorsal. Ventral small, broad, obtuse, and inserted nearly midway between posterior basal edge of first dorsal and origin of second dorsal. Color when fresh in arrack slaty-gray, paler below. Upper surface of body and pectoral, also dorsal and caudal, variegated with deep leaden-gray blotches, and many of those on side of trunk more or less elongate and vertical. Length $39\frac{1}{4}$ inches. Padang, Sumatra (Harrison and Hiller).

Very large jaws from Guaymas, Mexico; also a pair from Beesley's Point, N. J. (S. Ashmead); a pair from between Turk's Island and Barbadoes (Dr. W. H. Freeman).

Prionace glauca (Linnæus).

Head 5; depth about $10\frac{1}{2}$; width of head about 2 in its length; snout $2\frac{2}{5}$; eye about $7\frac{1}{2}$; width of mouth about $3\frac{1}{3}$; interorbital space $2\frac{3}{5}$; front margin of first dorsal $2\frac{1}{5}$; front margin of second dorsal $4\frac{2}{5}$; front margin of anal about 4; least depth of caudal peduncle about $7\frac{1}{8}$; pectoral $1\frac{2}{7}$; ventral $3\frac{1}{4}$. Teeth with entire edges, and each lateral tooth of upper jaw followed by about four cusps and in lower by one or two. Median teeth in each jaw erect, smaller and with a single slender point. Color in alcohol deep chocolate-brown on back and upper surface, and lower surface pale creamy-white. Dorsals and caudal, except basally at lower lobe, which is whitish, dark like back. Upper surface of pectoral and ventral dark like back, though latter paler, and lower surfaces grayish to whitish like belly. Entire lower surface of head whitish like belly. Iris grayish-slaty, pupil pale. Length 23 inches. Italy (Bonaparte, No. 250).

Another dried skin, without data, is 48 inches long.

Eulamia milberti (Müller and Henle).

One from Great Egg Harbor Bay (Dr. J. Leidy).

The name *Carcharias* Rafinesque cannot be applied to this genus, as the only species mentioned for it, and therefore its type, is *taurus*, a sand shark identical with Agassiz's genus *Odontaspis*. *Carcharhinus* Blainville[12] is next in order. It is based on *commersonii, lamia, lividus, ustus, heterodon, verus, broussonetii, glaucus, cæruleus, megalops, heterobranchialis, cornubicus, monensis?, vulpes.* Drs. Jordan and Gilbert restrict the first species (*commersonii*) as its type, but all the evidence shows it to be a nomen nudum, and their suggestion that it is based on Lacépède's figure of *Le Squale Requin*[13] seems only assumption when

[12] *Bull. Soc. Philomath.*, Paris, 1816, p. 121.
[13] *Hist. Nat. Poiss.*, I, 1799, pp. 165, 169, Pl. 8, fig. 1.

judged from Blainville's work alone. If the next of Blainville's specific names are considered, *lamia* is found first proposed as *Carcharias lamia* by Rafinesque,[14] without description or diagnosis, and simply as "(Squalus carcharias Linnæus). Carcaria lamia. Pesce Caine, Imbestinu, ò Lamia." Thus it would be typified by *S. carcharias* Linnæus, which would upset *Carcharodon* of Smith, in which case I shall consider the *Squalus vulpes* Gmelin the type of *Carcharhinus* Blainville. The next generic name available is *Eulamia* Gill, which had best be adopted.

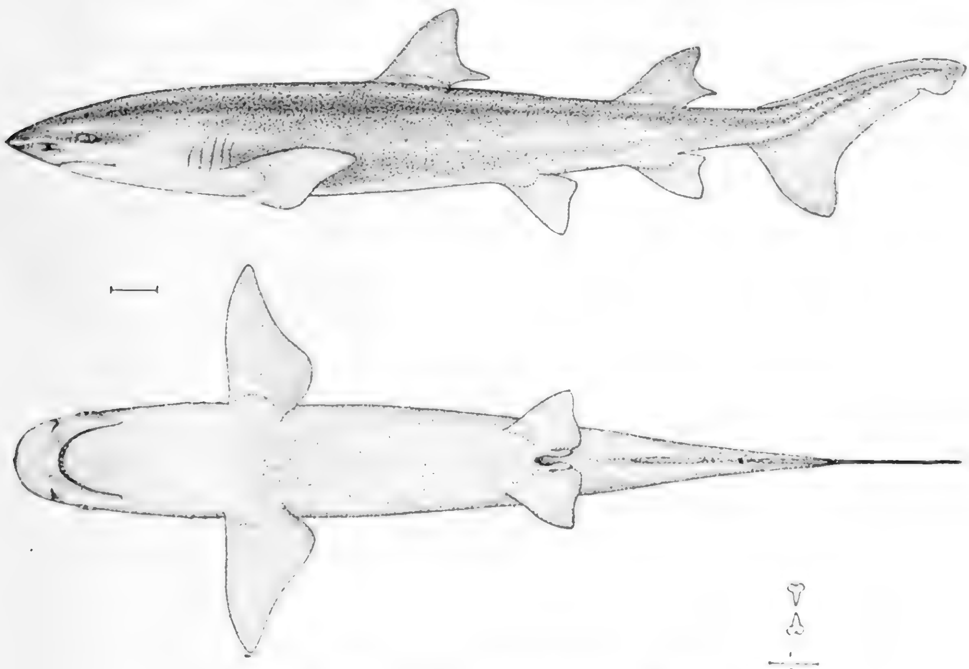


Fig. 2.—*Eulamia odontaspis* Fowler. (Type.)

Eulamia odontaspis sp. nov. Fig. 2.

Head $5\frac{1}{4}$; depth $8\frac{2}{3}$; width of head about $1\frac{2}{3}$ in its length; depth of head at first gill-opening $1\frac{3}{4}$; snout $2\frac{3}{5}$; width of mouth $2\frac{4}{7}$; interorbital space 2; front edge of first dorsal $1\frac{2}{3}$; of second dorsal 2; of anal $2\frac{1}{6}$; of lower caudal lobe $1\frac{2}{3}$; least depth of caudal peduncle about 5; pectoral $1\frac{1}{3}$; ventral $2\frac{3}{7}$.

Body depressed anteriorly, apparently rather robust, a slight median

[14] *Ind. It. Sicil.*, 1810, p. 44.

depression down back and another down postventral and postanal regions, greatest depth about origin of dorsal. Caudal peduncle compressed, and its least depth about $1\frac{7}{8}$ in its length.

Head rather well depressed, profiles similar apparently. Snout well depressed, rather short, when viewed above broadly convex, and its length to front of mouth about $\frac{3}{5}$ its width at that point. Eye small, elongately ellipsoid, and its center about first $\frac{2}{5}$ in head. Nictitating membrane rather broad. In profile end of mandible a little before front rim of eye, as seen from below profile of symphysis rather broadly convex in front, and its length $\frac{4}{5}$ its width. No grooves at corners of mouth. Teeth about $\frac{25}{22?}$, similar in both jaws, without basal cusps, edges entire, slender, compressed, of rather uniform size and sharply pointed. Nostrils large, lateral, below on snout near last third of its length. Interorbital space broadly convex.

Gill-openings 5, second and third deepest or about 5 in head, and last two over base of pectoral. No spiracle.

Body covered with very fine shagreen, scarcely rough to touch.

Origin of first dorsal about midway between tip of snout and tip of posterior depressed point of second dorsal, and posterior point $2\frac{7}{8}$ in length of fin. Origin of second dorsal about an eye-diameter nearer that of upper caudal lobe than posterior basal margin of first dorsal, and posterior point of fin $2\frac{3}{4}$ in its front margin. Caudal rather small, upper lobe begins a trifle behind lower, and its length about $3\frac{3}{5}$ in rest of body. A pit on caudal peduncle, both above and below, at origins of caudal lobes. Anal begins very slightly behind origin of second dorsal, and fin reaching $1\frac{1}{2}$ to origin of lower caudal lobe, tip of posterior process not extending back beyond that of end of fin in front. Pectoral broad, inserted rather low, and when depressed reaching about opposite origin of first dorsal, its greatest width $1\frac{2}{3}$ in its length. Ventral broad, its origin slightly behind tip of depressed dorsal, and depressed fin reaching $1\frac{3}{4}$ to anal. Claspers small.

Color of dried skin dull brown generally, lower surface scarcely paler. Fins all unicolor.

Length about $20\frac{7}{8}$ inches.

Type No. 34,634, A. N. S. P. No data, but probably from the Indian Ocean?

This interesting specimen is probably identical with Day's figure of *Carcharias ellioti*.[15] His description, however, differs in the outer labial groove, serrated teeth with basal cusps, first dorsal beginning

[15] *Fishes of India*, IV, 1880, p. 716, Pl. 189, fig. 2.

behind base of pectoral with its base being nearer latter than ventral, inner margin of pectoral $\frac{1}{3}$ of its outer and fin reaching below end of base of dorsal, anal below last $\frac{2}{3}$ of second dorsal, and caudal $3\frac{3}{4}$ in total. His figure of a skin, 6 feet long, differs in some minor details from my example, which however may be due to age.

('Οδώς, tooth, 'ασπὶς, scale; hence *Odontaspis*, an old generic name applied to the sand sharks, and here used with reference to the superficial resemblance of this species.)

Eulamia longimanus (Poey).

Head about $6\frac{2}{7}$; depth $8\frac{1}{5}$; width of head $1\frac{3}{5}$; snout $2\frac{3}{4}$ in head; width of mouth $2\frac{1}{5}$; interorbital space $1\frac{9}{10}$; height of first dorsal $2\frac{1}{3}$; of second dorsal $7\frac{3}{4}$; least depth of caudal peduncle 4; lower caudal lobe $2\frac{1}{5}$; pectoral $1\frac{1}{5}$; ventral $2\frac{3}{4}$; upper caudal lobe $3\frac{3}{5}$. Teeth all finely serrated and upper but little notched on outer margins. Dorsal inserted just after base of pectoral. Width of pectoral 2 in its length. Length 39 inches. Dried skin without data.

Jaws of large example from West Palm Beach (G. B. Wood), Fla., in 1907. Another pair of jaws from the Gulf of Florida (Dr. G. Watson) is probably this species.

Eulamia menisorrah (Müller and Henle).

Head $6\frac{1}{6}$; depth $8\frac{7}{8}$; width of head $1\frac{2}{3}$ in its length; snout $2\frac{1}{4}$; width of mouth $2\frac{2}{3}$; tip of snout to mandible 3; interorbital space 2; height of first dorsal $1\frac{1}{8}$; pectoral 1; length of ventral to posterior tip $1\frac{1}{12}$; least depth of caudal peduncle $4\frac{2}{3}$; caudal 3 in rest of body. Teeth without serrations, each with several small cusps. Length $25\frac{1}{8}$ inches. Padang (Harrison and Hiller), Sumatra.

Also a very young example with same data. Edge of first dorsal very narrowly margined with black, also ends of second dorsal and caudal.

Eulamia oxyrhynchus (Müller and Henle).

Head about $4\frac{3}{5}$; depth $11\frac{1}{4}$; width of its head $2\frac{2}{5}$ in its length; snout about $2\frac{1}{16}$; width of mouth $2\frac{3}{4}$; interorbital space $3\frac{2}{5}$; front margin of first dorsal $2\frac{1}{8}$; of second dorsal 4; of anal about 4; of lower caudal lobe $2\frac{9}{10}$; pectoral $1\frac{3}{5}$; length of ventral $3\frac{2}{3}$; least depth of caudal peduncle $3\frac{1}{2}$ in snout; eye 8; upper caudal lobe equals head; length $17\frac{1}{2}$ inches. Dried skin without data, though probably from Surinam? (Hering?).

It differs a little from Müller and Henle's figure, most likely in respect to age, in having insertion of first dorsal a little more posterior or opposite posterior basal edge of pectoral, depressed pectoral not reaching beyond posterior basal margin of first dorsal, depressed first dorsal reaching $1\frac{2}{3}$ to ventral, origin of anal slightly before that of second dorsal, and origin of ventral nearly midway between posterior basal margin of first dorsal and origin of anal.

Scoliodon laticaudus (Müller and Henle).

A small example, $7\frac{1}{2}$ inches long. Straits of Malacca. It agrees largely with Müller and Henle's figure.

Scoliodon terræ-novæ (Richardson).

Bayport (Cope), Fla.

Two dried skins, larger 38 inches long, are evidently this species; no data.

SPHYRNIDÆ.

Sphyrna tiburo (Linnæus).

Newport (Powel) R. I.; St. Augustine (W. Blanding), Fla., in May, 1832.

Sphyrna tudes (Valenciennes).

Head $4\frac{3}{5}$; depth 7; length of disk, along its posterior margin, $\frac{3}{4}$ its width transversely at second undulation; width of head just after hammer $2\frac{1}{10}$ in head; width of mouth about $3\frac{1}{8}$; third gill-opening $5\frac{3}{4}$; front margin of first dorsal $1\frac{1}{5}$; length of second dorsal $2\frac{2}{5}$; of anal 2; least depth of caudal peduncle 4; pectoral $1\frac{3}{5}$; ventral $2\frac{2}{7}$. Teeth in about 26 series in mandible. Color in alcohol plain pale brown, a little darker on upper surface of body and paler or whitish on lower. Fins all grayish-brown. Iris slaty. Length 8 inches. Surinam (Hering).

Sphyrna zygæna (Linnæus).

Nantucket (Sharp), Mass.; Sea Isle City (W. J. Fox), Holly Beach (Miss Edith Ives) and Grassy Sound (Fowler), N. J.; Surinam (Hering); Panama (W. S. W. Ruschenberger); Italy (Bonaparte, 251); Padang (Harrison and Hiller), Sumatra. Also 4 dried skins without data.

Sphyrna blochii (Cuvier).

Head $6\frac{3}{4}$; depth about $9\frac{3}{4}$?; least width of head behind hammer $1\frac{2}{5}$ in its length; greatest width of hammer $2\frac{3}{4}$ in its length, measured along its inner margin; least width of hammer 4; space between tip of snout medianly and margin of upper jaw about 3 in head; width of mouth 2; length of third gill-opening about 4; base of first dorsal $1\frac{1}{3}$; entire length of second dorsal about $1\frac{7}{8}$; base of anal about $2\frac{1}{3}$; least depth of caudal peduncle $3\frac{1}{2}$; front margin of lower caudal lobe $1\frac{1}{3}$; length of pectoral 1; base of ventral $2\frac{2}{7}$; clasper $1\frac{5}{8}$.

Body long, slender, apparently little compressed, but rather rounded or robust, greatest depth about origin of dorsal, and edges of body depressed or flattened. No very evident pits at origins of caudal lobes. Caudal peduncle rather robust, scarcely compressed, and its least depth $1\frac{3}{7}$ in its length.

Head moderately large, well depressed both above and below and with evenly convex surfaces. Snout rather broadly depressed and moderately short, as viewed from above front margin undulate with a median emargination where tip would form. Each side of head produced laterally into a very narrow long depressed hammer-like process with its front margin much thicker than posterior, also former as viewed above a little undulate in profile while posterior is nearly straight. Along anterior margin of each hammer a rather deep groove, extending from nostril half-way to median point of snout and distally to end of hammer. Eye at anterior external lateral extremity of hammer, elongate, rather small, and its horizontal diameter about $4\frac{1}{5}$ in distal expansion of hammer. Nictitating membrane broad, conspicuous, and evidently leaving a deep pocket on each side. Mouth broad, margin of upper jaw rather evenly lunate or convex, and ramus of mandible would form a very obtuse angle. Gape of mouth about $\frac{3}{5}$ its width. No groove at each corner of mouth. Teeth all moderately large, directed laterally, entire, rather broadly triangular, and each with an external notch, no basal cusps. About 28 series of teeth in upper jaw and about 24 series in lower. Nostril inferior on hammer along its anterior margin near basal fifth of latter, as measured along its posterior margin, or about inner $\frac{2}{5}$ of space between tip of snout and end of hammer. Nostril furnished with but a slight flap. Top of head rather broadly convex.

Gill-openings, first a little nearer posterior margin of hammer basally than origin of dorsal, last two over base of pectoral, and second and third largest. No spiracle.

Body covered entirely with very minute shagreen denticles of apparently uniform size. On lower surface of hammer anteriorly a number of more or less conspicuous small pores.

Origin of first dorsal nearer tip of snout than that of second or about opposite first fifth in space between origin of pectoral and that of ventral, fin high, falcate, apex forming above just behind its base which is $1\frac{3}{4}$ in its height, and its posterior point about $3\frac{1}{5}$ in head. Origin of second dorsal a little nearer that of first dorsal than end of last caudal vertebra or about over middle of base of anal, base of fin about $\frac{3}{7}$ of its total length and long posterior point $3\frac{3}{5}$ in head. Origin of anal a little nearer posterior basal margin of ventral than origin of lower caudal lobe, larger and also inserted well before second dorsal, posterior point about $1\frac{3}{4}$ in its length and anterior lobe about equal to length of base. Origins of caudal lobes nearly opposite(?), and distal expansion of upper $7\frac{2}{3}$ in its length. Anterior lobe of lower caudal lobe $2\frac{1}{10}$ in length of latter. Upper caudal lobe $2\frac{1}{3}$ in rest of body. Pectoral much smaller than first dorsal, interventral space about $\frac{1}{3}$ in length of fin, and greatest width about 2 in latter. In form pectoral rather falcate and pointed and would reach about $\frac{3}{5}$ of space to ventral. Ventral inserted a little nearer origin of pectoral than that of lower caudal lobe, fin low, its greatest height about last fourth of its length, and clasper well developed.

Color of dried skin deep dusky-brown over entire upper surface of body, including dorsals and upper lobe of caudal. Upper surfaces of pectoral and ventral of same tint. Entire lower surface of body pale gray-bown, this also largely over remaining portions of fins, anal and claspers. Teeth whitish.

Length $50\frac{1}{2}$ inches.

Pondichery, India. June 9, 1840. Thomas Ryan.

It differs from Cantor's figure[16] in the narrower and longer hammer.

SQUALIDÆ.

Oxynotus centrina (Linnæus).

Head $5\frac{3}{5}$ to $5\frac{3}{4}$; depth $5\frac{3}{4}$ to $7\frac{1}{5}$; width of head $1\frac{4}{7}$ to 2 in its length; depth of head $1\frac{1}{2}$ to $1\frac{5}{7}$; snout $2\frac{5}{6}$ to 3; eye $3\frac{3}{5}$ to 4; width of mouth $3\frac{2}{3}$ to $4\frac{1}{3}$; interorbital space $2\frac{1}{10}$ to 3; first dorsal spine $1\frac{1}{3}$ to $1\frac{3}{5}$; second dorsal spine $1\frac{2}{3}$ to $1\frac{9}{10}$; least depth of caudal peduncle 4; height of lower caudal lobe 2 to $2\frac{4}{7}$; pectoral 1; ventral $1\frac{4}{7}$ to $1\frac{2}{3}$; length $9\frac{1}{4}$ to 12 inches Italy (Bonaparte, No. 242). From Wilson.

Also another, dried skin, with same data, No. $\frac{41}{T}$.

Squalus acanthias Linnæus.

Castine (G. B. Wood) and Mt. Desert (Dr. H. C. Chapman), Maine; Gloucester (U. S. N. M.), Mass.; Cape May (H. W. Hand), N. J.; Italy (Bonaparte, No. 246).

Squalus blainville (Risso).

Head $5\frac{1}{2}$; depth 8 to $9\frac{2}{5}$; width of head $1\frac{2}{5}$ to $1\frac{1}{2}$ in its length; depth of head at first gill-opening $1\frac{1}{5}$ to $2\frac{1}{3}$; snout $2\frac{1}{3}$ to $2\frac{5}{6}$, measured from front of mouth; eye $3\frac{5}{6}$ to $4\frac{1}{3}$; width of mouth $2\frac{4}{7}$ to $2\frac{9}{10}$; interorbital space $2\frac{1}{3}$ to $2\frac{2}{3}$; first dorsal spine $2\frac{2}{3}$ to $2\frac{4}{7}$?; second dorsal spine $2\frac{2}{7}$ to

[16] *Quart. Journ. Calcutta Med. Phys. Soc.*, No. V, January 1, 1838, Pl. 1.

$2\frac{2}{3}$; least depth of caudal peduncle 7 to $8\frac{1}{6}$; pectoral $1\frac{1}{12}$ to $1\frac{5}{7}$; ventral $1\frac{4}{5}$ to $1\frac{7}{8}$; teeth in 26 series in jaw; length $18\frac{5}{8}$ to 26 inches. Italy (Bonaparte, No. 249). Three examples.

Entoxychirus uyato (Rafinesque).

Head $4\frac{4}{7}$; depth 8; width of head $1\frac{3}{5}$ in its length; snout $2\frac{3}{4}$; eye $3\frac{2}{5}$; width of mouth $2\frac{7}{8}$; interorbital space $2\frac{2}{5}$; first dorsal spine $2\frac{7}{8}$; second dorsal spine $3\frac{2}{5}$; least depth of caudal peduncle $5\frac{1}{5}$; pectoral $1\frac{2}{3}$; ventral 2; teeth about $\frac{44}{30}$; length $20\frac{1}{8}$ inches. Italy (Bonaparte, No. 241).

Centrophorus granulosus (Schneider).

Head about $5\frac{1}{4}$; depth about $7\frac{2}{5}$; width of head about $1\frac{7}{8}$ in its length; snout 3; eye-cavity 4; snout to front of mouth about $2\frac{1}{8}$; width of mouth 3; interorbital space $2\frac{1}{5}$; first dorsal spine 4; second dorsal spine $4\frac{1}{6}$; least depth of caudal peduncle 6; pectoral 2 along front margin; length of ventral $2\frac{1}{4}$; teeth $\frac{40}{30}$; length, dried, about $33\frac{1}{4}$ inches. Italy? (Bonaparte, No. 42).

Also another example, dried, without data, probably same as above?

Dr. Doderlein included *Squalus uyato* Rafinesque[17] as a synonym of this species. From the latter's very rude figure,[18] though of course of little value, one would be obliged to retain it under *Squalus*.

Etmopterus spinax (Linnæus).

Head $5\frac{1}{10}$ to $5\frac{5}{6}$; depth about $6\frac{1}{2}$ to $9\frac{4}{5}$?; width of head $1\frac{4}{7}$ to $1\frac{4}{5}$ in its length; snout $2\frac{7}{8}$ to $3\frac{1}{8}$; eye 3 to 5 (iris); width of mouth $2\frac{2}{5}$ to $2\frac{5}{6}$; space between tip of snout and front margin of upper jaw $1\frac{4}{5}$ to $1\frac{9}{10}$; interorbital space $2\frac{1}{5}$ to $2\frac{2}{3}$; least depth of caudal peduncle $5\frac{2}{3}$ to $6\frac{1}{2}$; height of lower caudal lobe $3\frac{2}{5}$ to $3\frac{5}{6}$; pectoral $1\frac{9}{10}$ to $2\frac{1}{10}$; ventral $1\frac{3}{5}$ to $1\frac{5}{7}$; teeth $\frac{30}{40}$; length $11\frac{1}{2}$ to $16\frac{3}{8}$ inches. Italy (Bonaparte, No. 243). Three examples.

Centroscyllium fabricii (Reinhardt).

George's Bank (U. S. N. M.). A young example.

DALATIIDÆ.

Dalatias licha (Bonnaterre).

Head $6\frac{1}{2}$; depth $8\frac{2}{3}$ to 9; width of head $1\frac{3}{5}$ to $1\frac{7}{8}$; depth of head about $1\frac{2}{3}$ to $2\frac{2}{7}$; snout $4\frac{1}{3}$ to $4\frac{1}{2}$; eye, to edge of iris, $6\frac{1}{3}$ to 7; space between tip of snout and front margin of upper jaw $3\frac{2}{5}$; width of mouth $2\frac{3}{4}$ to $3\frac{2}{5}$; interorbital space $2\frac{5}{6}$ to 3; length of first dorsal $1\frac{1}{2}$ to $1\frac{3}{5}$; length of second

[17] *Car. Nuov. Gen.* Sicilia, 1810, p. 13.

[18] *Squalus uyatus* Rafinesque, *l.c.*, Pl. 14, fig. 2.

dorsal $1\frac{3}{5}$ to $1\frac{2}{3}$; least depth of caudal peduncle 6 to $6\frac{1}{2}$; height of lower caudal lobe $2\frac{2}{5}$ to $2\frac{3}{5}$; pectoral $1\frac{1}{3}$; ventral, without clasper, $1\frac{1}{10}$; length $32\frac{1}{2}$ to $33\frac{3}{4}$ inches. Italy (Bonaparte, No. 240). Two examples.

SQUATINIDÆ.

Squatina squatina (Linnæus).

Three from Italy (Bonaparte, No. 238); one from Bay of Naples (Dr. H. C. Chapman); large example without data.

Also three dried skins, without data.

DESCRIPTION OF A NEW SPECIES OF SQUALOID SHARK FROM JAPAN.

BY CHIYOMATSU ISHIKAWA, PH.D.

Squalus japonicus Ishikawa, new species.

Acanthias vulgaris Schlegel, Fauna Japonica, Poisson, p. 304, Pl. 135, 1850; *Acanthias vulgaris*, Ishikawa, Prelim. Cat., p. 61, 1897. Not of Risso.

Body elongate, slender, tail moderately tapering behind. Head rather narrow; snout produced, pointed, upper surface flattened; nostrils nearer mouth than tip of snout, nearly midway between angle of mouth and tip of snout. Nasal flaps normally formed.

Eyes large, lateral, situated nearer first gill-opening than end of snout. Length of eyelid a little less than half distance from its anterior angle to tip of snout. Spiracles large, closely posterior to and little above eye, vertical diameter of spiracle slightly over one-third length of eye. Spiracular valve not very fleshy. Narrow groove between posterior angle of eye and lower border of spiracle.

Mouth moderate, slightly curved, situated at about three-fifths distance from tip of snout to level of first gill-opening. Upper lip well developed, lower closely attached to teeth within. Oral groove nearly straight, deep.

Teeth of upper jaw smaller than those of lower, and somewhat more erect. Gill-openings in front of base of pectoral, and slightly above, fourth and fifth gill-slits somewhat nearer together than preceding ones.

First dorsal nearer to pectoral than to ventral, its origin somewhat in advance of inner posterior angle of pectoral, midway between tip of snout and origin of second dorsal; first dorsal spine slightly less than height of fin; posterior border somewhat emarginate and slightly produced. Second dorsal about midway between ventral and caudal, smaller, posterior margin rather deeply emarginate, lower lobe moderately produced; spine as long as fin and longer than that of first. Both spines triangular, without any lateral groove, but hinder margin slightly hollowed out. Pectorals large, but shorter than head, reaching beyond origin of first dorsal, its hinder margin moderately emarginate. Ventrals midway between first and second dorsals; caudal lobes well developed. Upper caudal groove triangular and very distinct; lower rather inconspicuous.

Scales very minute, closely set; each with a median keel which ends in a point and with smaller ones on each side. Scales at extreme end of snout granular, and without any keel. Lateral line distinct.

Male copulatory organ large, with a hook-like appendage near extreme end on inner side, and with another hook on outer side proximally to the former.

Three specimens were examined, two males bought at the Tokyo market, and said to have been caught in the Sagami Bay, and a single female from Kagoshima. They are in the Imperial Museum of Tokyo.

The proportional lengths of different parts in a male specimen are as follows:

	♂	
Total length	700	mm.
Snout to nostril	42	"
Snout to first gill-slit	120	"
Snout to mouth	75	"
Nostril to mouth	30	"
Mouth to anus	276	"
Diameter of body at first gill-slit	74	"
Diameter at spiracles	73	"
Length of upper caudal lobe	132	"
Length of lower caudal lobe	72	"
Base of first dorsal	30	"
Height of first dorsal	39	"
First dorsal to ventral	43	"
Base of second dorsal	24	"
Height of second dorsal	25	"
Second dorsal to upper caudal lobe	73	"
Length of pectoral	88	"
Breadth of pectoral	60	"
Eye to dorsal end of first gill-slit	44	"
Distance between nostrils	33	"
Gape	36	"
Length of eye	26	"
Length of oral groove	24	"
Deepest part of oral groove	8	"
Snout to eye	50	"
First dorsal spine to second dorsal spine	230	"
Eye to first gill-slit	45	"
Snout to first dorsal spine	220	"
Length of first dorsal spine	38	"
Dorsal margin of dorsal fin	63	"
Length of second dorsal spine	49	"
Dorsal margin of second dorsal fin	47	"

General Considerations.—Judging from the very scanty literature we have, I am inclined to consider the present species to come nearest to

Acanthias blainvillii of Risso, from which it differs only in the position of the first dorsal, the origin of which Günther gives as being placed "conspicuously in advance of the inner posterior angle of the pectoral" (Günther, *Catalogue of Fishes*, Vol. VIII, p. 419, 1870), otherwise it accords well with the description given by Müller and Henle to this species (Müller and Henle, *Plagiostomen*, 1841, pp. 84–85), so that I was rather inclined to regard our specimen to be the same species. Since, however, the descriptions of these authors are very short, making the identification of the species difficult, I have allowed myself to propose a new name for our Japanese form.

A fact of some interest regarding this species, however, is the presence of two hooks attached to the copulatory organ in our forms, whereas Müller and Henle give it to be the generic character of *Acanthias* that the "Männchen haben an der äussern Seite des Endes der Anhänge *einen* beweglichen, am Ende wenig gekrümmten Dorn oder Stachel." Whether the second spine we find in our specimen does exist in the specimens of these authors, or whether it was overlooked by them, which fact is, judging from the otherwise very careful and accurate descriptions of the German authors, very improbable, I am at loss to form any definite opinions. In case, however, the first alternative proves to be the fact, then the specific distinction of our forms is beyond any doubt.

This species is well distinguished from the more common Japanese species of this genus, *Squalus mitsukurii* of Jordan and Snyder.

ANIMAL NAMES AND ANATOMICAL TERMS OF THE GOSHUTE INDIANS.

BY RALPH V. CHAMBERLIN.

The Indians commonly known as Goshutes represent a tribe of the great Shoshone family, now much reduced in numbers. At this time the remnant of the tribe is gathered principally in two colonies, one located in Skull Valley, Utah, and the other across the desert in Deep Creek (Ibapah), near the Utah-Nevada border. Permanent camps existed in these same places long before the advent of white settlers. The Indians of these two colonies had a single tribal organization, the last recognized chief of which, Ta'bi by name, died a number of years ago.

The Indians that formerly held possession of the region from Salt Lake Valley to Weber Valley were close in language and customs to the Goshutes proper; but they had a distinct tribal organization. Their last chief, named Goship, is said to have been buried south of Salt Lake City, near the present site of the State Prison. According to the statement of survivors of this band, in the days of Goship's prime, when he seems to have been renowned as a war-chief, his followers numbered some thousands. Beginning with the advent of the Mormon pioneers, however, a rapid decrease in this band occurred, so much so that in a surprisingly few years it was practically extinct. The principal agency in this decimation was certain diseases, brought by the whites, to which the natives had never before been exposed, and to which, as a consequence, they had acquired no special resistance. They died off, it is said, by the hundreds. Almost overnight an entire camp would be swept free of every living soul. In 1848, for example, an epidemic of measles broke out among them. Ignorant of the proper treatment of the disease, and not knowing whence it came, many assembled at the Warm Springs north of Salt Lake City, and sought relief by bathing in these waters. They died off in large numbers, as many as forty being heaped in a single grave. The few individuals that now survive from a once proud tribe have taken up their abode with neighboring tribes and bands. The Goshutes proper, in the valleys to the west, also suffered strong reduction.

The languages of the Goshutes and of the Goships, as we may conveniently and in accordance with their own usage designaté the Indians of the two chieftaincies above mentioned, are very close to that of the Shoshones proper, much closer than to that of Utahs, notwithstanding some widespread statements to the contrary. Between the dialect used by the Goships and that of the more western bands the differences are largely phonetic, certain sounds in one replacing certain ones in the other with great regularity. Thus, *y* at the beginning of syllables in Goshute words commonly becomes *n* in the Goship. For example, *yĭñ'ŭp*, Goshute for sternum, becomes *nĭñ'ŭp* in Goship; and, similarly, *pai'ya*, Goshute for wasp, becomes *pai'na*. The names for less common animals or other objects were occasionally quite different. Even between the Indians of the Skull Valley and Deep Creek bands, between which there has been continual intercourse and migration, certain phonetic differences in language are found. Thus, the sound of *z* in the Skull Valley dialect commonly changes to the sound of *th* in the Deep Creek; *e.g.*, *ma dzi'ka*, to cut, and *madza'tua*, to close, in the former, become respectively *ma dthi'ka* and *ma dtha'tu a* in the latter.

In the present paper I give a list of animal names and anatomical terms used by these Indians. Where differences between the terminology of the Goshutes and that of the Goships are known to exist the different forms are given. Where no such difference is indicated the term given is to be regarded as common to both in most cases. Many of the names of animals are imitative, as is true of a larger number in our own tongue than we commonly realize; a large number are descriptive of feature or habit; while fewer have some legendary reference. No effort is made in this place to present such philosophy as this people had or has concerning the animal world, their animal legends, or their many observations upon the habits and characteristics of the different forms. Where the significance of a name is sufficiently clear the analysis is indicated. Some of the names, because of age, seem to have undergone changes, rendering analysis no longer possible.

Certain endings and significant syllables occurring frequently may be noted with advantage.

1. The nominal ending *-nŭmp* or *-ŭmp* is affixed to verbs to indicate the means or instrument by which the actions represented by the verbs are performed. For example:

ha'vi nŭmp, bed; from *ha'vi do*, to lie down, and *-nŭmp*.
tĭ'tsi a nŭmp, table-fork; from *ti'tsi*, to stick into, and *-nŭmp*.

Less commonly it is used in the same sense as *-ŭp* or *-p* as indicated under 2.

2. The ending *-ŭp* or *-p* is used.

(*a*) As a nominal ending indicating the object, substance or material produced or involved. For example:

tĭk'ŭp, food; from *dĭ'ka rro*, to eat, and *-ŭp*.
pa'gĭn ŭp, cloud; from *pa'gĭn*, to produce water, and *-ŭp*.

(*b*) As an adjective ending. For example:

wi'do ŭp, leaky; from *wi'do ĭn*, to leak, and *-ŭp*.

3. The particle *na*, used both as prefix and affix, designates a support, instrument or means. For example:

na'dzi ta, walking cane; from *na*, and *dzi'ta*, a stick or rod.
na'tze ya, handle; from *na* and *ma tze'ya*, to carry.

4. The particle *do* or *rro* is common

(*a*) As an ending in verbs, particularly in those indicating personal action. For example:

ka'rri do, to sit down.
gĭts'hwai do, to chew.

(*b*) As a nominal ending, designating the thing as the agent performing or the thing concerned in some action or object. For example:

ma'si do, finger-nail; from *ma*, the hand (in compounds), *si*, indicating extension in plate-like form, and *do*.

5. *ma*, a particle indicating the hand or relation to the hand. For example:

ma'so gi, finger.
mam'bi shu ga, to rub the hands together.

6. *da*, a particle similarly indicating the foot or relation to it. For example:

da'so gi, toes.
da'pi shu ga, to rub or scrape with the foot.

7. *tso*, a particle often used as referring to or meaning the head. For example:

tso'tĭ gi nŭmp, pillow; from *tso*, *ma tĭ'gi*, to place, and *-nŭmp*.
tso'go tĭn, to bump the head; from *tso* and *go'tĭn*, to strike.

8. *bi*, a particle widely used to indicate life or part of a living body. For example:

bi'a or *bi*, the heart.
-bĭtc, an affix frequent in animal names; as *mom'bĭtc*, owl, and *tu'ko-bĭtc*, wildcat.
pam'bi, head; from *pam* (*pa*, top, *-m*, adj. ending) and *bi*.
tĭm'pi, mouth.

This particle was, it seems, formerly the ending in the names of some parts of the body now designated by different terms, in some of which the particle no longer occurs. Thus for head there was a more ancient term, *tso'pi*, the first syllable of which is now alone used as indicated under 7. Foot, now designated by *namp*, seems to have had another name, *da'pi*; and similarly with hand, for which the present term *moq* was apparently preceded by *ma'bi* or *mam'bi*. The first syllables in these are used in similar way to *tso*, as indicated under 5 and 6.

9. *wa* as a verbal particle means to bend, to turn aside, to wriggle. Probably secondarily it means to produce, etc. Hence in some Shoshone dialects, used alone, it means infant, young. It is frequent in names of animals, where its primary use would seem to be to indicate a young animal, or an animal so regarded.

ai'wa, a fawn.
wa'bi, a worm.

10. *T*, *s*, *ts*, *tc*, *tci*, and *k* are noun endings, the exact force of which need not be here discussed.

11. *N* or *m* added to a noun converts the latter into an adjective. For example:

pa, water; *pam*, aquatic.
ni'wa, liver; *ni'wam*, hepatic.

When a merely phonetic difference exists between words as used in Skull Valley and Deep Creek, the pronunciation of the former is followed, that of the latter being readily derivable from it. The values of the different letters as used in the present paper are indicated below.

a, e, i and o when unmarked are given their usual long sound in European tongues.

ă is sounded like a in fat.
ĕ is sounded like e in met.
ĭ is sounded like i in pit.
ŭ is sounded like u in butter.
ü is sounded like ü in German müde or as u in the French lune.
u is sounded like oo in boot.
ai is sounded like ai in German Kaiser or i in bite.

oi is sounded like oi in boil.
q is sounded like ch in German lachen, Dach, etc.
sh is sounded as in shell.
tc is sounded like ch in English chance, or like c in Italian cicerone.
rr is sounded with a roll as in the Spanish perro.
ñ is sounded like ng in the English words sing, gong, etc.
Other consonants have their usual force in English.

English-Goshute.

A.

abdomen; belly:
  sap.
  bo′tsi (Deep Creek, in addition to sap).

after-birth:
  ga′rrĭp.

animal:
  mi′a gwain.

ant (general term):
  a′ni.

ant, red (*Pogonomyrmex occidentalis*, var.):
  a′ni gwi tchŭk.
  a′rran gotsabi (Goshute, D. C.).

ant, black (*Camponotus pennsylvanicus*, etc.):
  a′ni.
  a′rra si wĭtc (Goshute).
  This ant and related forms is said to have been eaten formerly by the western Goshutes during times of scarcity. The red ant, because of its strong taste, was not eaten. The ants were gathered by being allowed to cover thickly a hide spread over their nest, and were then brushed off into a suitable receptacle or bag. They were cooked by being placed in hot ashes in a wicker or other vessel.

ant, velvet (*Mutilla*, etc.):
  ga′go (Goshute, D. C.).
  This name means "grandmother."

antelope (*Antilocapra americana*):
  (*a*) female: kwa′ri.
  (*b*) male: pi′ŭ wants.

antenna (as of locust):
  ap.
  [*a*, process, horn, etc. + *p*.]
  gwa′shi bŭ hŭ (this term was applied to the long antennæ of the crayfish).
  [*gwa shi*, tail or tail-like object + *bŭ hŭ*.]

anus:
  gwi′tŭts.
  [*gwi* (*kwi*), a root meaning to shoot forth, expel, etc. + *tŭts*, the latter likely composed of *to*, designating a tube-like object + *ts*, nominal ending.]

aorta:
  Bi′a mo ko.
  [*bi′a*, heart + *mo′ko*.]

arm:
  bu′i do; bü′rro.

avocet (*Recurvirostris americana*):
pa'rro gots; pa'do gots.
[*pa*, water + *rro* or *do* (*vid. supra*) + *gots*.]
axilla; arm-pit:
a'na.
axolotl (larva of *Amblystoma*):
pa'bo go tci.
[*pa*, water + *bo* (*po*) + *go tci*.]

B.

back:
gwai'ŭmp; gwai'ŭm.
back-bone; vertebral column:
gwai'o rra.
[*gwai'ŭmp*, back + *o'rra*, trunk, stalk, etc.]
badger (*Taxidea americana*):
u'na.
bangs; front hair:
mo'pi bañ ga sa (*mo pai bañ ga sa*).
[Prob. *mo'bi*, nose + *bañ'ga-sa*, general term for pendent hair or locks, *q. vid.*]
bat (general term):
o'na bĭtc.
beak; bill (of bird):
mĭ'tcu ga; mĭ'tcŭg.
bear, general term:
wu'da.
bear, black (*Ursus americanus*):
(*a*) black: tu'wu da.
[*tu*, from *tu'o bĭt*, black + *wu'da*.]
tu'mŭ su i; tu'mŭsh.
[*tu*, black + *mŭ'su i*.]
(*b*) brown: o'a wu da.
[*o'a* from *o'a bĭt*, yellow or brown + *wu'da*.]
o'a mŭ su i; o'a mŭsh.
[*o'a*, brown + *mŭ'su i*.]
oi'ya rro.
bear, grizzly (*Ursus horribilis*):
a'shi wu da.
[*a'shi*, from *a shi bĭt*, gray + *wu'da*.]
to'sa wu da.
[*to'sa*, from *to'sibĭt*, white, gray + *wu'da*.]
beaver (*Aplodontia rufa*):
ha'ni; a'ni.
pa'o ŭnts; pa'o ŭnts a ni.
[*pa'o*, referring to water + *-ŭnts*.]
bee, bumble (*Bombus*, various species):
ĭ'bi mŭ.
pi'ĭ bi mŭ.
[*pi'ŭp*, big + *ĭ'bi mŭ*.]
bee, honey (*Apis mellifica*):
tai'bo pai na (Goship).
[*tai'bo*, white man + *pai'na*, wasp, bee.]
tai'bo pai ya (Goshute).
beetle (general term):
ĭ'sha gŭ; ĭ'sha gi a.
[*i'sha*, wolf + *gŭ*, probably from *gi'a*, to bite, to eat, etc.]
Beetles are called "wolf's food," because said to be eaten at times by the coyote and wolf.
beetle, wood-borer, larva of:
a'rrŭts (Goship).
u'o a bi (Goshute).
beetle, dung (*Aphodius*, etc.):
kwi'tŭ bu i.
[*kwit'ŭp*, manure + *bu'i*.]

beetle, lady-bird (*Coccinella*, etc.):
?a′ka na bun.
[*a′ka*, branch, etc. + *na* + *bun*, thing resting or living upon, etc.]

beetle, tumble-bug:
wo′tsa wan dĭ tci.
[*wo′tsa wan*, to roll + *bĭ tci*.]
The name of these beetles is given in reference to their well-known habit of forming balls of manure which they roll often long distances before depositing their eggs in them.

beetle, water-scavenger (*Hydrophilus*):
tu′ban di sip.
[*tu* from *tu′o bĭt*, black + *pa*, water + *n*, adjective ending + (prob.) *di′si*, signifying, from its composition, to stick or press into, press through, pass through, etc. + *p*, nominal ending.]
The latter part of this name, *ban di sip*, is a somewhat general term applied to various aquatic forms, both animal and plant.

bile:
ni′wam bu i.
[*ni wa*, liver + *m*, adjective ending + *bu i*.]

bile-duct:
si′gwa na di wok.
[*si′gwa* + *na′di wok*, indicating a connecting tube or cord, etc.]

bird (general term):
oi′tcu; hoi′tcu.

bison (*B. americanus*):
(*a*) cow: tsa′kwĭtc u; sa′kwĭtc-u. tĭ′bĭ tci gwĭtc.
[*tĭ′bĭ tci*, true + *kwĭtch*, from *kwĭtcen*, a word now commonly applied to the domestic cow (*Bos*).]
(*b*) bull: po′i jĭn.

bittern, American (*Botaurus lentiginosus*):
mo′pũñ gwi.
This name is imitative of the Spring song or "booming" of this bird, which is well represented by the repetition of these syllables six or seven times, with the accent strongest upon the second syllable and the last one sounded least distinctly.

black-bird (general term):
pa′gŭn sŭk.

black-bird, red-winged (*Agelaus phœniceus*):
puñ′go pa gŭn sŭk.
[*pŭn′go*, horse + *pa′gŭn sŭk*.]
The name of "horse-blackbird" is given to this species, because observed frequently to follow after horses in fields in order to work over the droppings.

black-bird, yellow-headed (*Xanthocephalus icterocephalus*):
sai′pa gŭn sŭk.
[*saip*, bulrush + *pa′gŭn sŭk*, blackbird.]

bladder, urinary:
sip.
[*sip* in strictness means the

urine (*q. vid.*), but is also applied to the urinary sac.]

si'mo gŭts.

[*sip*, urine + *mo gŭts*, pouch or sac.]

blood:

bu'ŭp; bwap.

blood-vessel (vein or artery):

bai'bŭp; bai ŭ bi; bai.

[*bai*, to fill or swell + *bu'ŭp*, blood.]

blue-bird, Rocky Mountain (*Sialia arctica*):

ho'ka du i; wo'kwa du i.

bob-white (*Colinus virginianus*):

tai'bo hu i tcu.

[*tai'bo*, white man + *hu'i tcu*, bird.]

?wu'pa mu gi; wu'pa mu gi gaha (Goship).

[*wu'pa*, probably from *ma-wu'pain*, to beat + *woo'gi*, with or without *ga'ha*.]

Not a native of but early introduced into Utah. Thus the first name.

bone:

dzo'nĭp.

brain:

ku'bĭsh.

tso'ku bĭsh.

[*tso*, pertaining to the head + *ku bĭsh*.]

bug, stink (Pentatomid):

a'ka na buñ.

[*a'ka*, branch of tree, etc. + *na* + *buñ*, that which lies or rests upon, etc.]

kwi'tŭ pĭ shu ĭnt.

[*kwit'ŭp* + manure + *pĭ shuĭn* + *t*.]

This term, obtained from a Deep Creek Indian, is not in general use.

pĭñ'ŭts.

Of these three terms the first is the standard.

bug, giant, water (*Belostoma*):

ban'di sip.

[*pa*, water + *n*, adjective ending + prob. *dĭ'si*, to thrust into, pass through, etc. + *p*.]

butcher-bird (*Lanius borealis*):

tĭn'tso na.

butterfly (general):

hai'po rrŭñ.

buttocks:

bĭ'ta go.

C.

caddis-worm:

pa'si wŭt.

[*pa*, water.]

calf:

kwĭtc'ĕn du a.

[*kwĭtc'ĕn*, cow + *ĕn du'a*, young one, etc.]

calf (of leg):

witc.

caribou (*Rangifer*):

?tu'pa rri a (Goship).

See Moose.

carp (*Cyprinus carpio*):

tai'bo păñ wĭtc.

[*tai'bo*, white man + *păñ wĭtc*, fish.]

Called by this name because introduced into the region by white men.

carpus; carpal bone:

pi'a ma tso ni.

[*pi'ŭp*, large + *ma*, pertaining to the hand + *tso'ni*, *tso'nĭp*, bone.]

cartilage:
si'no wi.

caterpillar (of *Samia*, *Archippus*, etc.):
pi'a ga.

caterpillar (various hairy forms):
pu'i wa bĭt.
[*pu'i* + *wa'bi*, worm.]

cedar-bird (*Ampelis cedrorum*):
wa'wĭ tco go bĭtc.

centipede (*Scolopendra;* also *Lithobius*, etc.):
tĭm'pĭn to go a.
[*tĭm'pi*, stone, etc. + *n*, adjective ending + *to' go a*, rattlesnake.]

cerebellum:
te'e ku bĭsh.
[*te'e*, small + *ku'bĭsh*, brain, nerve material.]

cerebrum:
pi'a ku bĭsh.
[*pi'ŭp*, large + *ku'bĭsh.*]

chickadee, black-capped (*Parus atricapillus*):
ĭ'jŭ gi.
[Imitative.]

chickadee, mountain (*Parus montanus*):
a'ni ki.
[Imitative.]
The call of this bird is represented by the Goshutes as *a'ni kĭ*, *kĭ*, *ki*, etc.

cheek:
sob.

chin:
gĭ'pĭñ go.
[*gĭ'piñ*, pertaining to mouth + *go*, bending round, angle, etc.]

chipmonk (*Tamias lateralis*):
hoi.

chub (*Leuciscus*):
wi'tca păñ gwĭtc.

cicada, two-year, or dog-day harvest fly (*Cicada tibicen*):
gi'a; gŭ.
The cicada and its larvæ were formerly used as food when abundant. They were placed in holes lined with hot stones, covered, and allowed to remain thus until cooked.

cicada, seventeen-year (*Cicada septendecim*):
ta'bi da.

clam, fresh-water (*Anodonta*):
wa'go ŭn du ru a.
[*wa'go*, frog + *ŭn*, article + *du ru a*, child.]
wa'go (short for that above).

clam-shell:
wa'go ŭn kar ni.
[*wa'go*, short for clam + *ŭn*, article + *kar'ni*, house, enclosure, etc.]

clavicle:
o'ko.
tso'ni wok.

claw. See finger-nail.

coccyx:
gwa'shi tso nĭp.
[*gwa'shi*, tail + *tso'nĭp*, bone.]

colt:
  pŭñ′go ĕn du a.
    [*pŭñ′go*, horse + *ĕn* or *ŭn* + *du a*, young one.]
comb:
  ăñ′ka go si ŭp.
    [*ăñ′ka bĭt*, red + *go si ŭp*.]
cow (*Bos*):
  kwĭtc′ĕn.
cow-bird (*Molothrus ater*):
  pa′su ŭm pa gŭn sŭk.
    [*pa′su ŭmp*, sand + *pa′gŭn-sŭk*, black-bird.]
coyote (*Canis latrans*):
  i′jŭ pa.
crane, blue. See blue heron.
crane, northern brown (*Grus canadensis*):
ko′rra.
    [Imitative.]
crane-fly (*Tipula*, etc.):
  i′jŭ pa mo po.
    [*i′jŭ pa*, coyote + *mo′po*, mosquito.]
    This name, "Coyote mosquito," is legendary.
  pi′a mo po (not approved).
    [*pi′a*, big + *mo po*, mosquito.]
cray-fish:
  pa′to go bi.
    [*pa′to* + *go′bi*, face.]
cricket, black (*Anabrus simplex*):
  mă′so.
    These crickets, in particular, were formerly regularly eaten when abundant, being roasted in pits lined with hot stones and covered (*vid.* under *Cicada*). Sometimes they were eaten without previous cooking. During certain seasons this form occurred in vast swarms or "armies," at such times furnishing an easily obtainable, abundant and relished food-supply. It is likened by the Goshutes to the shrimp, which, indeed, they term the "fish-cricket" (*mă so-pañwĭtc*). This cricket and the *Cicada*, which occurred in similar abundance, were apparently the most important sources of Arthropod food.
cricket, common (*Gryllus*):
  tsu′rru pĭntc (Goship).
  tsu′du kŭm bĭtc (Goshute).
  tsĭn′a pĭntc (Goshute).
  ti′da kŭm.
crow (*Corvus americanus*):
  hai.
curlew (*Murenius longirostris*):
  ko′hwi (Goship).
  ko′ki (Goshute).
    [Imitative.]

D.

deer, black-tailed or mule:
  (*a*) general term: so′ko rri.
  (*b*) male: so′ko rri ŭn gu ŭm pa.
    [*so′korri* + *ŭn*, article + *gu-ŭm pa*, male, mate.]
deer, white-tailed or Virginia (*Odocoileus virginianus*):
  jo′gwi.
deerskin:
  so′ko rra ĕm bur.
    [*so′korri*, deer + *ĕm bur*, hide.]

dew-claw:
ma'bin tca.
[*ma'bĭn*, pertaining to the hand, etc. + *tca*.]

diaphragm:
a'bo.

dipper or water ouzel (*Cinclus mexicanus*):
pau'wi tcu; pau'oi tcu.
[*pa*, water + *oi'tcu*, bird.]
During times of drought, the Goships claim, rain may be brought by grinding up the flesh of one of these birds, casting the same overhead and pronouncing certain sentences.

dog (*Canis famliaris*):
sa'dctĭ; sa'rrĭtc; sa'rri.

dove, mourning (*Zenaidura carolinensis*):
ai'wi.

dragon-fly (general term):
pa'ga mu tu nats.
[See humming-bird.]

duck (general term):
bu'i.

duck, black-head (*Fulix affinis*):
tu'pam pi bu i.
[*tu*, black + *pam'bi*, head + *bu'i*.]

duck, golden-eyed (*Glaucionetta clangula americana*):
ko'ka pĭ gĭn.
[Reference to whistle or whirr produced by wings.]

duck, mallard (*Anas boscas*):
pi'a bu i.
[*pi'ŭp*, big + *bu'i*.]

duck, red-head (*Fuligula ferina americana*):
ăñ'ka pam pi bu i.
[*ăñ'ka*, from *ăñ'ka bĭt*, red + *pam'pi*, head + *bu'i*.]

duck, pin-tail (*Dafila acuta*):
wo'vĭñ gwa shi bu i.
[*wo'vĭñ*, pole, sprout, etc. + *gwa'shi*, tail + *bu'i*.]

duck, spoonbill or shoveller (*Spatula clypeata*):
so'a bu i.

duck, teal (general term):
so'ko bu i.
[*so'kŭp*, ground + *bu'i*.]
The name, "ground duck," refers to the habit of these ducks of nesting upon the ground rather than among rushes in water.
tĭ'sa bu i.
[*tĭ'sa*, small + *bu'i*.]

duck, teal, blue-winged (*Querquedula cyanoptera*):
ăñ'ka so ko bu i.
ăñ'ka tĭ sa bu i.
[*ăñ'ka bĭt*, red + *so'ko bu i* or *tĭ'sa bu i*, teal duck.]
The name refers to the cinnamon-colored breast.

duck, wood (*Aix sponsa*):
o'bĭñ bu i.
[*o'bĭñ*, pertaining to wood + *bu'i*.]

dura mater:
dzo'po a.
[*dzo*, pertaining to the head or brain(?) + *bo'a*, skin, etc.]

E.

eagle (general term):
gwi'na.

eagle, bald (*Haliæetus leucocephalus*):
pa′si a.

eagle, golden (*Aquila chrysætos*):
pi′a gwi na.
[*pi′ŭp*, big + *gwi′na*.]

ear:
năñ′kŭs; năñk.

ear-hole:
năñ′kĭn dain.
[*năñ′kĭn*, pertaining to the ear + *dain*, hole.]

ear, lobule of:
năñ′kĭn du a.
[*năñ′kĭn*, pertaining to the ear + *du′a*.]

earth-worm (*Lumbricus*, etc.):
so′ko wa bi (Goshute).
pa′u wa bi; pa′u hwŭp (Goship).
[The first term consists of *so′kŭp*, earth + *wa′bi*, worm; the second of *pa′u*, pertaining to water + *wa′bi* (cf. German *Regenwurm*).]

egg:
noi′ya.

elbow:
gip.

elk (*Cervus canadensis*):
(*a*) general term: pa′rra hi.
(*b*) male: pa rri ĕn gu ŭm pa.
[*pa′rri* + *gu′ŭm pa*, male, mate.]

esophagus:
dĭñ′gi ok.

eye:
bu′i; bu.

eye-brow:
gai′ba.

eye, humor of:
bu′i pa.
[*bu′i*, eye + *pa*, water.]

eye, lens of:
bu′i rrĭn du ga.

eye-lash:
bu′rro sip.
[*bu′i*, eye + *rro* + *sip*, that which protrudes in plate- or leaf-like form, etc.]

eye-lid:
bu′i bo ŭmp.
[*bu′i*, eye + *bo*, cover, etc. + *ŭmp*.]

epiglottis:
ai′go bi shi a.
[*ai′go*, tongue + *bi* + *shi′a*.]

F.

face:
go′bi; gob.

fat:
yuq.
[so′yo hobui; so′yo ho bwi.]

fawn, young of deer:
ai′wa.
[Probably *ai*, to spring or leap, etc. + *wa*.]

feather:
shi′ŭp.
ga′sa gŭnt; ga′sa (applied commonly to long wing feathers. Cf. wing).

ferret, black-footed:
kwi′pu ka (Goship).
[Said to be imitative, the cry being represented as *kwĭp*, *kwĭp*, *kwĭp*.]
The identification was from figure and description of habits.

fetlock:
ma′pŭ.
[*ma*, hand, paw, etc. + *pŭ*.]

fetus:
du′ĭ tci.
[*du′a*, child, young + *tci, tsi*, diminutive.]

fin (of fish):
pa′wu gi.
[*pa*, water + *wu′gi*, flail, etc.]

finch, Allen's rosy (*Leucosticte australis*):
kai′ma.
pi′a kai ma.
[*pi′ŭp*, large + *kai′ma*.]

finch, crimson (*Carpodocus purpurea*):
kai′ma.

finger (general term):
ma′su·ĭ ki.
ma′so gi.
[*ma*, hand, pertaining to the hand + *su′ĭ ki* or *so′gi*, indicating things repeated or of the same kind.]

finger:
(*a*) index: ma′tsi tsuk.
(*b*) little: ma′tu a.
(*c*) middle or second: ma′ti bi-a ka.
(*d*) third: tu′i ma tsi tsuk.

finger-nail; claw:
ma′si do.
[*ma*, hand, pertaining to hand + *si′do*, to protrude in plate-like form, plate-like object protruding.]

flesh, meat:
du′ku; tu′kwa.

fly, horse (*Tabanus*):
pi′pĭ ta.

fly, horse, banded (*Chrysopa*):
on′ti ya kwa.
[*on′ti*, probably from *on ti gait*, brown + *ya′kwa*.]

fly, house (*Musca*):
a′ni bo.

fly-catcher, yellow-bellied (*Empidonax flaviventris*):
pĭn′ji rrŭ.

fly-catcher, yellow-bellied striped (*Myodinastea luteiventris*):
añ′i ta; wañ′i ta.
[*añ′ go*, timber, etc. + *i′ta* (cf meadow-lark.)]

foot:
namp.
[Apparently *na*, support, that which is beneath and supports, etc. + *ŭmp*, nominal ending (*vid. ante*).]

forehead:
ga; gai.

foreskin:
pa′skĭn ĭp.

fowl, domestic:
(*a*) general: tai′bo ka ŭm buñ.
[*tai′bo*, white man + *ka ŭm-buñ*.]
ka ŭm buñ ŭm gum pa.
(*b*) cock.
[*ka′ŭm buñ* + *gum′pa*, male mate, etc.]

fowl, guinea (*Numida meleagris*):
wi′jŭn gwi na.
[*wi′ja*, sage-hen + *gwi′na*.]
Socalled because thought to resemble in some ways the sage-hen.

fox, general term:
wa′ni.

fox:
(*a*) gray: to′sa wa ni.
[*to′sa*, from *to′sibĭt*, white or gray + *wa′ni*.]
(*b*) kit or burrowing: yĭ′ba.
(*c*) red: wai′am bĭtc.
on′ti wa ni.
[*on′ti*, from *on′ti gait*, reddish brown, etc. + *wa′ni*.]
(*d*) silver or black: tu′wa ni.
[*tu*, from *tu′obĭt*, black + *wa′ni*.]

G.

gall-bladder:
ni′wam bu i.
ni wam bu i tsuk.
[*ni′wa*, liver + *m* + *bu′i*, blood, fluid, etc. *Tsuk*, when not added, is to be understood. It means sack or pouch. (Cf. bile.)]

gill (of fish):
pa′so na.
[*pa*, water + *su′na*. Cf. lung.]

giraffe:
pai′wa.
This name was applied by these Indians to certain mythical creatures with long necks which were supposed to live in the Warm Spring Lake north of Salt Lake City, in which they were supposed to have holes. When the giraffe was first seen by them at circuses exhibiting at Salt Lake, they immediately identified it with the creature they claimed formerly dwelt in the lake before mentioned.

gizzard:
bi′bonts.

goat, Rocky Mountain (*Oreamnos montanus*):
ka′ni ru ŭnts; ka′ni runts.

goat-sucker (*Chordeiles virginianus*):
ho′i dŭk.

glans penis:
wu′ĭm pam bi.
[*wu*, penis + *m* + *pam′pi*, head.]

goldfinch, Arkansas (*Astragalinus psaltria*):
tu′kai yam pa.
["Bird that calls at dark," is the effect of this compound.]

goose, Canada (*Branta canadensis*):
nu′gŭn ta.

goshawk, Western (*Accipiter atricapillus*):
să′na kwi na.
[*să′na* + *gwi′na*, general term for certain large-sized bird, eagle, etc.]

gopher, pocket (*Geomys*):
i′a bĭtc.

grasshopper, long-horned (*Orchelimum*, etc.):
a′ma tsu bĭtc (Goship).
a′wa tu bi (Goshute, D. C.).

grebe, Western (*Æomophorus occidentalis*):
ti′i dĭts a pam buñ.
ti′i dĭts a pam buñ ăñ ka bu i.

[*ti'i dĭts*, small + *pam'buñ*, swimmer, etc. + with or without *ăñ ka bui*, red eye, in reference to this well-known feature of the bird.]

grebe, American eared, or Hell-diver (*Auritus californicus*)
noi'ya wu ta.
[*noi'ya*, egg + *wa'to*, two, changed to wu'ta for euphony.]

grosbeck, black-headed rosy (*Zamelodia melanocephala*):
mo'bi os.
[Name refers to the conspicuous beak or nose (*mo'bi*).]

grouse, pine (*Canice obscura*):
wañ'go ha; añ'go go ha.
[*wañ'go*, timber + *ga'ha*, general term for this type of bird.]

grouse, Canada (*Canace canadensis*):
ko'go.
My informants claim that this grouse was formerly fairly common in Weber Valley. The identification was from figure, no specimen being available.

ground-squirrel (*Spermophilus*, various species):
kĭm'ba.

gull, California (*Larus californicus*):
pa'u a.
[*pa*, water + *u'a*, possibly, from composition, to move or glide above.]

H.

hair (general term):
(*b*) of head: wu.
pam'pi wu.
[*pam'pi*, head + *wu*.]
(*c*) front locks ("bangs"): mo'pai bañ ga sa.
(*d*) hind locks: bañ'ga sa.
[Probably *bañ*, top, pertaining to head, etc. + *ga'sa*, wing or similar object.]
(*e*) of pubic region: su'ŭp.

hair-snake (*Gordius*):
pan'du rra; ban'du rrai.
[*pan*, aquatic + *du'rra*.]

hand:
(*a*) general term; right: moq; mok.
(*b*) left: kwi'ba.

hand, heel of:
ma'piñ go.
[*ma'biñ*, pertaining or belonging to the hand + *go*, angle, bend, etc.]

hawk, chicken (*Accipiter cooperi*):
pan'dza ya.

hawk, duck (*Falco peregrinus anatinus*):
pa'gi ni.

hawk, fish (*Pandion haliætus*):
pa'nŭñ ka.
[*pan*, aquatic + *un* + *ka*.]

hawk, marsh (*Circus cyaneus hudsonius*):
ki'ni.

hawk, rough-legged (*Archibutio lagopus sancti-johannis*):
năn'du ga.

hawk, rough-legged, ferruginous (*Archibuteo ferrugineous*):
nă̌n′doi.

hawk, pigeon (*Falco columbarius*):
ko′na gi dĭ ka.

hawk, sharp-shinned (*Accipiter velox*):
o′a da.

hawk, sparrow (*Falco sparverius*):
gĭ′di dĭ ki.
[Imitative, the call being represented as *gĭ′di, gĭ′di, gĭ′di,* etc.]

hawk, red-shouldered (*Buteo lineatus*):
ash′i um a da.
ash′i u a da.
[*a′shi bĭt*, gray, grizzly, etc. + *o′a da.*]

hawk, Swainson's (*Buteo swainsoni*):
nañ′gai.

head:
pam′bi; pam′pi.
[*ba, pa,* top, etc. + *m,* adjective ending + *bi,* life, part of living body, etc.]

heart:
bi′a; bi; bi′hi.
[*bi,* life, living thing or part, etc.]

heart, auricular and ventricular cavities of:
bi′am bai hyu.

heart, valves of (tricuspid and mitral):
bi′am nam ba.

heel of foot:
da′pĭñ go.
[*da′piñ,* pertaining to the foot + *go,* angle, etc.]

heron, black-crowned night (*Nycticorax nycticorax nævalis*):
to′sa ko kwa jo.
[*to′sa,* from *to′si bĭt,* white + *ko′kwa jo,* crest, etc.]

heron, great blue (*Ardea herodias*):
ko′kwa jo.
[The name means a crest, the reference being to the long crest at the back of the head of this bird.]

hip:
dzi′ŭmp.

hip-bone (os innominatum):
dzi′ŭñ ŭp.
[*dzi′ŭn,* from *dzi′ŭmp,* hip + *ŭp.*]

honey:
pai′yam pi na.
[*pai yam,* pertaining to bee or wasp + *pi′na,* sweet.]

hoof:
ta′si do.
[*ta,* referring to the foot + *si′do,* leaf- or plate-like object. Cf. finger-nail or claw.]

horn:
a; ha.

horn or antlers, new, in velvet:
I′gi a sañ gŭn.

horn-tail:
o′pi tu Its.
o′bIn bi duts.
[*o′bĭn,* pertaining to wood + *tu′ĭts,* apparently borer, hole-maker (cf. mud-dauber).]

horned toad (*Phrynosoma douglasii*, etc.):
ma'ki jŭñ ŭk.

horse:
pŭñ'go.

humerus:
dzo'ŭp.

humming-bird (general term):
mu'tu nats (Goship).
pa'ga mu tu nats; ti'bi tci pa ga mu tu nats (Goshute).
[*mu tunats*, straight nose or beak; *pa'ga*, probably *arrow*, in reference to swift flight. *Tibitci* is prefixed to distinguish from dragon-fly, *q. vid.*]

hypochondriac region:
i'pŭmp.

I.

instep:
dau'wo.
[*da*, pertaining or belonging to the foot (the *a* sound changing to *au* before *w* as always) + *wo*, bow, arch.]

interdigital space or croutch:
man'na si ga.

intestines:
go'ha.

iris of eye:
gĭñ'wai bi.

J.

jay, Rocky Mountain (*Perisoreus canadensis* var. *capitalis*):
yu'rro gots.
[*yuq*, fat + *rro'gots.*]
The name refers to the fondness of birds for fat, which they boldly approach camps to obtain.

jay, long-crested (*Cyanocetta macrolopha*):
hañ'go tsai bitc.
[*hañ'go* refers to crown or crest + *tsai bĭtc.*]

jay, woodhouse (*Aphelocoma floridana woodhousi*):
tsai'bitc.

K.

katydid (general term):
u'bi a gŭn.

kidney:
da'ki po.

killdeer (*Ægialites vociferus*):
tĭn'di (Goship).
pan'di (Goshute).
[*pan*, aquatic.]

kingfisher (*Ceryle alcyon*):
păñ'gwi tsa rra pĭntc.
[*păñ'gwĭtc*, fish + *tsa'rra* + *pĭntc.*]

kite, swallow-tailed (*Elanoides forficatus*):
tĭm'bai wa ga.
[*wa'ga*, from *wa'gasaga*, forked, is applied to several birds with forked tails (cf. tern).

knee:
dañ'ŭp.

knuckle:
ma'pon dza.
[*ma*, belonging to the hand etc. + *pon'dza*, eminence protuberance, etc.]

L.

labia majora:
gwa'bi nu.

larynx:
  wai′a tĭñ.
leech (general term):
  pa′na wi tcŭt.
leg:
  mo′a; mo.
ligament, transverse of foot (*L. trans. cruris* and *cruciatum cruris*):
  dau′wĭn tca.
    [*da*, pertaining to foot + *wĭn′tca*.]
ligamentum nuchæ; also muscles of back of neck in man, etc.
  mŭ′ta.
linnet, pine (*Chrysometris pinus*):
  i′jŭ pa oi tcu aip.
    [*i′jŭpa*, coyote + *oi tcu*, bird + *aip*, that which is made.]
    This name is given because this is supposed to be one of the birds made by the coyote.
liver:
  ni′wa.
lizard (*Sceloporus*, etc.):
  po′ka ji.
lizard (*Crotaphytus wesleyenus*, and several other large forms resembling it):
  sa′bi yats.
lizard, Gila monster (*Heloderma*):
  tĭn′hu a.
lizard (large form mentioned by Indians, but not yet identified by me):
  mu′kwi ta.
locust, short-horned (general term):
  a′tŭñ; a′tĭñ.
locust, black-winged (*Dissosteira carolina*):
  ti′ba tsa rra kŭm bĭtc.
    [*ti′ba*, pine-nuts + *tsa′rra* + *kŭm* + *bĭtc*.]
    The Goshutes say that this locust shrills particularly at the season when pine-nuts are ripe, when it continually calls *ti′ba*, *ti′ba*, *ti′ba*. Hence the name.
locust (several one-striped species of *Schistocerca*):
  ba′nĭ sha.
locust, spotted form (species of *Hippiscus*):
  so′ni a tŭñ.
locust, dusky:
  tu′a tuñ.
    [*tu*, from *tu′o bĭt*, black + *a′tŭñ*.]
loon (*Colymbus torquatus*):
  pam buñ′.
    [*Vid.* water-strider.]
louse, head or body (general term):
  po′si a.
lung:
  sŭñ′wa; sŭñ′gwa; sŭñ.

M.

magpie (*Pica rustica hudsonica*):
  kwi′to wo ya.
malar bone:
  so′ba dĭ ja rrŭñ.
mamma:
  bĭ′ji.
malleolus (internal and external):
  da′pon dza.
    [*da*, pertaining to the foot + *pon′dza*, protuberance, etc.]

mandible:
a′rrŭ pa; a′rrŭp.
mantis, praying:
u′na dzi ta.
[*u*, probably wood + *na′dzi-ta*, cane, etc.]
marrow:
du′hu.
marten (*Mustela americana*):
añ′go sau wa; añ′go sau.
[*añ′go*, timber + *sau′wa*. Cf. mink.]
mastoid process or region:
năñ′go sa.
meadow lark (*Sturnella neglecta*):
i′ta.
merganser (*Mergus merganser*):
păn′gwi dĭ ka.
[*păñ′gwi*, from *pan gwĭtc*, fish + *dĭ′ka*, eater, etc.]
păñ′gwi di ka ko kwa jo.
[*păñ′gwidika*, as above + *ko′kwa jo*, crest, head appendage, etc.]
mesentery:
sa′si ga (Goship).
o′sa ni pwŭp (Goshute).
milk:
bĭ′ji.
millipede (juloid forms):
tĭm′pĭn wu a bi.
[*tim′pĭn*, pertaining to rocks, etc. + *wu′a bi*, worm; thus, rock-worm.]
mink (*Putorius vison*):
pa′sau wa.
minnow:
sai′păñ gwĭtc.
[*sai*, probably from *saip*, bulrush + *păñ′gwĭtc*, fish.]
mosquito (var. kinds):
mo′po.
mole:
ta′kŭm go ŭm bĭtc (Goship).
[*ta′ka*, snow + *m* + *go′ŭm*. possibly cutting or burrowing about + *bĭtc*; hence, snow-burrowing animal.]
ta′ka mu di wants (Goshute).
ta′ka mo di bo ŭn (Goshute).
[*ta′ka* in each, snow, as in the Goship.]
moose (*Alces americana*):
kwi′pa rri a (Goship).
[*kwi*, probably from root of *kwi′ŭmp*, lazy, slow + *pa′rri a*, elk, etc.]
The name is given in reference to the animal's lack of great speed.
tu′pa rri a (Goshute).
[*tu′*, black + *pa′rri a*, elk.]
moth, general term (as *Samia*, etc.):
ĭ′pai bi.
moth, pupa of:
ĭ′pai bi ŭñ kar ni.
[*i′paibi*, moth + *ŭñ* + *kar′ni*, house, nest.]
mons pubis:
ga′rri.
mountain sheep (*Ovis montana*):
(*a*) female: muts′ĕm bi a.
(*b*) male: du′ku.
mourning dove (*Zenaidura carolinensis*):
ai′wi.
moth, sphinx (*Deilephila*):
a′ka mo go ru ĭtc.

mouse and rat kind in general (*Muridæ*, etc.):
to'ĭmp.
mouse (*Mus*):
po'nai.
mouse, field:
kĭm'ba bo nai.
[*kĭm'ba*, spermophile + *po'nai*, mouse.]
mouse, kangaroo:
bai'a.
moustache:
mo'tso; muts.
mouth:
tĭm'pi; tĭmp.
tĭm'bĭ tci.
mucus, from nose:
mo'bi ship.
[*mo'bi*, nose + (*bi'ship*?).]
mud-hen (*Rallus*):
sai'a; sai.
muscle, general term:
rrok.
muscle, adductor hallucis, etc.:
da'ti ba na rrok.
[*da'tibana*, sole of foot + *rrok*, muscle.]
muscle, biceps:
mau'wĭntc (Goship).
bañ'gwi (Goshute).
muscle, deltoid:
dzo'a rrok
[*dzo'ŭp*, shoulder, + *rrok*, muscle.]
muscles of forearm:
ma'tsi dau (Goship).
mau'wĭntc (Goshute).
muscle, gastrocnemius, etc.:
wi'tca rrok.
[*witc*, calf of leg + *rrok*, muscle.]
muscle, frontalis:
gai'bo rro ŭn.
[*gai'ba*, eyebrow + *rro'ŭn*.]
muscle, masseter:
a'rrŭm yĭm a gĭn.
[*a'rrŭm*, from *a'rrŭpa*, lower jaw + *yĭm*, apparently raising + *gĭn*.]
muscle, orbicularis oris:
? dĭ'ga tso kai.
muscle, pectoral:
nĭ'na rrok (Goship).
yĭñ'ga rrok (Goshute).
[*nĭ'nŭp* (Goship) or *yĭñ'ŭp* (Goshute), sternum + *rrok*, muscle.]
muscle, rectus abdominis, etc.:
wo'a rra (Goship).

N.

nares:
mo'bĭn dain.
[*mo'bĭn*, pertaining to the nose + *dain*, hole.]
nasal bone:
mo'bĭn dzo nĭp (Goship).
[*mo'bĭn*, nasal + *dzo'nĭp*, bone.]
mu'tcŭk (Goshute).
[*mu*, from *mo'bi*, nose + *tcŭk*.]
navel:
si'go.
neck:
do'i ŭmp.
neck, lower lateral region of:
an'di wi a.
nerve:
du'hu.
nest, bird:
no'tso ni.

[*no*, from *noi'ya*, egg + *tso'ni*, enclosure, something surrounding, etc.]

night-hawk (*Chordediles popetue henryi*):

wai'bŭn ta.

nose:

mo'bi.

nose, ala of:

mo'bi pa nĭ gĭn.

[*mo'bi*, nose + *pa'ni gĭn.*]

nutcracker, Clarke's (*Picicorvus columbianus*):

to'a gŭts.

nuthatch (*Sitta*):

jo'gi.

O.

occiput:

ga'ŭm bĭt.

orbit of eye:

bu'i ko i kĭn.

[*bu'i*, eye + *ko'i kĭn.*]

oriole, Baltimore (*Icterus galbula*):

mo'bi os.

[*mo'bi*, nose, in reference to conspicuous beak.]

The same name is applied to the grosbeck.

otter (*Lutra canadensis*):

pan'tsuk.

[*pan*, aquatic + *tsuk.*]

ovary:

bai'hyu.

oviduct:

bai'na di wok.

[*bai*, from *bai hyu*, ovary + *na di wok*, tube, cord.]

oyster:

ăt (Goship).

Origin uncertain.

wa'go (Goshute).

[Same as clam, *wa'go ŭn du ru a* in full, or *wa'go* for short.]

P.

palate, soft; uvula:

ai'gwan du a.

[*ai gwan*, adj. form, meaning protruding (cf. tongue) + *du'a.*]

palate, hard:

a'ta ko (Goship).

mi'ta ko (Goshute).

palm of hand:

ma'ti ba na.

[*ma*, pertaining to the hand, *ti'ba na.*]

pancreas:

ni'wan da ka wĭntc.

[*ni'wan*, hepatic + *da'ka wĭntc*, term used approximately as our word "sweet-bread."]

parrot, poll:

tai'bo de gwa gwi na.

[*tai'bo*, white man + *de'gwa*, talk + *gwi'na*, bird, eagle; "white man's talking eagle."]

patella:

dañ'gŭt a mŭ.

[*dañ'ŭp*, knee.]

pelican (*Pelecanus trachyrhynchus*):

tu'ku.

penis:

wu.

pericardium:

bi'am bo a.

[*bi'am*, cardiac + *bo'a*, skin, envelope.]

peritoneum:
sa'pa go na (Goship).
[*sap*, belly + *go'na*.]
phalanx of finger, first:
ma'tso ni.
[*ma*, hand + *tso'ni*, bone, probably bone adjacent to hand.]
phalanx of finger, those beyond first (together):
na'ta wi a.
phalangid, harvestman (general term):
an'ga so gŭnts (Goship).
pa'rri a (Goshute).
[*pa'rri a*, elk.]
The reference in the second name is to the long legs, "elk legs."
phalarope, Wilson's (*Steganopus wilsoni*):
pa'na da komp.
pan'tsi kwŭt (female).
placenta:
du'i noib.
[*du'i*, from *du'i tci*, young one + *noib*.]
planarian (general term):
pan'di sip a.
[General term for various aquatic invertebrates. Cf. *Hydrophilus*.]
plover:
u'ŭn gwi wĭ ta.
[Imitative.] See snipe.
plover, ring-necked (*Ægialitis impalmatis*):
tu'pan dzo no.
porcupine (*Erethizon epixanthus*):
yu'na; yŭn.
potato worm:
ta'gŭ.
pubic region:
bu'i sip.
puma (*Felis concolor*):
to'ga rro ka.
toi'rrok.
kwi'ni a rro ko bĭtc.
to'kwŭ tsi.
pupa of *Phlegethonotus*, etc.:
bi'ji ma ku ĭnts.
[*bi'ji*, milk + *ku'i ĭnts*.]
pupil of eye:
du'u.

Q.

quill of feather:
ga'sa o rra.
[*ga'sa*, wing, large feather + *o'rra*, stalk.]
quill, porcupine:
yun'a ai gwo bi.
[*yŭn*, porcupine + *ai'gwo bi*, to prick, that which pricks, etc.]

R.

rabbit, jack (*Lepus callotis*):
kŭm.
This hare was formerly a chief dependence of the Goshutes for their animal food and for clothing. The skins were, and to some extent still are, cut into strips, which were so rolled into ropes that only fur was exposed. These were then bound into blankets (*kŭm-wĭ ga*), or made into clothes which are warm and very

serviceable. It was the custom to hold a grand hunt every year in November when great numbers of hares were killed. In these hunts the Goshutes were often joined by Pahutes and Pahvants. Cedar Valley was a favorite resort for these hunts.

rabbit, cotton-tail (*Lepus sylvaticus*):
ta'bo; ta'bo kŭm.
i'wa ta bo.

raccoon (*Procyon lotor*):
na'tsa ko rra (Goship).
[Name borrowed from the Bannock.]

rat, Rocky Mountain (*Neatoma cinerea*):
ka.

rattle, of rattlesnake:
to'go se ya gi nŭmp.
[*to'go*, a rattlesnake + *se ya-gi nŭmp*, instrument for making noise, etc.]

rib:
a'ma tŭmp (Goship).
pi'a ma tŭmp (Goship).
dzu'ni ma hau wa tŭmp.
[*dzu'nĭp*, bone + *ma* + *hau wa tŭmp*.]

robin (*Turdus migratorius*):
su'i ku ko.
[Imitative.]

S.

sacrum.
bi'wo sa (Goship).

sage-hen (*Centrocercus urophasianus*):
wi'ja.

salamander (*Amblystoma tigrinum*, etc.):
pa'bo go na (Goship).
pa'bo go tci (Goshute).
[*pa*, water + *bo* + either *go'na* or *go'tci*.]

salmon:
tsa'păñ'gwitc.
[*tsa*, to pull? + *păñ'gwĭtc*, fish.]
a'gai.
[In this sense borrowed from Bannock. See whale for usual significance in Goshute.]

sand-piper (*Tringoides macularius*):
pa'na da kump; pa'na da kum.
[*pa*, water + *na'da*, to run, etc. + *ko*, probably with force of around or about + *ŭmp*.]

sand-piper (*Tringa*):
pa'na ni wa.

scale, fish:
păñ'wĭtc ŭn da si a.
[*păñ'gwĭtc*, fish + *da'si a*, scale.]

scab, sheep, (*Psoroptes*):
ship'ŭn da si a.
[*ship*, sheep + *da'si a*, scale, flake, etc.]

scalp:
pam'pi bu.
[*pam'pi*, head + *bu*, skin.]

scapula:
si'kwo tŭmp.

scar or cicatrix:
? go'ŭn.

scorpion (general term):
nĭ'na gwi pŭts.

seal:
pi'a pan tsuk.
[*pi'ŭp*, big + *pan'tsuk*, otter.] Known to the Indians from narrative and seen by some.

septum naris:
mo'bi sok.
[*mo'bi*, nose + *sok*, probably a shortened form.]
mo'bi sañ ko.
[*mo'bi*, nose + *sañ'ko*, extension, partition.]

sheep:
ship.
[From the English sheep.]

shell, in general:
bo'a.
[*po*, enclose, cover.]

shell, of egg:
dzu'ni bo a.
[*dzu ni*, from *dzu'nĭp*, bone + *bo'a*, shell, integument, etc.]

shiner:
pu'i wa.
[*pu'i*, ?duck + *wa*.]

shore-lark (*Eremophila alpestris*):
tsi'do bi.

shoulder:
gi'tci tca gĭn.

shrew (*Sorex*):
so'gwai wa.
[*so'kŭp*, ground + *ai'wa*, fawn, etc.]

shrimp, various kinds (as *Gammarus*):
ma'sŭ păñ'gwĭtc.
[*ma'sŭ*, cricket + *păñ'gwĭtc*, fish.]

skin:
bu'a; bu.

skull:
pam'pi dzu nĭp.
[*pam'pi*, head + *dzu'nĭp*, bone.]

skunk, great basin (*Chincha occidentalis major*):
po'ni ŭts.
[*po'ni*, stripe + *ŭts*.]
pi'a ka bo ni ŭts.
[*pi'ŭp*, big + *ka'bo ni ŭts*; *vid. infra*.]

skunk, small spotted:
ka'bo ni ŭts.
[*ka'* + *po'ni ŭts*, skunk; *vid. supra*.]

snail, various kinds:
tats'ĭn kwi tŭp.
[*ta'tsi ŭmp*, stars + *kwit'ŭp*, excrement.]
Meteorites in this connection are fancied as excreta falling from the stars, and appearing upon the earth as snail-shells. It may be noted that throughout the Goshute and Goship territory snail-shells are abundant in deposits from old Lake Bonneville and over the hills, etc., as well as in ponds and streams.

snake, blow (*Bascanion constrictor*):
ko'ka.

snake, blue-racer:
tĭn'ti wa rra.

snake (*Ophibolus pyrrhamelas*):
ko'go; ko' go a.

snake, rattle- (*Crotalus*, var. species):
to'go a.

snake, water- (*Eutænia sirtalis*):
pa'o iñ go a.
[*pa'o ĭñ*, apparently pertaining to water, floating, swimming + *go'a*, snake, etc.]

snake, water- (*Eutænia elegans* and *macrotæniatum*):
pa'siñ ko go.
[*pa'sĭñ*, penetrating or passing through water + *ko'go*.]

snake, general term (especially in compounds):
go'a; go.
[The root *go* has here its force of winding or bending, moving in curving path, etc.]

snipe, American (*Gallinago delicata*):
wu'ĭn gwi wĭ ta.
[Imitative.]
i'jŭ pa ba wo nŭp.
[*i'jŭpa*, coyote + *ba'wo na*, seemingly to cry, call out, etc. + *ŭp*.]
The reference in the name is to the calling out at dusk or in night, like the coyote.

snow-bird, Mexican (*Junco cinereus*):
kai'ma.
ti'sa kai'ma.
[*ti'sa*, small + *kai'ma*. See .]

snow-bird Oregon (*Junco hiemalis oregonus*):
ta'ka mu tu nants.
[*ta'ka*, snow + *mu'tu nants*, a general term. See under humming-bird.]
The black patch over the head of this bird, square cut behind and suggesting a head of black hair, is accounted for by these Indians in a myth which represents the bird as having descended on one side from an Indian woman, whose descendants were changed into this form by the coyote deity.

sole of foot:
da'tĭ ba na.
[*da*, pertaining to the foot + *ti'ba na*. Cf. palm.]

sparrow, Western song (*Melospiza melodia*, var. *fallax*):

sparrow, yellow-winged (*Coturniculus passerinus*, var. *perpallidus*):
an'da wite.

sparrow, white-browed crown (*Zonotrichia leucophrys*):
yu'rra ba.

solpugid:
to'sa mŭsh.
[*to'sa*, white + *mŭsh*, probably from *ma'su i*.]

sow-bug (*Oniscus*, etc.):
mi'ta mŭts.

spermophile (var. species of *Spermophilus*):
kĭm'ba.

spermophile, thirteen-lined:
ai'wa dzip.
[*ai'wa*, fawn + *dzip*.]

spider (general term):
a'ni su ŭnts.

spider, grass (*Agalena*):
? a'sañ gots.

spider-web:
a′ni su ŭnts a wa na.
[*a′ni su ŭnts*, spider + *wa′na*, trap, etc.]
spleen:
so′no (Goship).
wai′gwi (Goshute).
spur, of cock, etc.:
dau′wi yu.
[*da*, pertaining to the foot + *wi′yu*, needle, etc.]
squirrel, flying (*Volucella*):
pa′ko ĭn.
squirrel, ground:
See spermophile.
squirrel, gray (*Sciurus*):
tsi′kwĭts.
squirrel, brown pine:
añ′go wa tsi rrĭ gi (Goship).
[*añ′go*, timber + *wa′tsi rri gi*, referring to springing, leaping, etc.; "pine or timber leaper" is the effect of the compound.]
sternum:
añ′go sai wi (Goshute).
nĭn′ŭp (Goship).
yĭn′ŭp (Goshute).
stink-bug, gray form, found on pine (species?):
ti′ba mu gu ru ĭtc.
[*ti′ba*, pine-nut + *mu′gu ru ĭtc.*]
stomach:
se′gwa bi.
stone-fly:
kwa′tsa wu pu ru ĭtc.
kwa′tsa i pu ru ĭtc.
styloid process of ulna:
ma′pon dza.
[*ma*, hand + *pon′dza*. See malleolus.]
sucker:
tu′kŭm pañ wĭtc.
[*tu′kŭm* + *păñ′wĭtc*, fish.]
superciliary ridge:
bu′i tĭñ go.
[*bu′i tĭñ*, pertaining to the eye + *go*, ridge, angle, etc.].
swallow, or martin, bank and barn:
pa′sa gom bi.
swallow, wood:
wo′vĭm pa sa gom bi.
[*wo′vĭm*, pertaining to wood + *pa′sa gom bi.*]
swan (*Cygnus*):
ni′wa dam pa.
swim-sac of fish:
pa′su a.

T.

tadpole:
pau′wi to ga.
pa′na wi tcŭt.
tail:
gwa′shi.
[*gwa*, to extend out from, etc. + *shi.*]
tanager, Cooper's or Western summer red-bird (*Pyranga æstiva cooperi*):
ăñ′ka hui tcu.
[*ăñ′ka*, from *ăñ′ka bĭt*, red + *hu′i tcu*, bird.]
tanager, crimson-headed (*Pyranga ludoviciana*):
wu′tsi kĭ gi.
It is said by Goshutes that the young of this bird are easily reared, and that the Indians formerly reared them and kept them caged as pets.

tape-worm (*Tænia*, etc.):
si'wa.

tarantula (*Eurypelma hentzii*):
pi'a na su ŭnta.
[*pi'ŭp*, big + *a'na su ŭnts*, spider.]
hau'wi tu go bĭtc.

tear (from eye):
to'paip.

teeth (in general):
damp.

teeth, of upper jaw:
mo'tsĭn dam pa.
[*mo'tsĭn*, apparently pertaining to the upper jaw (cf. *mo'tso*, moustache) + *dam'pa*, *damp*, teeth.]

teeth, of lower jaw:
a'rron ko dam pa.
[*a'rron*, from *arrup*, lower jaw + *ko* + *dam'pa*, teeth.]

tendo-achilles:
wi'tca rrŭmp (Goship).
[*witc*, calf of leg + *rro* + *ŭmp*.]
da'pĭn dam (Goshute).
[*da'pĭn*, pertaining to the foot + *dam*, tendon.]

tendon (general term):
da'ma; dam.

tendons (extensors digitorum of foot):
dau'wi a ta.
[*da*, pertaining to the foot + *wi'a ta*.]

tendons of muscles of front of forearm (as of brachio-radialis, flexor carpi radialis, etc.):
mau'wĭn dam.
[*ma*, the hand + *wĭn*, probably to raise up + *dam*, tendon.]

tent-caterpillar:
pu'hi wa bi.
[*pu'hi* + *wa'bi*, worm.]

tern, common (*Sterna hirundo*):
pi'wa ga (Goship).
pu'i wa ga (Goshute).
[*waga*, from *wa'gasaga*, forked, refers to the forked tail. *Pu'i*, in second term, duck (probably); *pi*, abbreviated form.]

testes:
noi'ya.
dau'wi.

thigh:
bŭñ'ŭp.

throat:
go'ĭts.

thumb:
ma'to ga.
[*ma*, hand + *to'ga*.]

thymus:
bi'hĭn da ka bĭntc.
[*bi'hĭn*, cardiac + *da ka pĭntc*. See spleen.]

thyroid:
a'rrŭn da kam bĭntc.
[*a'rrŭn*, tracheal + *da'kam-pĭntc*, "sweetbread."]

tibia; shin =:
gots'tĭ na.
go'tsi an.
o'ts'ĕm bi a.

tick, wood:
mi'tats.

toad (*Bufo columbianus*, etc.):
sañ'ko wa go.
[*sañ'ko*, wart + *wa'go*, frog.]

toad-fish:
pa'tsoñ.
[*pa*, water + *tsoñ*.]

toe:
dan'kwo.
do'kwo.
da'so gi.
[*da*, pertaining to the foot + *kwo*, or *so'gi*.]

toe, great (hallux):
pi'a rro to ga.
[*pi'ŭp*, big + *rro'to ga*.]

toe, great, basal joint of:
do'nai.

tonsil, pharyngeal:
ai'go yĕm bĭt.
[*ai'go*, tongue, that which protrudes + *yĕm'bĭt*.]

tongue:
ai'go.
[*ai*, to bring forth, shoot or spring out, etc. + *go*.]

tooth. See teeth.

trachea:
oi'rrŭñ.

trout (*Salmo virginalis*, etc.):
toi'ya pañ gwĭtc.
[*toi'ya*, from *toi'yabi*, mountain + *păñ'wĭtc*, fish.]
tsa păñ wĭtc.
[*tsa*, to pull + *păñwĭtc*, fish. See salmon.]

turkey (*Meleagris gallipavo*):
ku'i nĭt (Goship).
ku'yi na (Goshute).

turkey buzzard (*Cathartes aura*):
we'gom bĭtc.

tympanum of ear:
nañ'ka qa.

U.

umbilical cord:
si'go na di wok.
[*si'go*, navel + *na'diwok*, cord, tube.]

ureter:
da'ki po na di wok.
[*da'kipo*, kidney + *na'di wok*.]

urethra:
si'na di wok.
[*si*, from *sip* or *si mo gŭts*, urinary bladder + *na'diwok*, cord or tube.]

urethra, part of in penis:
wu'ĭm na di wok.
[*wu'ĭm*, pertaining to the penis + *na'diwok*, tube, cord.]

urethra, external orifice of in male:
wu'ĭm bai shu.

urethra, external orifice of in female:
wuñ'gi.

urine:
sip.

uterus:
no'ĭb.

V.

vagina; vulva:
o'a tai.

vagina, external orifice of:
dai'dain.
[Probably *dai*, from *o'atai*, vagina + *dain*, orifice, hole.]

vas deferens:
noi'ya na di wok.
[*noi'ya*, testis + *na'di wok*, cord.]

vertebra:
tso′ni gwai ŭmp.
[*tso′nĭp*, bone + *gwai′ŭmp*, back.]

vertebral column:
gwai′o rra.
[*gwai*, from *gwai′ ŭmp*, back + *o′rra*, trunk, stalk, etc.]

W.

wasp (general term):
pai′ya.

wasp, thread-waisted; mud-dauber:
so′go bi tuts.
[*so′kŭp*, earth + *bi′tuts*. Cf. horn-tail.]

wasp-nest:
pai′yam na kar ni.
[*pai′ya*, wasp + *m* + *kar′ni*, house.]

water-ouzel. See dipper.

water-strider (*Hygrotrechus*):
pam buñ′.
[*pam*, aquatic + *buñ*, the root of which means here to float.]

wattles, of fowl:
ăñ′ka gi ŭp.
[*ăñ′ka*, from *ăñka bĭt*, red + *gi′ŭp*, pertaining to the mouth or throat.]

weasel (*Putorius longicauda*):
pa′bi tci.

wart:
dzi′a.

wart on hand:
ma′tzi a.
[*ma*, hand + *tzi′a*.]

wart on face:
go′bi tzi a.
[*go′bi*, face + *tzi′a*.]

whale:
a′gai. (Cf. Bannock a′gai, salmon.)
The Goshutes and Goships more particularly identify the whale with certain great aquatic animals said by them to have lived formerly in Utah Lake. They have stories concerning numerous adventures with this creature, and tell of the loss of many Indians caught afloat and swallowed by the a′gai. In one tale the victim cuts through wall of stomach and body and escapes with his life.

white of eye:
to′sa kiñ wai bi.
[*to′sa*, from *to′sa bĭt*, white + *kĭñ wai bi*.]

widgeon, American, or bald-pate (*Anas americana*):
pa′o ŭm bu i.
[*pa′o ĭm*, aquatic, frequenting water + *bu′i*, duck.]

wildcat (*Lynx rufus*):
tu′ku bĭtc.

wing:
ga′sa gŭnt; ga′sa.

wolverine (*Gulo borealis*):
wo′ni.

woodchuck (*Arctomys monax*):
ya′ha.

woodcock (*Philohela minor*):
i′ju pa mo na pa.
[*i′jupa*, coyote + *mo′napa*.]

The name is given from a myth according to which these birds are descended from the coyote deity's daughter.

woodpecker, ivory-billed:
o'pi do na.
[*o'pi*, wood + *do'na*, to stab, to peck.]

woodpecker, red-shafted, or flicker (*Colaptes mexicanus*):
ko'rra wats.
ko'rri mats.

worm, general term:
wa'bi; wu'a bi.

wolf, gray (*Canis lupus*):
ĭ'sha.
(Identified in a way with the ancestral deity of the Goshutes and Goships.)

wren, Bewick's (*Thryothorus bewicki*):
tĭm'pi tam pi a wa.

wren, Western house (*Troglodytes domesticus parkmanni*):
tu'ĭm pĭn tci rrĭtc (Goship).
tu'ĭm pĭn tci rrŭ (Goshute).

wrist:
mau'wi to gan.
[*ma*, hand + *wi to gan.*]

X.

xiphoid or xiphisternum:
yĭn'gi po nŭmp.
[*yĭn'gi*, referring to the sternum + *po* + *nŭmp.*]

ON THE CLASSIFICATION OF SCALPELLIFORM BARNACLES.

BY HENRY A. PILSBRY.

The genus *Scalpellum* as at present limited is more numerous in species than any other genus of Cirripedes, comprising about 170. Since nearly all of them live in rather deep water, and only small areas of the sea bottom beyond the 100-fathom line have been thoroughly explored, we have reason to believe that their number will be vastly augmented by future investigation.

The species now known are very unequally related. Up to the year 1907 not much progress had been made towards a natural classification, although the "key" constructed by Dr. P. P. C. Hoek for the arrangement of the *Challenger* species was a stride in that direction. In 1907 two attempts were made to group the species more naturally, and to indicate their phylogenetic relations. Dr. Hoek[1] and the present writer[2] independently and almost simultaneously proposed to split *Scalpellum* into a number of subgeneric groups. The two essays were based upon antipodal material, Dr. Hoek's upon East Indian, my own upon American forms. Some divergence in the view taken of the comparative value of characters would be expected; yet the points of agreement are so numerous that one may entertain the idea of attaining an approximately natural arrangement by uniting the best features of the two classifications.

Hoek's studies have illumined the more primitive groups so richly represented in the East—forms inadequately represented in the collections I had studied. On the other hand, the material before me demonstrated, I think, that the form of the carina has little value in classification. Groups based upon the structure of this plate I believe to be heterogeneous. I was first led to this conclusion by an examination of the species composing the group of *Scalpellum stroemii*, as assembled in my report on the barnacles of the National Museum. These forms agree so completely in the total structure that it is quite impossible to doubt their close relationship, yet the carina varies

[1] *Siboga-Expeditie*, Cirripedia Pedunculata, p. 58. October, 1907.

[2] *Bulletin 60, U. S. National Museum*, p. 71. November 9, 1907.

by insensible degrees from simply arched with apical umbo to angular with the umbo remote from the apex.

In the group of *Scalpellum scalpellum* and the group of *S. diceratum* there is similar variation in the carina, yet one cannot doubt that these are natural groups. These and other like instances show that, to rank the shape of the carina, whether simply bowed or angular, as a character of the first importance, is to oppose it to the evidence of all the rest of the organism. In *Scalpellum stearnsi* I find that the umbo of the carina is very close to the apex in quite young individuals, becoming more remote with age; hence the angular shape of the carina,

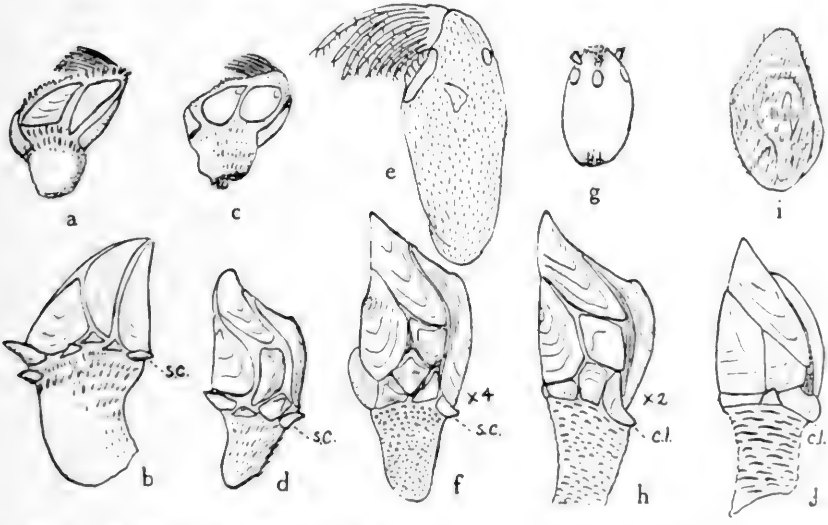


Fig. 1.—Types of the Scalpelliform genera: a, b, *Calantica villosa*; c, d, *Smilium peronii*; e, f, *Euscalpellum rostratum*; g, h, *Scalpellum scalpellum*; i, j, *Scalpellum* (*Arcoscalpellum*) *velutinum*. Upper line males (very much enlarged); lower line hermaphrodites or females. The figures are somewhat diagrammatic; carinal side of all towards the right. *s.c.*, subcarina; *c.l.*, carinal latus.

being a feature acquired late in the ontogeny of the individual, has probably been assumed only recently in the evolution of the groups.

These considerations teach, I think, that an angular carina has been independently acquired by unrelated species of many phyla. It cannot be considered a criterion of relationship.

Another character which has not received due weight in taxonomy is the morphology of the complementary males. Former classifications have been based solely upon the hermaphrodite or female form, which has been far less diversely modified than the male. When we drop as misleading the arrangement of species according to the shape of the carina, it appears at once that the structure of the little males is wonderfully correlated with certain features of the hermaphrodites, especially the development of a subcarina. The least specialized males belong to hermaphrodite forms which are known by morphological and palæontological evidence to be old generalized types. The most modified males are those of the highly evolved hermaphrodite or female forms. A classification fully supported by both sexes surely rests upon a broader base than one ignoring the males.

Classification of Scalpelliform Barnacles.

I. Male having six jointed cirri and a mouth, 3 to 6 valves, and a more or less distinct peduncle. Female or hermaphrodite *always having a subcarina*. Unpaired valves never fewer than 3.

a. Male with 6 well-developed valves, and distinctly divided into capitulum and peduncle. Female or hermaphrodite with 13 valves (sometimes 14 by addition of a subrostrum, or 15 when another pair of latera is added).

b. No plate interposed below the tergum between scutum and carina, ... Genus Calantica Gray.

b′. An upper lateral plate interposed between scutum and carina, ... Genus Smilium Gray.

a′. Male with 3 valves and an oblong capitulum hardly differentiated from the peduncle. Female and hermaphrodite with 15 valves, three pairs of lower latera and an upper latus, ... Genus Euscalpellum Hoek.

II. Male oval or sack-like, without mouth or peduncle, the alimentary system and cirri being vestigeal; plates wanting, or very small scuta and terga may be present. Female or hermaphrodite never having a subcarina. Plates 14, or 13 by suppression of the rostrum, there being a pair of upper latera and three pairs of lower latera. Never more than 2 unpaired plates,
Genus Scalpellum Leach.

Genus **CALANTICA** Gray.

Calantica Gray, Annals of Philosophy, n. ser., X, 1825, p. 101, for *Scalpellum villosum* Leach. Pilsbry, Bull. 60, U. S. Nat. Mus., 1907, p. 8.

In *Calantica* there are but three pairs of latera, all basal. All the plates have apical umbones, as in *Mitella*. There are therefore 13 valves, or sometimes 14 by addition of a subrostrum. The complemental male has a distinct capitulum with 6 large valves. Type *S. villosum* Leach (fig. 1, *a*, *b*). There are two groups of species.

Oriental Group—*Calantica s. str.*

C. villosa (Leach). East Indies?

C. trispinosa (Hoek). Sulu Sea, 82–102 fathoms.

C. cos (Pilsbry). Japan, 71 fathoms.

North Atlantic Group—*Scillælepas* Seguenza:

Besides a few living species, this group includes numerous tertiary and mesozoic forms from European horizons, mostly described as *Pollicipes*. It was evidently a group developed in the mesozoic North Atlantic basin, at that time cut off from the Southern Ocean.

C. calyculus ((Aurivillius). Azores, 850–900 meters.
C. falcata (Aurivillius). Azores, 454 meters.
C. gemma (Aurivillius). Greenland, 1800 meters.
C. superba (Pilsbry). Southeastern United States, 352–440 fathoms.
C. grimaldi (Aurivillius). Azores, 845–1,230 meters.

Genus SMILIUM Gray.

Smilium Gray, Annals of Philosophy, n. ser., X, 1825, p. 100, for *S. peronii*, Pilsbry, Bull. 60, U. S. Nat. Mus., p. 13, exclusive of division *aa*. *Protoscalpellum* Hoek, Siboga-Expeditie, Cirripedia, 1907, p. 58 (for *S. pollicipedoides, S. aries, S. acutum*).

In this group a median pair of latera lies *between the scutum and carina*. There are 3 or 4 pairs of latera in all, 13 or 15 plates. Otherwise both sexes are similar to *Calantica*. In a few species (*peronii, uncus*) the carina is angular, but in others it has an apical umbo. Most of the known species are Indo-Pacific. Type *S. peronii* Gray (fig. 1, *c, d*).

Dr. Hoek's group *Protoscalpellum*, of which I take *S. pollicipedoides* to be the type, differs from *Smilium* chiefly by having an additional pair of latera in the type species. *S. pollicipedoides* is interesting from its tendency toward multiplication of basal latera, which Dr. Hoek has discussed with his accustomed insight.

Smilium and *Calantica* might without great violence be united as subgenera of a single more comprehensive genus, yet I think the elevation of a pair of latera above the basal whorl to the position of "upper latera" is a morphological advance worthy of being signalized by generic distinction. In other characters the two groups are almost identical. The complemental males are alike.

S. peronii Gray.
S. uncus (Hoek).
S. pollicipedoides (Hoek).
S. aries (Hoek).
S. sexcornutum (Pilsbry.)
S. scorpio (Aurivillius).
S. acutum (Hoek).
S. longirostrum (Gruvel).

Genus EUSCALPELLUM Hoek.

Euscalpellum Hoek, in part, Siboga-Expeditie, Cirripedia, 1907, p. 59, for *Scalpellum rostratum, peroni, uncus* and *stearnsi*.

This genus differs from those preceding chiefly by the more degenerate males, which are rather sack-like, not distinctly divided into capitulum and peduncle, and have only three valves, the scuta being larger than in *Scalpellum*. A subcarina is always present. The inframedian latera have a peculiar square shape, and are quite large. There are 4 pairs of latera in all, therefore 15 valves (a number never reached in *Scalpellum*, which has no subcarina). The rostrum is very large and prominent. The carina has a submedian umbo in the first two species, apical in the others. Type *S. rostratum* Darwin (fig. 1, *e*, *f*). Species four or five.

Dr. Hoek selected no type for his group *Euscalpellum*, and I have therefore taken his first species as typical. The characters and limits of the group are also much modified, since I place no weight upon the shape of the carina, but emphasize the structure of the male, the presence of a subcarina, etc.

E. rostratum (Darwin). Malay archipelago.
E. renei (Gruvel). St. Paul de Loanda.
E. bengalense (Annandale). Bay of Bengal, 98–102 fathoms.
E. stratum (Aurivillius). Antilles.
E.(?) *squamuliferum* (Weltner). Indian Ocean, 3200 meters.

Genus **SCALPELLUM** Leach.

Scalpellum Leach, Journal de Physique, etc., LXXXV, 1817, p. 68.

The males are very degenerate, sack-like, without a peduncle or mouth, the cirri vestigeal, valves absent or extremely small. The female or hermaphrodite has no subcarina (thereby differing from all the preceding genera); upper latera are always present, and three pairs of lower latera; rostrum is comparatively small or absent. The position of the umbo of the carina varies from submedian to apical. Plates 14, or when the rostrum is absent 13.[3] Type *S. scalpellum* L. (fig. 1, *g*, *h*).

Scalpellum is morphologically the highest or most modified member of its family, both by the profoundly degenerate males and the advanced type of armor of the hermaphrodites or females. Primarily the genus divides into two subgeneric groups, as follows:

a. Inframedian latus *large*, pentagonal (or with the angles rounded), *wide throughout*, the umbo varying from submedian to basal, or on the rostral border, never apical. Subgenus *Scalpellum s. str.*
a'. Inframedian latus generally smaller than the other latera, triangular, hour-glass-shaped or irregular. Subgenus *Arcoscalpellum* Hoek.

[3] The mere *number* of plates in the capitulum is not especially significant, since the same number may be present in different genera, but made up of morphologically different plates, as in the case of 13-valved species of *Scalpellum* and *Calantica*.

The restricted subgenus *Scalpellum* is undoubtedly a natural group, well characterized by the development of a large inframedian pair of latera. The umbones of the carina and scutum are frequently removed from the apices of those plates, but this is a variable character. Two species, *S. inerme* Annandale and *S. patagonicum* Gruvel, have the plates imperfectly calcified. The following species belong here:

Group of *S. scalpellum*:

S. stearnsi Pilsbry.
S. inerme Annandale.
S. calcaratum Aurivillius.
S. hamatum Sars.
S. scalpellum (Linné).
S. patagonicum Gruvel.
S. gibbum Pilsbry.
S. gibberum Aurivillius.
S. ornatum (Gray).
S. salartiæ Gruvel.

Group of *S. californicum*:

S. californicum Pilsbry.
S. osseum Pilsbry.

Group of *S. stroemii*:

S. stroemii Sars.
S. s. obesum Aurivillius.
S. s. luridum Aurivilius.
S. s. aduncum Aurivillius.
S. s. septentrionale Aurivillius.
S. s. substroemii Pilsbry.
S. s. latirostrum Pilsbry.
S. pressum Pilsbry.
S. groenlandicum Aurivillius.
S. angustum Sars.
S. nymphocola Hoek.
S. cornutum Sars.

Subgenus **Arcoscalpellum** Hoek.

All of the other species described as *Scalpellum* form a group systematically equivalent to the restricted subgenus *Scalpellum*, but the great number of species, including several phyla with degenerate, partly chitinous plates, may make it expedient to recognize several sections by name.

Arcoscalpellum Hoek,[4] type *S. velutinum* Hoek (fig. 1, *i*, *j*), includes all of the species of Sections IV and V of my paper on National Museum Barnacles, pp. 25 to 68, and all of those included in *Arcoscalpellum* in Hoek's *Siboga* report, pp. 85 to 120, besides various other allied forms, previously known, which need not be enumerated here.

There is a distinct tendency in certain forms of *Arcoscalpellum* towards the evolution of a phylum which will have only eleven plates, by elimination of the inframedian latera. In barnacles of the group of

[4] *Arcoscalpellum* is exactly equivalent to *Holoscalpellum* Pils., *Bull. 60, U. S. N. Mus.*, p. 25, published a few days later than Hoek's work.

Scalpellum aurivillii these latera are very much reduced, and in some cases are displaced, lying free over the adjacent rostral latus, which actually comes in contact with the carinal latus.[5] The considerable number of species showing this reducting of the inframedian latera gives ground for the belief that an 11-valved type of *Scalpellum* will eventually be evolved, if indeed it does not already exist.

The following groups with partially calcified valves have been derived from the *Arcoscalpellum* stock.

The section *Mesoscalpellum* Hoek, type *S. javanicum* Hoek, consists of partially calcified barnacles which are shown by their ontogeny, now known pretty fully in a few forms, to be descended from fully calcified forms of *Arcoscalpellum*, like *S. idioplax* or *S. carinatum*. The evidence at hand indicates the existence of several collateral lines, probably derived from as many normal species, so that the group is a polyphyletic one. The early post-larval stages in at least two species, which I have worked out and figured (*S. larvale* and *S. japonicum*), are indistinguishable from *Arcoscalpellum*.

Mesoscalpellum will include, for the present, besides the forms described in Hoek's *Siboga* report, the group of *S. intermedium* (*S. intermedium*, *S. nipponense*, *S. laccadivicum*), the group of *S. japonicum*, the group of *S. larvale*, and that of *S. gruveli* (*S. gruveli*, *S. imperfectum*, *S. sanctæbarbaræ*).

The section *Neoscalpellum* Pilsbry, type *S. dicheloplax*, contains the most modified of the imperfectly calcified forms,—bizarre, skeleton-like creatures with all the paired plates reduced to narrow, diverging rami.

The early stages are not known, but half-grown individuals show an approximation to the condition of adults of the *S. japonicum* group, so that a common origin is probable, and it may be found superfluous to retain *Neoscalpellum* as a separate section. The species are widely scattered geographically, and all inhabit abysmal depths.

S. edwardsi Gruvel. Azores, 4,255 meters.
S. dicheloplax Pilsbry. Off Eastern United States, 1525–1544 fathoms.
S. phantasma Pilsbry. Off California, 2196 fathoms.
S. marginatum Hoek. Off New Guinea, 5640 fathoms.

The nearly simultaneous publication of some 32 new species of *Scalpellum* by Dr. Hoek and 38 by myself, in 1907, has resulted in

[5] See *Bull. 60, U. S. Nat. Mus.*, p. 65, fig. 26.

several homonyms. Two species require new names. Both belong to the subgenus *Arcoscalpellum.*

Scalpellum chiliense n. n.

Scalpellum gracile Pilsbry, Bull. 60, U. S. Nat. Mus., p. 60, fig. 23 (November 9, 1907). Not *S. gracile* Hoek, Siboga-Expeditie, Cirripedia Pedunculata, p. 105, Pl. 8, fig. 8 (October, 1907).

Scalpellum bellum n. n.

Scalpellum formosum Pilsbry, Bull. 60, U. S. Nat. Mus., p. 58, fig. 22 (November 9, 1907). Not *S. formosum* Hoek, Siboga-Expeditie, Cirripedia Pedunculata, p. 110, Pl. 8, figs. 11, 11*a* (October, 1907).

GENERIC TYPES OF NEARCTIC REPTILIA AND AMPHIBIA.

BY ARTHUR ERWIN BROWN.

By the adoption of the new Article 30 of the International Zoological Code at the Boston meeting of the seventh Congress in August, 1907, the methods of nomenclature are brought measurably nearer to uniformity; perhaps as near as is possible under any set of rules, for it must always be true of inelastic rules—and fortunate that it is so—that they cannot excuse the individual from the exercise of independent judgment in cases such as those where diverging opinions may fairly be held as to their application. Absolute agreement is not likely to be reached until, in respect of the past, names themselves are formally adopted by general accord, instead of rules.

So completely representative a body as the International Zoological Congress having unanimously adopted the new Article, the way is made easy for the minority of zoologists who are dissenters as to some of its provisions, for they may now be willing to yield their practice to so great a preponderance of opinion in matters which are those only of convention.

For this reason the Code is here followed in all essential details, even to the acceptance of undefined genera, such as those of Fitzinger in the *System Reptilium*, in place of others which in the author's own opinion have a better claim to be preferred. But it is not now profitable to discuss the question.

For most of the genera here included types have been ascertained from time to time as necessity required, but the whole list has now been revised in accordance with the present rule.

No full synonymy of the genera has been attempted, the names cited as equivalents being only those that have been in recent use for the whole or a part of the contents of the one adopted.

REPTILIA.

The name was first used by Laurenti (1768) for his three divisions, (I) *Salientia*, (II) *Gradientia*, (III) *Serpentes*, and included all reptiles and amphibians. The correct limits of the class were first laid down by Gray (*Annals of Philosophy*, (2), 10, p. 194, 1825).

CROCODILINI.

First separated as a distinct order, under this name, by Oppel (*Ord. and Fam. Rept.*, p. 19, 1811). By Linnæus they were placed in his genus *Lacerta*. By Laurenti in *Gradientia* with lizards and tailed amphibians. By most other early authors under "sauriens" or *saurii*, usually with lizards. "Emydosauriens" was used by Latreille (1801) and Blainville (1816). This was Latinized into *Emydosauria* by Gray (1825). *Loricata* Merrem (1820) was used twenty-eight years earlier for a subdivision of edentate mammals by Vicq. d'Azyr (*Syst. Anat. des Anim.*, 1792).

Crocodilus Laur. (Syst. Rept., p. 53, 1768).

Type by tautonomy *Crocodilus niloticus* Laur. (= *Lacerta crocodilus* Linn. part.).

Alligator Cuvier (Ann. du Musée, X, p. 63, 1807).

Type by elimination *Crocodilus lucius* Cuv. (= *Crocodilus mississippiensis* Daudin).

TESTUDINATA.

Oppel (*Ord. and Fam. Rept.*, p. 3, 1811). Turtles were placed in the genus *Testudo* by Linnæus. They were not mentioned by Laurenti. According to Dr. Stejneger they were named *Testudines* by Batsch (1788). They were called "cheloniens" by Brongniart, Daudin and Cuvier. *Chelonii* by Latreille (*Hist. Nat. des Salamandres de France*, etc., p. xi, 1800) and Duméril (1806). *Cataphracta* Link (1807). Dr. Stejneger properly objects to the use of the mere plural of the generic terms *Testudo* and *Chelonia*, and accepts Oppel's name rather than resurrect the obscure *Cataphracta* Link, four years earlier.

ATHECÆ.

DERMOCHELIDÆ.

Dermochelys Blain. (Bull. Soc. Philom., 1816, p. 111).

This genus was based upon the "tortue a cuir" (= *Testudo coriacea* Linn.).

= *Sphargis* Merrem (1820), same type.

THECOPHORA.

CHELYDRIDÆ.

Chelydra Schweig. (Prod., p. 23, 1814).

Monotype *Testudo serpentina* Linn.

= *Chelonura* Fleming (1822). Same type.

Macroclemmys Gray (Cat. Sh. Rept., I, p. 48, 1855).

Monotype *Chelonura temminckii* Holb.

= *Macrochelys* Gray (1856). Same type.

CINOSTERNIDÆ.

Cinosternum Spix (Spec. Nov. Test., p. 17, 1824).

Founded upon *Kinosternon longicaudatum* and *K. brevicaudatum*. Both being synonyms of *Testudo scorpioides* Linn., the genus is monotypic.

> *Thyrosternum* Agass. (1857). Type *Cinosternum pennsylvanicum*.
> *Platythyra* Agass. (1857). Type *Cinosternum flavescens*.

Sternothœrus Gray (Ann. of Philos., 1825, p. 193).

Type by elimination *S. odoratus* Daudin. Also by designation of Fitzinger (*Syst. Rept.*, p. 29, 1843).

Sternothœrus as cited by Gray from Bell's manuscript contained *S. odorata* and *S. pennsylvanica*. The last belonging strictly to *Cinosternum* Spix, *odorata* becomes the type. This use of the name antedates by a short time *Sternothœrus* Bell (*Zool. Jour.*, 11,305, 1825). *Aromochelys* Gray (1855) also has *odorata* for type.

TESTUDINIDÆ.

Chrysemys Gray (Cat. Tort., p. 27, 1844).

Founded on *Emys picta* Schweig. and *E. belli* Gray. Gray retained *picta* as the type (*Proc. Zool. Soc. Lond.*, 1869, p. 191).

> *Pseudemys* Gray (1855). Type *Pseudemys concinna*.
> *Ptychemys* Agass. (1857). Type *Ptychemys concinna*.
> *Trachemys* Agass. (1857). Type *Trachemys scabra*.
> *Deirochelys* Agass. (1857). Type *Deirochelys reticulata*.
> *Callichelys* Gray (1863). Type *Emys ornata*.

Malacoclemmys[1] Gray (Cat. Tort., p. 27, 1844).

Monotype *Testudo concentrica* Shaw (= *Testudo terrapin* Schoepff).

> *Graptemys* Agass. (1857). Type *Graptemys geographica*.

Clemmys Ritgen (Nova Acta Acad. Leop. Car., XIV, pt. 1, 272, 1828).

Type by elimination *Emys punctata* (= *Testudo guttata* Schn.).

= *Chelopus* Rafin. (1832). Same type.
= *Nanemys* Agass. (1857). Same type.
> *Calemys* Agass. (1857). Type *Calemys muhlenbergi*.
> *Glyptemys* Agass. (1857). Type *Glyptemys insculptus*.
> *Actinemys* Agass. (1857). Type *Actinemys marmorata*.

Emys Oppel (Ord. Fam. Rept., p. 11, 1811).[2]

Oppel cited three species:

---

[1] Written *Malaclemys* by Gray, but stated by him to be a mistake.

[2] *Emys* Duméril (*Zool. Anal.*, p. 76, 1806) is not used in a properly generic sense and has no standing.

"Sterno antice mobile—*E. lutaria*."

"Sterno cruciforme { *serpentina*" = *Chelydra* Schw., 1814.
{ *longicollis*" < *Chelodina* Fitz., 1826.

Emys lutaria was also designated as the type by Fitzinger in 1843, under the name of *Emys europæa* Schw.

= *Emydoidea* Gray (1870). Type *Emys Blandingii.*

Terrapene Merrem (Tent. Syst. Amph., p. 27, 1820).

Type *T. clausa* Merr. (= *Testudo carolina* Linn.). By designation of Gray (*Ann. of Philos.*, X, 1825, p. 192).

Cistudo Fleming (*Phil. Zool.*, II. p. 270, 1822), often used for these turtles, is wanting in definition and in any case is an exact synonym of *Terrapene* Merrem, two years its senior, both being founded on Cuvier's "tortues a boite."

Didicla Rafin. (*Atl. Journal*, 1832, p. 64) has *T. clausa* for type and is also a synonym.

Testudo Linn. (Syst. Nat., Ed. X, p. 197, 1758).

Type *Testudo graeca* Linn. By designation of Fitzinger (*Syst. Rept.*, 29, 1843).

> *Gopherus* Rafin. (1832). Type *Testudo polyphemus.*
> *Xerobates* Agass. (1857). Type *Testudo berlandieri.*

CHELONIDÆ.

Chelonia Latreille (Hist. Nat. Rept., 1, p. 22, 1802).

Type *Testudo mydas* Linn. By original designation. This genus is often attributed to Brongniart (*Bull. Soc. Philom.*, 11, p. 89, 1800). In that place, however, it rests upon these words only, "G. Chelone-Chelonia (ce sont les tortues de mer)," and is a *nomen nudum*.

Caretta Rafin. (Speccio Sci. (Palermo), 11, 66, 1814).

Monotype *C. nasuta* Raf. (= *T. caretta* Linn.).

Rafinesque's words are "*Caretta nasuta* Raf., *Testudo caretta* Linn."

= *Thalassochelys* Fitz. (1835). Same type.

Eretmochelys Fitz. (Syst. Rept., p. 30, 1843).

Type *Chelonia imbricata* Cuv. By original designation.

TRIONYCHIDÆ.

Platypeltis Fitz. (Ann. Wien Mus., 1, pp. 120, 127, 1835).

Type *Platypeltis ferox* Schweig.

The two species named by Fitzinger, *Trionyx brongniartii* Schw. and *T. ferox* Schw. are identical, and the genus is therefore monotypic. The same species was designated by Fitzinger (*Syst. Rept.*, 30, 1843).

Amyda Oken (1816). Type *Trionyx euphraticus.*
Aspidonectes Wagl. (1830). Type *Trionyx aegypticus.*

SQUAMATA.

Correctly outlined by Merrem (*Tent. Syst. Amph.*, p. 39, 1820) with groups (I) *Gradientia*, (II) *Repentia*, (III) *Serpentia*.

Oppel used *Squamata* in 1811 with groups (I) *saurii*, (II) *ophidii*, but he included crocodiles in *saurii*.

LACERTILIA.

Authors previous to Owen either included with lizards the crocodiles, or omitted serpentiform lizards, under the names *Gradientia*, "sauriens," or *saurii*. They were first correctly delimited under the name *Lacertilia* by Owen (*Rep. Br. Ass. Adv. of Sc.*, 1841, p. 162).

GECKONIDÆ.

Phyllodactylus Gray (Spicilegia Zoologica, p. 3, 1830).

Monotype *Phyllodactylus pulcher* Gray.

Sphærodactylus Wagl. (Syst. Amph., p. 143, 1830).

Type *Sphærodactylus sputator* Sparr. By designation of Fitzinger (*Syst. Rept.*, 18, 1843). It was also the only one of Wagler's species retained in the genus by Gray (1831) and Duméril and Bibron (1836).

EUBLEPHARIDÆ.

Coleonix Gray (Ann. Mag. Nat. Hist., 1845, 162).

Type *Coleonyx elegans* Gray. By designation of Boulenger (*Cat. Liz. Br. Mus.*, 1, p. 234, 1885).

IGUANIDÆ.

Anolis Daudin (Hist. Nat. Rept., IV, p. 50, 1803).

According to Dr. Stejneger (*Herp. of Porto Rico*, 625, 1904) the type of *Anolis* is *A. bullaris*. But the pertinency of this name to any known species is far from certain. *Lacerta bullaris* Linn. rests on Catesby's plate 66, "*Lacerta viridis jamaicensis*," whose recognition is chiefly an act of faith. No other of the early authors added exactness to its use. *A. bullaris* Daud. (*l. c.*, p. 69) is based on *L. bullaris* Linn., adding thereto Catesby's plate 65, "*Lacerta viridis carolinensis*," and another unassignable Linnean name, *L. strumosa*. Duméril and Bibron (Vol. 4, pp. 117, 120) divide *A. bullaris* Daud. into *A. chloro-cyanus* and *A. carolinensis*, considering the first of these species to be questionably *L. bullaris* Linn. As *A. carolinensis* D. and B. rests on a firm basis in Catesby, it would seem that this name should not be disturbed, and that *bullaris* of authors should be permitted to remain in obscurity.

Ctenosaura Wiegman (Isis, 1828, p. 371).

Monotype *Ctenosaura cycluroides* Wieg. (= *Lacerta acanthura* Shaw).

Dipsosaurus Hallowell (Proc. Acad. Nat. Sci. Phila., 1854, 92).

Monotype *Crotaphytus dorsalis* B. and G.

Crotaphytus Holbrook (No. Am. Herp.,,II, p. 79, 1842).

Monotype *Agama collaris* Say.

Sauromalus Duméril (Arch. du Mus., VIII, 535, 1856).

Monotype *Sauromalus ater* Dum.

Callisaurus Blainville (Nouv. Ann. du Mus., IV, 286, 1835).

Type *Callisaurus draconoides* Blain. By original designation.

Uma Baird (Proc. Acad. Nat. Sci. Phila., 1858, p. 253).

Monotype *Uma notata* Bd.

Holbrookia Girard (Proc. A. A. A. Science, IV, 201, 1851).

Monotype *Holbrookia maculata* Gir.

Uta Baird and Girard (Stans. Exp. Gr. Salt Lake, 344, 1852).

Type *Uta stansburiana* B. and G. By original designation.

Sceloporus Wiegman (Isis, 1828, p. 369).

Type *Sceloporus torquatus* Wieg. By designation of Fitzinger (*Syst. Rept.*, p. 17, 1843).

Phrynosoma Wiegman (Isis, 1828, p. 367).

Subgenus *Phrynosoma* Wieg. Type *Lacerta orbiculare* Linn. By designation of Wiegman (*Herp. Mex.*, 18, 1834).

Subgenus *Anota* Hallowell (*Proc. Acad. Nat. Sci. Phila.*, 1852, p. 182). Monotype *Anota Mccallii* Hallow.

HELODERMATIDÆ.

Heloderma Wiegman (Isis, 1829, p. 627).

Monotype *Heloderma horridum* Wieg.

ANGUIDÆ.

Ophisaurus Daudin (Hist. Rept., VII, 346, 1803).

Monotype *Anguis ventralis* Linn.

Diploglossus Wiegman (Herp. Mex., 36, 1834).

Type *Tiliqua fasciata* Gray. By designation of Dum. and Bib. (*Erp. Gen.*, V, 588, 1839).[3]

Subgenus *Celestus* Gray (*Ann. Mag. Nat. Hist.*, 1839, p. 288). Monotype *Celestus striatus* Gray.

[3] The subgenus *Diploglossus* is extra limital.

Gerrhonotus Wiegman (Isis, 1828, p. 379).

Subgenus *Gerrhonotus* Wieg. Type *Gerrhonotus tessellatus* Wieg. (=*G. liocephalus* Wieg.). By designation of Fitzinger (*Syst. Rept.*, 21, 1843).

Subgenus *Barissia* Gray (*Ann. Mag. Nat. Hist.*, 1838, p. 390). Type *Barissia imbricata* Gray. By designation of Stejneger (*Proc. U. S. Nat. Mus.*, XIII, 183, 1890).

XANTUSIIDÆ.

Xantusia Baird (Proc. Acad. Nat. Sci. Phila., 1858, p. 255).

Monotype *Xantusia vigilis* Bd.

Zablepsis Cope (Amer. Naturalist, 1895, p. 758).

Type *Xantusia henshawi* Stej. By original designation.

Amœbopsis Cope (Amer. Naturalist, 1895, p. 758).

Type *Xantusia gilberti* Van Den. By original designation.

TEIIDÆ.

Cnemidophorus Wagler (Syst. Amph., 154, 1830).

Subgenus *Cnemidophorus* Wagl. Type *Seps murinus* Laur. By designation of Fitzinger (*Syst. Rept.*, 20, 1843). Dr. H. Gadow, in an interesting analysis of this genus (*P. Z. S. London*, 1906, 1, p. 288), makes reference to *C. sexlineatus* as being the type. But in no way could this be, for it is not one of the species enumerated by Wagler.

Subgenus *Verticaria* Cope (*Proc. Am. Phil. Soc.*, 1869, p. 158). Type *Cnemidophorus hyperythrus* Cope. By original designation.

SCINCIDÆ.

Lygosoma Gray (Zool. Journal, III, 1827, p. 228).

Monotype *Lacerta serpens* Bloch (= *L. chalcides* Linn.).

Subgenus *Liolepisma* Dum. and Bib. (*Erp. Gen.*, V, 742, 1839). Monotype *Scincus telfairi* Desj.

= *Oligosoma* Girard (1857). Type *Mocoa zelandica*.

Plestiodon Dum. and Bib. (Erp. Gen., V, 697, 1839).

Type *Lacerta quinquelineata* Linn. By designation of Fitzinger (*Syst. Rept.*, p. 22, 1843).

Eumeces Wiegman (*Herp. Mex.*, p. 36, 1834) can not be used for this genus. Wiegman included in it three species:

1. *Scincus pavimentatus* Geoff. < *Plestiodon* D. and B., 1839.
2. *Scincus rufescens* Merrem = type of *Eumeces* Fitz., 1843.
3. *Scincus punctatus* Schn. = type of *Eumeces* D. and B., 1839.

The selection of *S. punctatus* Schn. (not *Riopa punctata* Gray, 1839) as type by Duméril and Bibron (Vol. V, p. 630) ties *Eumeces* to a section of skinks with unseparated pterygoids. The available name for the present genus seems to be *Plestiodon*.

ANELYTROPIDÆ.

Anelytropsis Cope (Proc. Am. Phila. Soc., 1885, p. 380).

Monotype *Anelytropsis papillosus* Cope.

ANNIELLIDÆ.

Anniella Gray (Ann. Mag. Nat. Hist., 1852, p. 440).

Monotype *Anniella pulchra* Gray.

EUCHIROTIDÆ.

Euchirotes Cope (Amer. Naturalist, 1894, p. 436).

Monotype *Euchirotes biporus* Cope.

AMPHISBÆNIDÆ.

Rhineura Cope (Proc. Acad. Nat. Sci. Phila., 1861, p. 75).

Type *Lepidosternum floridana* Bd. By original designation.

OPHIDIA.

Serpentes Linn. included snakes, amphisbænians and cæcilians, as also did *Serpentia* Laur. (1768) and *Ophidii* Daudin (1803). *Serpentes* Duméril (1806) included cæcilians. *Ophidii* Oppel (1811) and *Serpentia* Merrem (1820) included amphisbænians. The serpents were first cleared of unrelated forms by Gray, using the name *Ophidii* (*Ann. of Philos.*, 1825, p. 204).

LEPTOTYPHLOPIDÆ.

Leptotyphlops Fitzinger (Syst. Rept., p. 24, 1843).

Type *Typhlops nigricans* Schlegel. By original designation

= *Glauconia* Gray (1845). Type *Typhlops nigricans*.
> *Rena* B. and G. (1853). Type *Rena dulcis* B. and G.
> *Siagonodon* Peters (1881). Type *Typhlops septemstriatus* Schn.

BOIDÆ.

Lichanura Cope (Proc. Acad. Nat. Sci. Phila., 1861, p. 304).

Monotype *Lichanura trivirgata* Cope.

Charina Gray (Cat. Sn. Br. Mus., p. 113, 1849).

Monotype *Tortrix bottæ* Blain.

= *Wenona* B. and G. (1853). Type *Wenona plumbea* B. and G.

COLUBRIDÆ.

Tropidonotus Boié (Isis, 1826, I, p. 204).

Type *Coluber natrix* Linn. By designation of Boié (*Isis*, 1827, p. 518).

= *Natrix* Laur. (Cope, 1888). Not Cope, 1862.
> *Nerodia* B. and G. (1853). Type *Coluber sipedon* Linn.
> *Regina* B. and G. (1853). Type *Coluber leberis* Linn.
> *Clonophis* Cope (1888). Type *Regina kirtlandii* Kenn.

The use of *Natrix* Laur. for this genus does not appear to me obligatory or excusable. The rule under which types of undefined genera are accepted does not constrain or even imply that, in the case of an originally defined genus, a species must be accepted as type having characters contrary to the definition. If it did so, the only consistent course would be to admit that the Code does not consider definitions at all. It was pointed out by me (*Science*, July 6, 1907, p. 117) that of the fourteen recognizable species cited by Laurenti under *Natrix*, now distributed among eight genera, the two belonging to the present genus are the only ones at diametric variance with "*Truncus glaber nitidus*," which is the sole character of diagnostic value in the definition.

Because Fleming (*Philos. of Zool.*, II, p. 291, 1822) chose to select an unconforming type for *Natrix* in *T. torquata* (= *Coluber natrix* Linn.), or because the rule of "type by tautonomy" could be applied to the case, it does not follow that we are compelled to use *Natrix*. It is still open to rejection for any group as a meaningless conglomerate. It is also questionable whether Fleming's citation of a species after some of the genera given by him constitutes selection of a type in accordance with paragraph 11*g* of Article 30.

As first published in a posthumous letter from Kuhl (*Isis*, 1822, p. 473) *Tropidonotus* is a *nomen nudum*. But four years later it was well defined by Boié (*Isis*, 1826, I, 204), who credited it to Kuhl, and named under it *Coluber natrix* Linn. and *viperinus* Daudin. The following year he definitely fixed *natrix* as the type.

Thamnophis Fitzinger (Syst. Rept., p. 26, 1843).

Type *Tropidonotus sauritus* Schl. By original designation.

= *Eutænia* B. and G. (1853). Same type.
> *Atomarchus* Cope (1883). Type *Atomarchus multimaculatus* Cope.
> *Stypocemus* Cope (1875). Type *Stypocemus rufopunctatus* Cope, by substitution for *Chilopoma* Cope, preoccupied.

Tropidoclonium Cope (Proc. Acad. Nat. Sci. Phila., 1860, p. 76).

Type *Microps lineatum* Hallow. By original designation.

Seminatrix Cope (Amer. Naturalist, 1895, p. 678).

Type *Seminatrix pygæus* Cope. By original designation.

Helicops Wagler (Syst. Amph., 170, 1830).

Type *Helicops carinicaudatus* Wagl. By designation of Fitzinger (*Syst. Rept.*, 25, 1843).

> *Liodytes* Cope (1885). Type *Helicops alleni* Garm.

Amphiardis Cope (Proc. U. S. Nat. Mus., 1888, p. 391).

Type *Virginia inornata* Garm. By original designation.

Haldea B. and G. (Cat. No. Am. Serp., 122, 1853).

Type *Coluber striatula* Linn. By original designation.

Storeria B. and G. (Cat. No. Am. Serp., 135, 1853).

Type *Tropidonotus dekayi* Holb. By original designation.

= *Ischnognathus* Dum. and Bib. (1853). Same type.

Drymarchon Fitzinger (Syst Rept., 26, 1843).

Type *Coluber corais* Daudin. By original designation.

< *Spilotes* Wagler (1830). Type *S. pullatus.*
= *Compsosoma* Cope (1895). No type. = *Compsosoma* Dum. and Bib. part.
= *Georgia* B. and G. (1853). Type *Coluber couperi* Holb.

Drymobius Fitzinger (Syst. Rept., 26, 1843).

Type *Herpetodryas margaritiferus* Schl. By original designation.

Callopeltis (Fitz.) Bonap. (Icon. Fauna Ital., Vol. II, and Mém. Acad. Torino (2), 11, 401, 1840).

Type *Coluber leopardinus.* By original designation of Fitzinger.

= *Coluber* auctores.
> *Scotophis* B. and G. (1853). Type *Coluber allegheniensis* Holb.
= *Natrix* Laur. (Cope, 1862). Not Cope, 1888.

Arizona Kenn. (U. S. Mex. Bound. Surv., 18, 1859).

Monotype *Arizona elegans* Kenn.

< *Rhinechis* Micah. (1833). Type *Rhinechis scalaris.*

Pityophis Holbrook (No. Am. Herp., IV, 7, 1842).

Monotype *Coluber melanoleucus* Daudin.

Coluber Linn (Syst. Nat. Ed., X, 216, 1758).

Type *Coluber constrictor* Linn. By designation of Fitzinger (*Syst. Rept.*, 26, 1843).

= *Zamenis* Wagler (1830). Type *Natrix gemonensis* Laur.
> *Bascanium* B. and G. (1853). Type *Coluber constrictor* Linn.
> *Masticophis* B. and G. (1853). Type *Coluber flagellum* Shaw.

Under the new Rule 30 we are no longer bound to Laurenti's notion, as first reviser, of the limits of *Coluber* and are therefore freed from the consideration of Dr. Stejneger's proposal (*Herp. of Japan*, pp. 307, 443, 1907) to transfer the name to the genus otherwise known as *Vipera* Laur.—a change which would have been serious in view of all the connotations of the word "coluber." The present shifting of the term to replace *Bascanium*, following Fitzinger's selection of a type, long antedates Collett's designation of *Vipera ferus* and has the good fortune to preserve both the long established family names *Colubridæ* and *Viperidæ*.

Salvadora B. and G. (Cat. No. Am. Serp., 104, 1853).

Type *Salvadora Grahamiæ* B. and G. By original designation.

= *Phimothyra* Cope (1860). Same type.

Phyllorhynchus Stejneger (Proc. U. S. Nat. Mus., 1890, p. 151).

Type *Phyllorhynchus browni* Stej. By original designation.

Opheodrys Fitzinger (Syst. Rept., 26, 1843).

Type *Herpetodryas æstivus* Schl. By original designation.

< *Leptophis* Bell (1826). Type *Leptophis ahætulla*.
< *Cyclophis* Gunther (1858). Type *Herpetodryas tricolor*.

Liopeltis Fitzinger (Syst. Rept., 26, 1843).

Type *Herpetodryas tricolor* Schl. By original designation.

> *Chlorosoma* B. and G. (1853). Type *Coluber vernalis* DeKay.

Contia B. and G. (Cat. No. Am. Serp., 110, 1853).

Type *Contia mitis* Bd. By original designation.

Pseudoficimia Bocourt (Miss. Sci. au Mex., 572, 1883)

Monotype *Pseudoficimia pulchra* Boc.

Conopsis Günther (Cat. Sn. Br. Mus., 6, 1858).

Monotype *Conopsis nasus* Gunth.

Toluca Kennicott (U. S. and Mex. Bound. Surv., 23, 1859).

Monotype *Toluca lineata* Kenn.

Diadophis B. and G. (Cat. No. Am. Serp., 112, 1853).

Type *Coluber punctatus* Linn. By original designation.

Lampropeltis Fitzinger (Syst. Rept., 25, 1843).

Type *Herpetodryas getulus* Schl. By original designation.

= *Ophibolus* B. and G. (1853). Type *Coronella sayi* Holb.
> *Osceola* B. and G. (1853). Type *Calamaria elapsoidea* Holb.

Stilosoma A. Brown (Proc. Acad. Nat. Sci. Phila., 199, 1890).

Monotype *Stilosoma extenuatum* A. Brown.

Carphophis Gervais (Dict. Hist. Nat. d'Orbigny, III, 191, 1843).

Monotype *Coluber amœnus* Say.

> *Carphophiops* Gervais (1843). Type *C. vermiformis*.
= *Celuta* B. and G. (1853). Type *Coluber amœnus* Say.
= *Brachyorros* Holbrook (1842). Same type. Not of Boié (1827).

Farancia Gray (Zool. Misc., p. 68, 1842).

Monotype *Farancia Drummondi* Gray (= *Coluber abacurus* Holb.).

Abastor Gray (Cat. Sn. Br. Mus., p. 78, 1849).

Monotype *Helicops erythrogrammus* Wagler.

Virginia B. and G. (Cat. No. Am. Serp., p. 127, 1853).

Type *Virginia Valeriæ* B. and G. By original designation.

Ficimia Gray (Cat. Sn. Br. Mus., p. 80, 1849).

Monotype *Ficimia olivacea* Gray.

Chilomeniscus Cope (Proc. Acad. Nat. Sci. Phila., 1860, p. 339).

Monotype *Chilomeniscus stramineus* Cope.

Cemophora Cope (Proc. Acad. Nat. Sci. Phila., 1860, p. 244).

Type *Coluber coccineus* Blum. By original designation.

Rhinochilus B. and G. (Cat. No. Am. Serp., p. 120, 1853).

Type *Rhinochilus Lecontei* B. and G. By original designation.

Hypsiglena Cope (Proc. Acad. Nat. Sci. Phila., 1860, p. 246).

Type *Hypsiglena ochrorhyncha* Cope. By original designation.

Rhadinea Cope (Proc. Acad. Nat. Sci. Phila., 1863, p. 10).

Type *Tæniophis vermiculaticeps* Cope. By original designation.

Prof. Cope subsequently (*Proc. Acad. Nat. Sci. Phila.*, 1868, 132) named *R. melanocephala* D. and B. as the type, and again (*Rep. U. S. Nat. Mus.*, 1898, p. 754) he says the type is *R. obtusa* Cope. The genus was, however, distinctly founded upon *T. vermiculaticeps* on its first publication in 1863.

Heterodon Latreille (Hist. Nat. des Rept., IV, p. 32, 1800).

Monotype *Heterodon platyrhinus* Latr.

Trimorphodon Cope (Proc. Acad. Nat. Sci. Phila., 1861, p. 297).

Type *Trimorphodon lyrophanes* Cope. By original designation.

Leptodira Fitzinger (Syst. Rept., p. 27, 1843).

Type *Dipsas annulatus* Schl. By original designation. *Sibon* Fitz. (*Neue Class Rept.*, 1826, p. 29) can not be used for this genus of opisthoglyph snakes. It has, by tautonomy, for type *Coluber nebulatus* Linn. (= *Coluber sibon* Linn.), which is the type of *Petalognathus* Dum. and Bib.

Manolepis Cope (Proc. Am. Philos. Soc., 1885, p. 76).

Type *Tomodon nasutus* Cope. By original designation.

Conophis Peters (Monats. Berl. Acad., 1860, p. 519).

Monotype *Conophis vittatus* Peters.

Erythrolamprus Boié (Isis, 1826, p. 981).

Monotype *Coluber venustissimus* Pr. Max.

= *Coniophanes* Hallow. (1860). Type *C. fissidens*.

Scolecophis Fitzinger (Syst. Rept., p. 25, 1843).

Type *Calamaria atrocincta* Schl. By original designation.

Tantilla B. and G. (Cat. No. Am. Serp., p. 131, 1853).

Type *Tantilla coronata* B. and G. By original designation.

= *Homalocranium* Dum. and Bib. (Erp. Gen., VII, 855, 1854). Type *H. planiceps* (not of Dum. and Bib., Mém. Acad. Sci., 1853, p. 490. Type *Calamaria brachyorros* Hallow.).

Elaps Schneider (Hist. Amph., II, p. 289, 1801).

Type *Elaps lemniscatus* Linn. By designation of Gray (*Ann. of Philos.*, 1825, p. 206).

Fleming (*Philos. Zool.*, II, p. 295. 1822) mentions *Elaps lacteus*, but it does not appear that in this work types are selected as required by the present rule.

VIPERIDÆ.

Ancistrodon Beauvois (Trans. Am. Philos. Soc., IV, p. 381, 1799).

Monotype *Agkistrodon mokasen* Beau. (= *Boa contortrix* Linn.). Beauvois says (p. 381) under *Agkistrodon*, "In this last division should be arranged the mokasen," which on p. 370 he refers to as *Agkistrodon mokasen*.

Sistrurus Garman (No. Am. Rept., p. 110, 1883).

Type *Crotalus miliarius* Linn. By substitution.

Crotalus Linn. (Syst. Nat., Ed. X, p. 214, 1758).

Type *Crotalus horridus* Linn. By designation of Gray (*Ann. of Philos.*, 1825, p. 205).

AMPHIBIA.

According to Dr. Stejneger *Batrachia* was used for the first time by Batsch (1788) as an exact synonym of *Salientia* Laurenti (1768), for which reason he thinks it should not be used for a division of wider scope. Brongniart (1800) had very nearly an exact conception of the contents of this class, for he even suspected that the cæcilians belong to it, but he used only the vernacular "batraciens." All other authors omitted cæcilians down to 1811, when Oppel used *Nuda* for the class, with orders (I) *Apoda*, (II) *Ecaudata*, (III) *Caudata*. Merrem (1820) used *Batrachia* with (I) *Apoda*, (II) *Salientia*, (III) *Gradientia*.

Amphibia Linn. included reptiles and amphibians, but was never used in exact form until Gray correctly applied it (*Ann. of Philos.* (n. s.), 10, p. 213, 1825).

By strict priority the name would be *Nuda* Oppel, but fortunately it is not necessary to replace a well-known class name by one so obscure.

SALIENTIA.

Salientia Laurenti (*Syn. Rept.*, p. 24, 1768) contained the genera *Rana*, *Pipa*, *Hyla* and *Bufo*, as well as *Proteus*, which seems to have been founded on a tadpole of *Rana*. It is therefore equivalent to and much older than *Ecaudata* Duméril (1806). *Anura*, attributed by Cope to Duméril, has no standing, as that author used only "anoures."

RANIDÆ.

Rana Linn. (Syst. Nat., Ed. X, p. 354, 1758).

Type *Rana temporaria* Linn. By designation of Gray (*Ann. of Philos.*, 1825, p. 214).

ENGYSTOMATIDÆ.

Engystoma Fitzinger (Neue Class Rept., p. 65, 1826).

Rana ovalis Schneider is the only one of Fitzinger's species retained in *Engystoma* by Duméril and Bibron (*Erp. Gen.*, 8, p. 741, 1841) and is consequently the type.

Hypopachus Kerferstein (Göttingen Nachrichten, 1867, p. 352).

Monotype *Hypopachus Seebachii* Kerf. (= *H. variolosum* Cope).

CYSTIGNATHIDÆ.

Lithodytes Fitzinger (Syst. Rept., p. 31, 1843).

Type *Hylodes lineatus* D. and B. By original designation.

Syrrophus Cope (Amer. Naturalist, 1878, p. 253).

Monotype *Syrrhophus marnockii* Cope.

HYLIDÆ.

Chorophilus Baird (Proc. Acad. Nat. Sci. Phila., 1854, p. 60).

Monotype *Cystignathus nigritus* Holb.

Acris Dum. and Bib. (Erp. Gen., 8, p. 506, 1841).

Type *Hylodes gryllus* DeKay. By designation of Baird (*Proc. Acad. Nat. Sci. Phila.*, 1854, p. 59).

Hyla Laurenti (Syst. Rept., p. 32, 1768).

Type *Hyla viridis* (= *H. arborea* Linn.) *fide* Stejneger.

Smilisca Cope (Proc. Acad. Nat. Sci. Phila., 1865, p. 194).

Monotype *Smilisca daulinia* Cope (= *Hyla baudinii* Dum. and Bib.).

BUFONIDÆ.

Bufo Laurenti (Syst. Rept., p. 25, 1758).

Type by tautonomy *Bufo vulgaris* Laur. (= *Rana bufo* Linn.).

PELOBATIDÆ.

Scaphiopus Holbrook (No. Am. Herp., I, p. 85, 1836).

Monotype *Scaphiopus solitarius* Holb.

Spea Cope (Jour. Acad. Nat. Sci. Phila., (2), VI, p. 81, 1866).

Type *Scaphiopus bombifrons* Cope (= *S. hammondi* Baird). By original designation.

CAUDATA.

Duméril (*Zoologie Analytique,* 94, 1806), "les batraciens urodèles (caudati)." The following year (*Nouv. Bull. des Sc.,* 1807, p. 36) he, definitely says "order Caudati." *Urodela* is often based upon this reference, but Duméril used neither it nor *Anura* in Latin form.

PLEURODELIDÆ.

Diemyctylus Rafinesque (Ann. of Nature, 1820, No. 22, p. 5).

Type *Triturus viridescens.* By original designation.

DESMOGNATHIDÆ.

Desmognathus Baird (Jour. Acad. Nat. Sci. Phila., (2), 1, pp. 282, 285, 1850).

Type *Triturus fuscus* Rafin.

PLETHODONTIDÆ.

Autodax Boulenger (Ann. Mag. Nat. Hist., 1887, p. 67).

Type *Anaides lugubris* Baird. By substitution for *Anaides* Baird (1849), preoccupied.

Gyrinophilus Cope (Proc. Acad. Nat. Sci. Phila., 1869, p. 108).

Monotype *Salamandra porphyriticus* Green.

Spelerpes Rafinesque (Atlantic Journal, I, p. 22, 1832).

Type *Spelerpes lucifuga* Rafin. (= *Salamandra longicauda* Green). By original designation.

Manculus Cope (Proc. Acad. Nat. Sci. Phila., 1869, pp. 95, 101).

Monotype *Salamandra quadridigitata* Holb.

Stereochilus Cope (Proc. Acad. Nat. Sci. Phila., 1869, p. 100).

Monotype *Pseudotriton marginatum* Hollow.

Plethodon Tschudi (Mém. Soc. Neuchatel, 1838, pp, 59, 92).

Type *Salamandra glutinosa* Green. By designation of Bonaparte (*Fauna Ital.,* II, 131).

Hemidactylium Tschudi (Mém. Soc. Neuchatel, 1838, pp. 59, 91).

Type *Salamandra scutata* Schl. By original designation.

Batrachoseps Bonaparte (Fauna Ital., II, 131).

Type *Salamandra attenuata* Esch. By original designation.

AMBYSTOMIDÆ.

Dicamptodon Strauch (Mém. Acad. Sci. St. Pétérs., (7), XVI, No. 4, p. 68, 1870).

Monotype *Triton ensatus* Esch.

Ambystoma Tschudi (Mém. Soc. Neuchatel, 1838, pp. 57, 92).

Type *Ambystoma subviolacea* Tsch. (= *Lacerta punctata* Linn.). By original designation.

> *Linguelapsus* Cope (1887). Type *L. lepturus* Cope.

Chondrotus Cope (Amer. Naturalist, 1887, p. 88).

Type *Chondrotus tenebrosus*. By original designation.

CRYPTOBRANCHIDÆ.

Cryptobranchus Leuckart (Isis, 1821, Litt. Anz., p. 260).

Monotype *Salamandra gigantea* Barton (= *Cryptobranchus alleghenensis*).

AMPHIUMIDÆ.

Amphiuma Garden (Smith's Corres. of Linnæus, I, 599).

Type *Amphiuma means* Gard. By original designation.

PROTEIDÆ.

Necturus Rafinesque (Jour. de Phys., Vol. 88, p. 418, 1819).

Monotype *Necturus maculatus*.

Rafinesque gave the names of six species under *Necturus*, of which *maculatus* is the only one recognizable, leaving the genus practically monotypic.

SIRENIDÆ.

Siren Linn. (Syst. Nat., Ed. XII, p. 371, 1766).

Monotype *Siren lacertina* Linn.

Pseudobranchus Gray (Ann. of Philos., 1825, p. 216).

Monotype *Siren striata* LeConte.

METHODS OF RECORDING AND UTILIZING BIRD-MIGRATION DATA.

BY WITMER STONE.

The custom of recording the dates of arrival of migrant birds has been practised for a great many years in various countries, and more recently attempts have been made to encourage the keeping of such records on a uniform plan and to gather them together for the purpose of study and comparison.

In America this work was begun in 1884 under the direction of the American Ornithologists' Union, and since 1885 has been conducted by the Division of Biological Survey (formerly Ornithology and Mammalogy) of the U. S. Department of Agriculture.

All the published records with which I am familiar represent the work of one individual at each station, and until very recently there has been no attempt made to compare the records of several observers at practically the same locality.

The meagerness of the data that it is possible for one individual to gather on bird migration, compared with the magnitude of the phenomenon, must be apparent to all, and yet we are constantly attempting all sorts of estimates—as to the rapidity of flight, the relation of fluctuation of migration to temperature variation, etc.—based for the most part upon the records of individual observers.

In 1901 the Delaware Valley Ornithological Club of Philadelphia organized a corps of observers for the study of bird migration in this vicinity. This corps now numbers sixty-three, of which thirty-five are located within ten miles of the center of Philadelphia.

The study and comparison of the yearly records of these observers throws some interesting light upon the accuracy of individual records and suggests some methods by which a more correct index of the progress of migration may be obtained.

Many of the records are presented in detail each year in *Cassinia* the annual publication of the Delaware Valley Ornithological Club, and to these, as well as to the original schedules returned by the observers, I am indebted for the data discussed in the present paper.

In a paper read before the American Ornithologists' Union in New York City in November, 1905, and later published in *The Condor*, I first called attention to the possibilities of combining a number of individual records, and later Prof. W. W. Cooke of the U. S. Department of Agriculture discussed the same question in a short paper in *The Auk* for July, 1907, p. 346. These are, I believe, the only papers dealing with this phase of the question. The well-known work of Mr. Otto Herman in Hungary, while probably based upon the most extensive series of data ever collected, does not, so far as I am aware, touch upon the comparison of individual records, at a single locality.

Individual and Bulk Arrivals.

One of the most important points for consideration in a bird-migration record is an understanding of just what our date of arrival indicates. A migrating species is not a definite mass, like a railroad train, but a scattered host of individuals requiring weeks or even months to pass a given point and moving intermittently; consequently there may be a great many dates of arrival at that point, according to what part of the moving procession we are considering.

In the schedules furnished by the U. S. Department of Agriculture the date of "first arrival" is called for, and in addition the date when the species was next seen and when it became common. The object being to differentiate between the arrival of the main flight or "bulk" of the species and that of individual early stragglers.

With the exception of these schedules, nearly all the American migration records with which I am familiar deal only with the date of "first arrival," and in the publications that have been based upon the records of the U. S. Department of Agriculture, only one date is usually given, presumably the date of first arrival.

This would seem to indicate the unsatisfactory nature of the records of bulk arrival, as estimated by an individual observer, a fact which has impressed itself upon me after twenty-five years' experience in recording and tabulating bird migration data. It seems altogether too variable a quantity to be of practical value in making any sort of comparisons except in special instances.

Different species of birds vary in the way in which they become abundant at any point; some may come in considerable numbers on the very first day upon which they are seen or a day or so after the "first arrival," while others gradually drift in, a few each day, until all the usual haunts are populated, though it is impossible to say upon just which day they became common. In other cases large flocks may be seen passing overhead some time before any individuals establish themselves in their local summer haunts. It seems, too, that certain species vary in their manner of arrival in different years, being concentrated one season and scattered in another.

The proper study of fluctuations in the numbers of each species at any point, such as would warrant an estimate of bulk arrival, requires, except in a few cases, far more time than the majority of observers can possibly give to the work—if indeed the task is possible for one individual—and consequently where such an estimate has been attempted the personal equation enters to such an extent as to render the results of little value.

It would seem that, with the comparatively small amount of time at the disposal of most observers, it would be better to suggest the recording of such occasional "bulk arrivals" as are so marked a feature of the migration as to become obvious, rather than to ask for a record of this sort for each species, which must from the nature of the case be in the vast majority of instances an estimate.

At the same time, however, the date of the first arrival, often an early straggler, does not in itself give us a proper record of the migration of the species, and it is here that the combination of a number of local records proves invaluable and furnishes a far more accurate résumé of the flight of the species than can possibly be obtained by any individual observer.

For instance take the arrival of the Wood Thrush in the ten-mile circle about Philadelphia in the Spring of 1906. Thirty-one observers recorded it as follows: One on April 25, two on April 28, ten on April 29, five on April 30, eight on May 1, and one each on May 2, 3, 4, 10 and 12. This record obviously warrants us in saying that for this area pioneer migrants arrived on April 25 and 28, while the bulk of the migration occurred from April 29 to May 1, after which date it was impossible, on account of the presence of the bird at almost all points, to judge how much further transient migration was in progress. The dates upon which the "first arrivals" are massed are obviously the dates upon which the "bulk" arrived. The late dates are to some extent due to failure on the part of the observer to be in the field on the day on which the species first arrived, but in part they represent actual absence of the species from these particular localities, as it is a matter of record that on several occasions a species has been seen regularly for some days at one locality before a single individual has appeared at another station nearby, in spite of careful search at the latter place.

The actual progress of the arrival of the Wood Thrush in 1906 within the Philadelphia ten-mile circle may be shown more graphically in the accompanying diagrams.

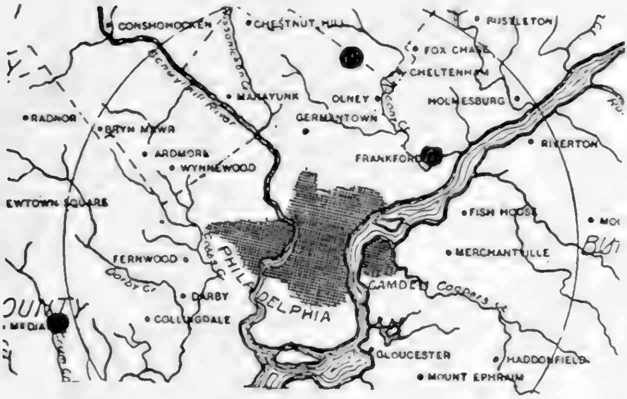


Fig. 1.

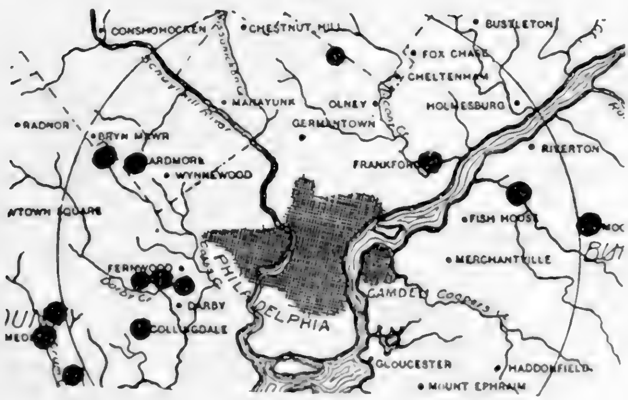


Fig. 2.

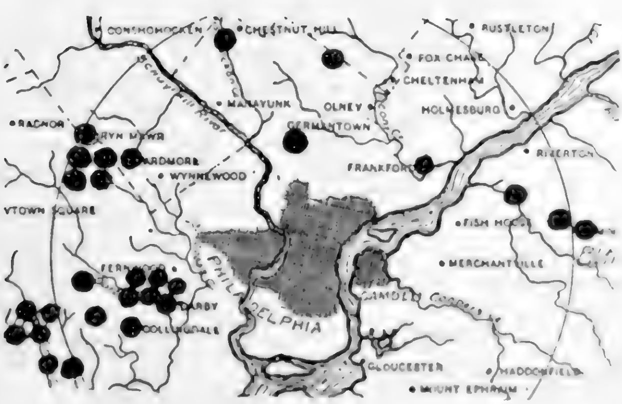


Fig. 3.

Up to April 28 (fig. 1) the species had been observed at but three stations, two of these being to the north and northeast of the city and the other to the southwest. On April 29 (fig. 2) it was present at thirteen stations, and by May 1 (fig. 3) had been reported by all but three of our observers.

Mr. Otto Herman's paper in *Proc. Fourth Internat. Ornith. Congress*, p. 163, was not received until after my diagrams had been prepared. In it he adopts practically the same plan in illustrating the migration of the Swallow in Hungary, and as his maps are based upon 5900 returns, it is needless to say they are far more convincing than mine.

Comparison of Records.

As already stated most migration records so far obtained are the work of one individual at each locality. Now when we come to compare the time of arrival of birds at two points or their arrival at the same point on successive years, it becomes very important for us to consider the extent to which such records reflect the actual progress of migration. The discussion on determining dates of bulk movements in the vicinity of Philadelphia has already shown that while a date of "first arrival" may be perfectly accurate for the limited area covered by an observer, it would differ very materially from the earliest date of arrival for the species in a circle of five or ten miles around that observer's station.

The work of the Delaware Valley Ornithological Club for the past seven years has shown that within the Philadelphia ten-mile circle, covering an area with but little variation in altitude, we can detect no constant difference in the time of arrival of a species at any two points dependent upon their geographic position.

The earliest record is just as likely to come from the northern portion of the circle as from the southern portion. At one time the records seemed to show a slightly earlier date of arrival immediately along the Delaware river, as compared with stations a few miles back on slightly higher ground, but further data showed this difference to be purely fortuitous. Therefore we can take the records of any one station within this circle as representing the progress of migration at Philadelphia, just as well as those of any other station within the same radius, and presumably the average dates of arrival of a species for a number of years at several stations within the circle will be the same.

For certain species which are very conspicuous and which usually arrive in force on the first day of their appearance this is true, but in the majority of species it is by no means so.

Selecting three localities within the ten-mile circle, at each of which the Club has had several accurate observers for the past seven years, we have the following dates of first arrival. I = Moorestown, N. J.; II = Media and Swarthmore, Pa.; III = Haverford and Ardmore, Pa.

Chætura pelagica (Chimney Swift).

	I.	II.	III.
1901	April 27	April 27	April 28
1902	" 21	" 22	" 19
1903	" 19	" 19	" 19
1904	" 24	" 24	" 24
1905	" 21	" 20	" 21
1906	" 14	" 12	" 12
1907	" 23	" 25	" 26
Average	April 21	April 21	April 21

Toxostoma rufum (Brown Thrasher).

	I.	II.	III.
1901	April 22	April 28	....
1902	" 22	" 22	April 24
1903	" 5	" 20	" 12
1904	" 17	" 23	" 15
1905	" 22	" 14	" 14
1906	" 21	" 16	" 17
1907	" 28	" 26	" 26
Average	April 19	April 21	April 18

Piranga erythromelas (Scarlet Tanager).

	I.	II.	III.
1901	May 5	May 12	May 12
1902	" 2	" 1	" 4
1903	" 18	" 2	" 10
1904	" 6	" 6	" 5
1905	" 5	" 2	" 4
1906	" 10	" 1	" 1
1907	" 12	" 2	" 10
Average	May 8	May 4	May 7

Sayornis phœbe (Phœbe).

	I.	II.	III.
1901	....	Mar. 11	Mar. 17
1902	Mar. 30	" 23	" 23
1903	" 17	" 6	" 15
1904	April 3	" 20	" 19
1905	Mar. 26	" 16	" 19
1906	April 8	" 12	April 1
1907	Mar. 17	" 15	Mar. 16
Average	Mar. 27	Mar. 15	Mar. 20

Or, tabulating the averages obtained as above for eleven species, we have:

	I.	II.	III.	No. of days difference.
Chimney Swift	April 21	April 21	April 21	0
Phœbe	Mar. 27	Mar. 15	Mar. 20	12
Chipping Sparrow	" 29	April 1	" 29	3
Scarlet Tanager	May 8	May 4	May 7	4
Barn Swallow	April 19	April 19	April 22	3
Black-throated Blue Warbler	May 5	May 2	May 3	3
Ovenbird	" 1	April 29	April 30	2
Maryland Yellow-throat	April 25	" 26	May 2	7
Catbird	" 28	" 25	April 30	5
Brown Thrasher	" 19	" 21	" 18	3
Wood Thrush	" 30	" 27	" 29	3

This demonstrates conclusively that the average date of arrival for a number of years, based upon the observations of a single individual, varies materially from the average date obtained by another equally accurate observer stationed but a few miles distant. The amount of difference in the case of individual observers is even greater than that shown above, as in these cases the record given for each of the three stations is the result of the combined work of several observers.

I called attention to the percentage of error in the records of individual observers in a paper read before the American Ornithologists' Union at New York in November, 1905, and during the Spring of 1907 Prof. W. W. Cooke made some experiments along the same line, and his results showed that, compared with the combined work of twenty-three other observers, in the immediate vicinity of Washington, D. C., in this single season his dates of arrival averaged one and three-tenths of a day late, and this in spite of the fact that he spent more time in the field and covered a greater variety of country. In my summary given above a single station averages one and nine-tenths of a day later than the earliest average date recorded for the species.

This information, however, does not help us in using the record of a single observer for comparative study, either as between different years or different stations, and we are forced to the conclusion that results based upon such individual records are really of but little value for comparative work, so great is the possibility of error.

For instance, quoting from Prof. W. W. Cooke's papers on the Migration of Warblers and Thrushes, as recorded in the schedules of the U. S. Department of Agriculture,[1] we have the average dates of the arrival of the following species at Germantown, Pa., a suburb of Philadelphia, and at Washington, D. C.:

[1] *Bird Lore*, 1905–1907.

	Germantown.	Washington.	Difference.
Wood Thrush	May 1	April 26	5 days.
Black-throated Blue Warbler	May 6	May 2	4 "
Ovenbird	May 1[2]	April 23	8 "
Maryland Yellow Throat	April 29	April 21	8 "

These dates being the averages of a number of years, would seem to be sufficiently accurate for the purpose of estimating the time of flight of the species mentioned between Washington and Philadelphia, and by comparing them we find that it is respectively five days, four days, eight days and eight days. The Germantown records quoted from Prof. Cooke's papers are based upon schedules which I filled out for the Department of Agriculture from 1883 to 1890. I now find that my dates vary from those obtained by other observers in the neighborhood of Philadelphia from 1901 to 1907, just as the latter have been shown to vary from each other.

Had any of the other records from the vicinity of Philadelphia been used in place of the Germantown series, as would have been perfectly justifiable, a very different result would have been obtained; and there is no doubt but that the dates of several individual observers in the vicinity of Washington would show just as much diversity as is shown in our Philadelphia series, which would still further vary the results.

In a number of instances moreover the difference between the average date of arrival at Washington and Philadelphia, as given in Prof. Cooke's papers, is no greater than that between two stations well within the Philadelphia ten-mile circle.

In comparing the dates of arrival of species for several consecutive years we also find a considerable variation in the records of nearby stations which we should expect to show uniformity.

For instance, taking the eleven species given in the table on page 134, and computing the average dates of arrival for the six years 1901 to 1906 at each of the three stations, and then comparing these with the dates of arrival at each of the stations in 1907, we find that at station No. I the 1907 dates averaged three days late, while at station No. II they averaged one day late and at station No. III they averaged exactly normal, and yet each one of these stations was represented by several accurate observers, and there is nothing in their relative geographic position to warrant any difference.

Combination of Individual Records.

After discrediting the value of individual records, one must natur-

[2] Omitted in Prof. Cooke's paper, and supplied from my own memoranda.

ally suggest some method of recording migration by which results sufficiently accurate for comparative work are to be obtained. This, I think, is to be found by securing a large number of observers in a limited area and by combining their results, as has been done by the Delaware Valley Ornithological Club in the vicinity of Philadelphia. If we had seven-year records kept by thirty-five individuals within ten miles of Washington, and a similar series within ten miles of Boston for comparison with the Philadelphia series, then I think we should be able to estimate with some degree of accuracy the progress of migration between these points.

In a composite record of this kind it is especially worthy of note that more or less fragmentary records are of great value, as an observer who only records a limited number of species may note some of them earlier than any other observer, while species which he fails to record are noted by others.

The way in which a number of indvidual records from one vicinity are to be combined in order to get the most reliable results is quite a problem.

Take, for example, the Ovenbird, *Seiurus aurocapillus*, for the years 1905, 1906 and 1907, as recorded within ten miles of Philadelphia by respectively thirty, thirty-two and thirty-four observers—the number of the observation corps varying somewhat from year to year.

We find that in 1905 it arrived at one station on April 25; at another on April 28; at eight stations on the 29th, ten on the 30th, etc., *i.e.*:

1905—April 25, 28, 29 (8), 30 (10), May 2, 3, 4, 6, 7 (2), 8, 12 (2).
1906—April 28 (2), 29 (7), 30 (4), May 1 (5), 2 (3), 3 (4), 4 (2), 5 (3), 8, 12.
1907—April 26 (2), 27, 28 (4), 29 (5), 30 (2), May 1 (5), 2 (2), 5 (4), 6, 8, 11 (4), 12, 13, 15.

If we select the earliest date for each year as the basis of our comparison, we shall say that 1905 was the earliest season and 1906 the latest. The objection to this is that it considers only the earliest stragglers, whose movements may or may not reflect those of the bulk of the species.

If we select the average of all the dates for each year we shall have for 1905 May 2, 1906 May 2, 1907 May 3, or 1905 earliest and 1907 latest. The objection in this case is that some at least of the late dates of arrival represent errors of observation—*i.e.*, failures to detect the species until it had been present for some days—while others are for stations which are not congenial haunts of the species under consideration and at which it is only occasionally seen, and by including these in our computation we obviously make the resultant date too late.

After considerating many methods it seems that the best date to select is that upon which the species had arrived at half of the stations, leaving out of consideration entirely the last quarter of the stations that recorded the species, in order to eliminate the probably erroneous or misleading dates.

Dropping the last quarter of the stations in the case of the Ovenbird, we shall have left for consideration in the three years twenty-three, twenty-four and twenty-six records respectively, *i.e.*:

1905—April 25, 28, 29 (8), 30 (10), May 2, 3, 4.
1906—April 28 (2), 29 (7), 30 (4), May 1 (5), 2 (3), 3 (3).
1907—April 26 (2), 27, 28 (4), 29 (5), 30 (2), May 1 (5), 2 (2), 5 (4), 6.

The dates by which the species had reached half these stations will then be 1905 April 30, 1906 April 30, 1907 April 30. This is perhaps a poor example as the Ovenbird is such a regular migrant. Indeed a mere glance at the records will show that the bulk of arrivals occurred in 1905 on April 29 and 30, in 1906 on the same days and in 1907 on April 28 and 29, which represents almost the same thing.[3]

In other cases, however, the massing of arrivals upon a few days is by no means so evident, and some such method as the above is absolutely necessary. For example:

Pipilo erythrophthalmus (Towhee).

1905—March 24, April 11 (2), 12 (2), 14 (3), 18, 19, 20, 21 (2), 22 (2), 23 (3), 24, 25 (3), 26 (2), 29, 30.
1906—March 6, April 7, 12, 15 (3), 16, 17, 19 (4), 20, 21 (5), 22 (3), 23, 24, 25 (2), 27 (2), 30 (2), May 8.
1907—March 23, 30 (2), April 3, 4, 6, 14, 16, 20, 24, 26 (5), 27 (3), 28, May 1, 4, 5, 6.

Rejecting the last quarter of the records in each year and selecting the middle one of those remaining, as before, we get:

1905 April 19, 1906 April 19, and 1907 April 20.

Hirundo erythrogastra (Barn Swallow).

1905—April 7, 20 (3), 21, 23 (3), 24, 25 (3), 27, 29, 30 (4), May 6, 7, 9.
1906—April 11, 12, 14, 17, 19, 21 (2), 22 (3), 25 (4), 26, 28 (2), 30, May 3, 6, 19.
1907—March 27, April 6, 20, 21, 22 (2), 24 (3), 26 (2), 27, 28 (3), 30, May 1, 2, 4, 5 (3), 8 (2), 10, 11, 12, 14.

1905 April 23, 1906 April 22, 1907 April 26.

Toxostoma rufum (Brown Thrasher).

1905—April 9, 13, 14 (2), 16, 18 (2), 19 (2), 21 (2), 22 (6), 23 (3), 24 (4), 25 (2), 26, 29, 30, May 3.

[3] While the migration of 1907 was very late, so far as most of the April and all the May migrants were concerned, a wave just at this time brought the Ovenbirds at their normal date.

1906—March 9, April 10, 16, 17 (2), 19 (3), 20, 21 (4), 22 (3), 24 (2), 25 (2), 26, 27, 28 (2), 30, May 1 (2), 5, 6.
1907—March 13, 17, April 20, 23, 25, 26 (6), 27 (7), 28 (2), 29 (2), 30 (2), May 1 (3), 2, 3, 4 (2), 5, 8, 11 (2).
1905 April 22, 1906 April 21, 1907 April 27.

The above plan gives us a definite date for all sorts of comparisons and one which is independent of the personal equation. The term "became common" may mean a different thing to each individual, but the date upon which a species reached half of the stations at which it was observed represents a *definite point* in the increase of its abundance, and is a matter of record and not of opinion.

As so little has been attempted in the way of combining local migration records, I find it difficult to discuss the comparative value of different methods. Some casual allusions by Prof. Cooke to the methods employed by him form indeed the only contribution to the subject with which I am familiar. He recognizes the danger of including the latest dates of arrival in computing averages and rejects them, just as I have advocated above, but in deciding how many to reject his method seems to lack definiteness and to involve the personal equation. He says (*Auk*, 1907, p. 347), "When using migration records for the calculation of average dates of arrival, I usually discard dates that are more than six days later than the probable normal date of arrival." This would seem to imply an arbitrary selection of "the probable normal" date before any averaging is done, which seems to be a dangerous method. Again, in referring to the combination of the observations of twenty-three observers at Washington, D. C., in the Spring of 1907, he says, "Many of the notes were duplicates or of *no value*, but after all these had been eliminated," etc. [Italics mine]. This is exactly the reverse of my method, instead of rejecting "duplicate" records, these seem to me to be of the utmost value as pointing to the dates upon which the greatest migration took place. It must, however, be borne in mind that Prof. Cooke in this instance is ascertaining the earliest date—not the date of bulk arrival which, as just explained, seems to me a more reliable basis for comparison of migration between two distant points, but one which, as I have also explained, is practically impossible in the absence of a large corps of observers at each point.

Graphic Representation of Migration.

In the *Auk* for 1889 (p. 139) and 1891 (p. 194) I published some papers on the Graphic Representation of Bird Migration, based in part upon records of the Delaware Valley Ornithological Club for 1890.

The attempt was made at this time to record the actual number of individuals or the relative abundance of certain species, as noted each day by five observers, and by plotting the daily totals a chart was obtained representing the fluctuations of the migration, which was shown to correspond to rises and falls in the curve of temperature variation for the same period. In my *Birds of Eastern Pennsylvania and New Jersey*, 1894 (p. 28), a like method was employed.

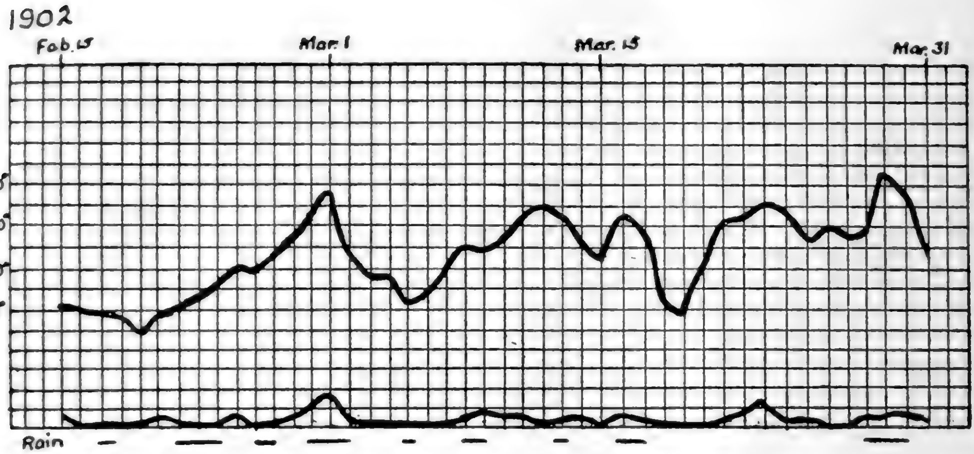
Similar and probably much more accurate results may be obtained by plotting a curve based upon the total "first arrivals" within the ten-mile circle as reported by our Philadelphia migration corps for each day of the Spring.

In the following diagrams such curves are shown for the years 1902 to 1907, accompanied by curves of temperature variation based upon the mean daily temperature at Philadelphia as recorded by the United States Weather Bureau, together with an indication of the days upon which rain or snow fell. For this meteorological data I am under obligations to Mr. T. F. Townsend, Director of the Pennsylvania Section, U. S. Weather Bureau.

In the early part of the season it will be noticed that "waves" of migration follow closely after marked rises in temperature, but later on at the height of the May migration the great "waves" or "rushes" often occur without any corresponding temperature increase.

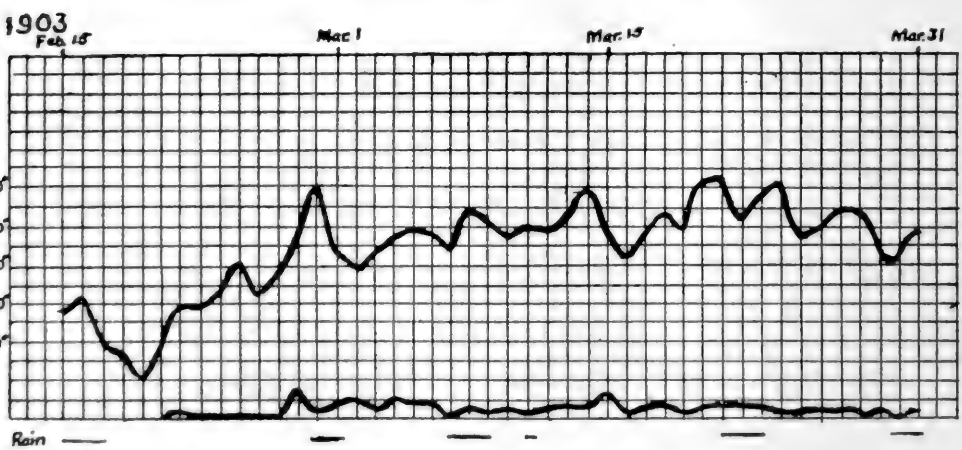
It is well known that birds do not start to migrate on a rainy night, so that it is natural to expect sudden drops in the migration curves to be correlated with spells of rainy weather, and such is often the case. Inasmuch as birds are sometimes overtaken by rainstorms after starting on a clear evening, they often arrive at a locality simultaneously with the rain, and as it is not possible to indicate in the diagrams the exact time and extent of the daily precipitation allowances must be made for some apparent discrepancies in this respect.

In the following diagrams the vertical lines represent the days from February 15 to May 18, while the horizontal lines denote five degrees difference in the temperature curve and ten units difference in the migration curve; a unit in the latter curve being a "first arrival" record at some one of the stations within ten miles of Philadelphia. Thus if the migration curve reaches ten on a certain day it means ten first arrivals, *i. e.*, one species recorded for the first time at ten stations, two species at five stations each, or ten different species each recorded at a single station as the case may be. Periods of rainy weather are indicated by the broken line immediately below the diagram, marked "rain." Each migration is divided into two sections placed opposite to each other, so that the curves run across both pages, with the comments below. In each chart the upper curve represents temperature variation, the lower migration.



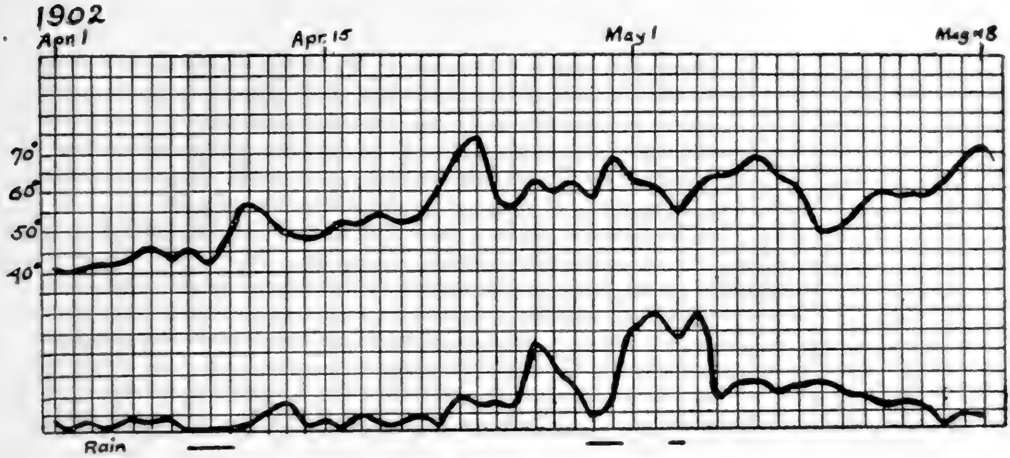
In 1902 the temperature rose steadily from February 19 to March 1, and a marked migration occurred February 27 to March 1, consisting mainly of the bulk movement of Purple Grackles and Robins.

The mean temperature during March was 46°, six degrees above the normal; the highest figures being on March 1, 12, 16, 23 and 29. Marked migratory movements occurred on March 10–11, March 23, and March

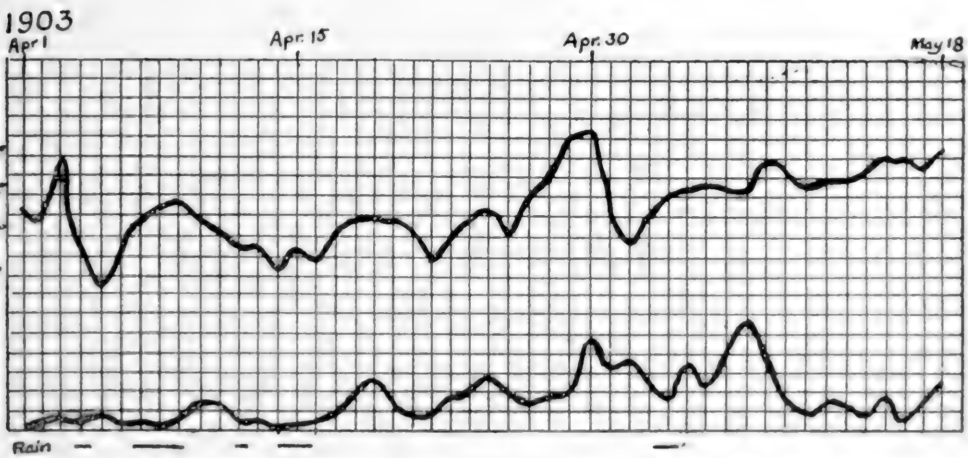


In the season of 1903 there was an almost unbroken rise in temperature from February 19 to February 28, most rapid from the 25th to the end of the month. The bulk movement of Robins and Purple Grackles took place on the 27th, accompanied this year by a considerable migration of Fox Sparrows.

The mean temperature during March was 49°—unusually high and

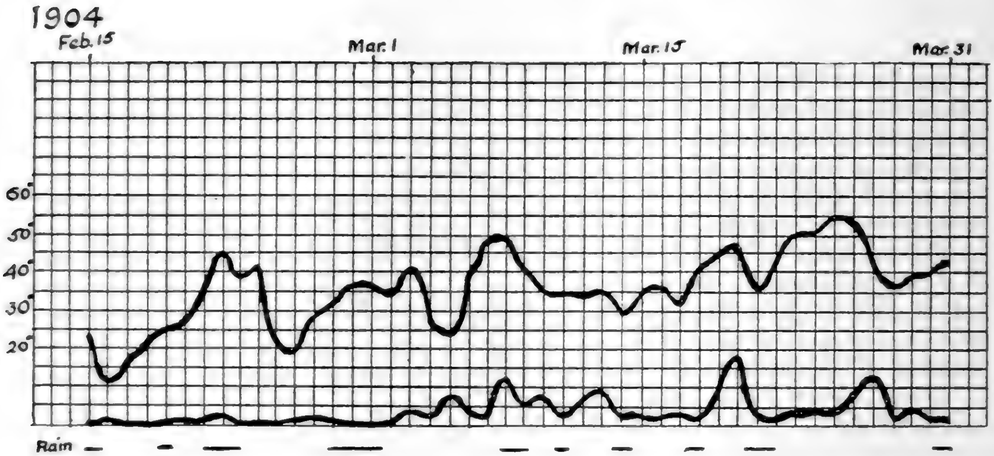


29, the Fox Sparrow being a characteristic species of the first movement, the Chipping Sparrow and Phœbe of the other two. April was but little above the normal temperature, the marked increase being on the 11th, 23d and 30th, with corresponding migration on April 12, 13, 21–22, 26, and May 1. The May movement continued until the 4th, broken on the 3d by rain.

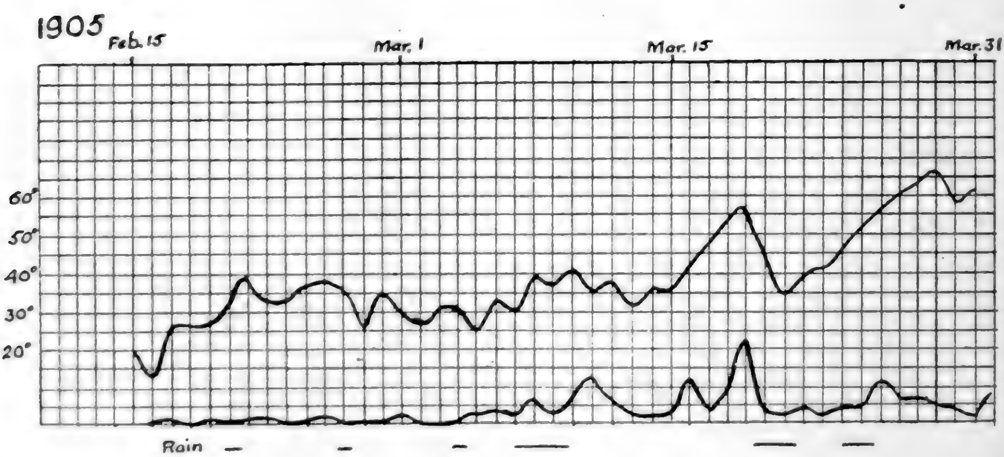


only equalled once in the previous thirty years. There was only one well-marked wave during the month, on the 15th, following the high temperature which culminated on the 14th.

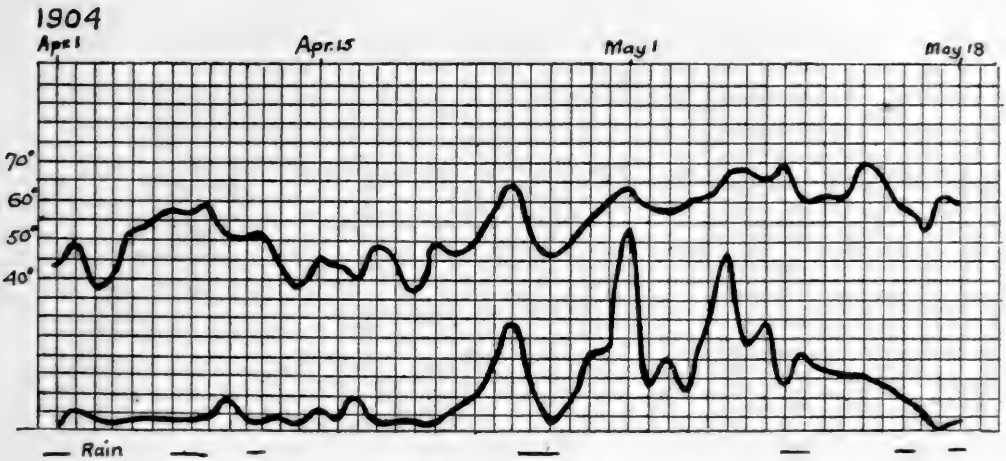
In April the coincidence of migration waves and increases in temperature will be noticed on April 9, 19, 25 and 30, with the great May movements on May 5 and 8.



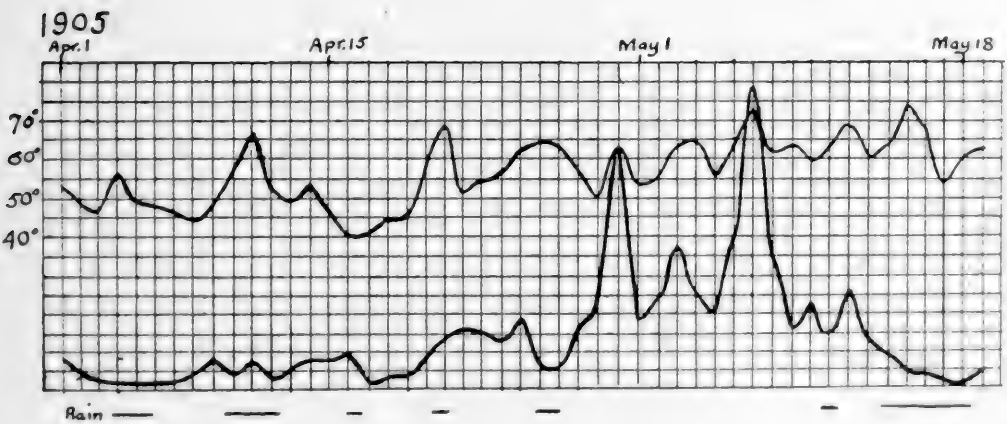
The early warm wave in 1904 occurred February 22–24, but brought only the first arrival of Robins, with no evidence of migration in other species. The rain which prevailed at the time no doubt checked any general movement. The weather during March was normal and the rises in temperature, which culminated on March 3, 7, 13, 20 and 26,



In 1905 there was no February migration. The rise in temperature on March 8 brought the first migratory movement which was checked by rain, but resumed again on March 11. High temperature March 16–19 brought two migratory movements. Rain in April at the time of sudden rises in temperature seems to have broken up the regularity of the migration or held it in check, and perhaps had something to do

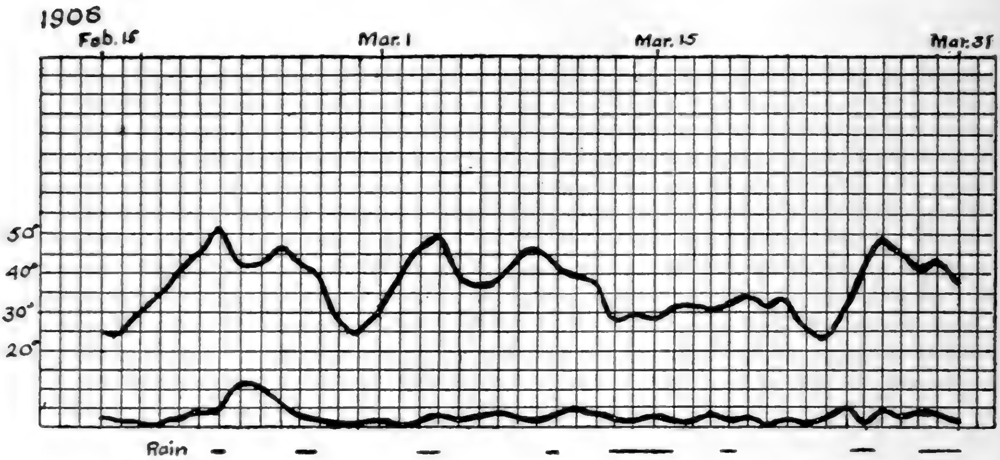


were followed by migrating movements on March 5, 8, 13, 20 and 27. In April the principal movements on the 10th and 25th corresponded to marked increases in temperature, while the great May waves occurred on the 1st and 6th.



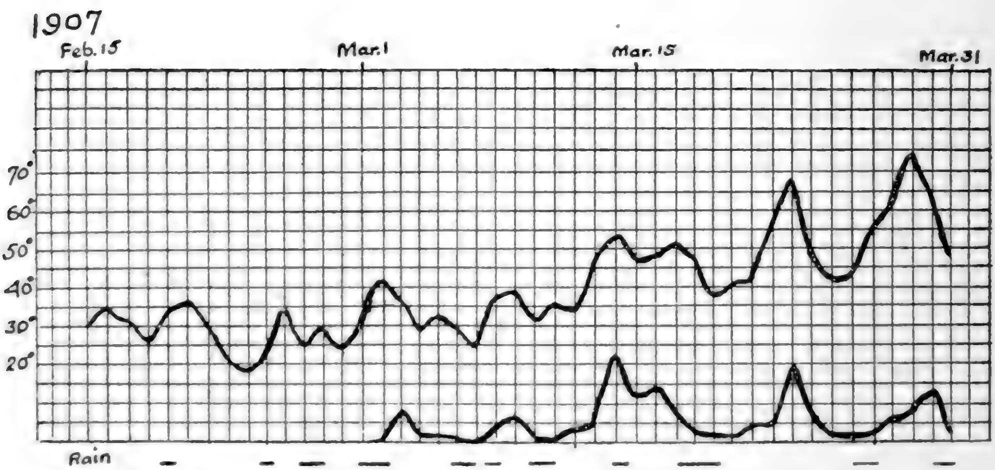
with the proportions of the wave of April 30, which followed the last spell of rainy weather and was the most extensive April movement that our records show. The May waves occurred on the 3d and 7th.

The correspondence in the migration curves for 1904 and 1905 is remarkable, the movements being about the same in number and extent and nearly the same in time of occurrence.

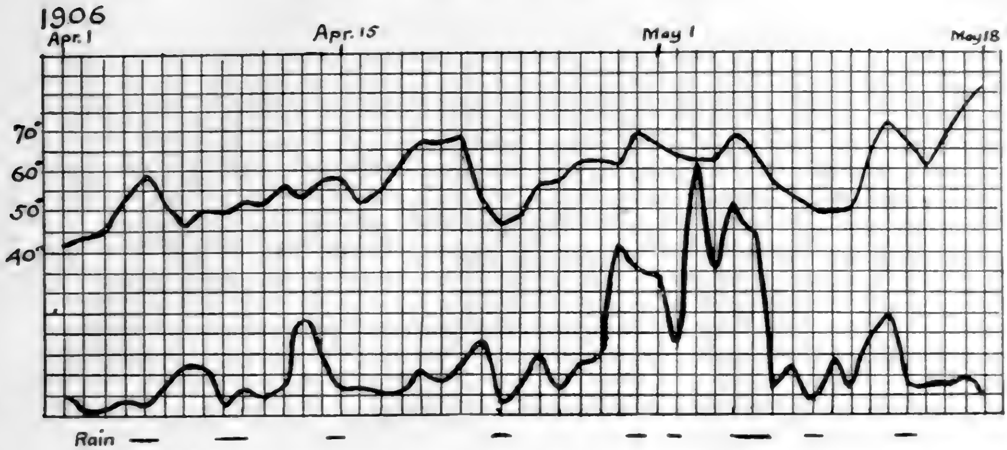


In 1906 the steady rise in temperature February 15 to 21 caused one of the most extensive February migrations of which we have record. In March, on the contrary, there was no movement of consequence, notwithstanding two considerable temperature increases culminating on the 4th and 26th.

The explanation of this is to be found in the fact that birds that usually form the early March waves had already advanced with the

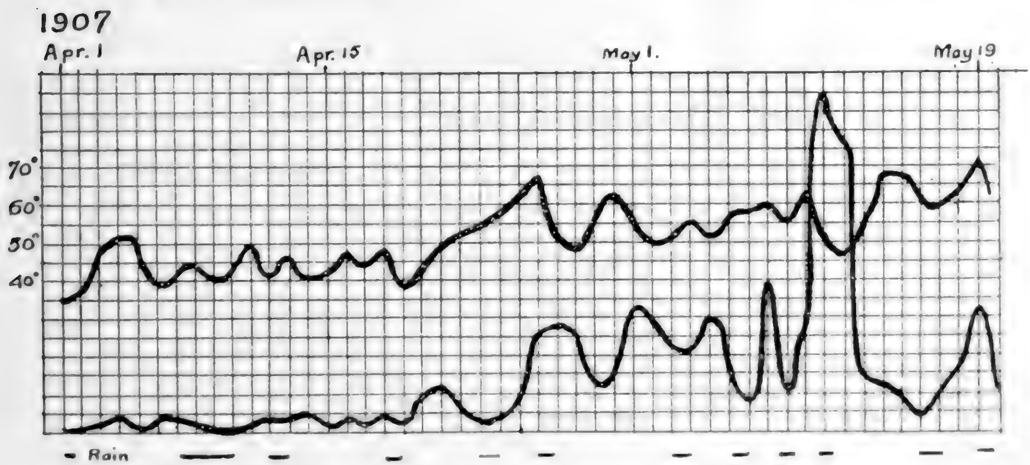


In 1907 there was no February migration whatever. March was rather warmer than usual, and the five well-marked waves correspond with unusual exactness to temperature increases. The phenomenal cold of early April brought migration to a standstill, followed by marked waves on April 21, April 26 and May 1, following increases in temperature culminating on April 26 and 30. The continued cold weather of May delayed the great migratory movements of that month until May 11–12 when the birds went through in a great throng, irrespective



great February movement, and there were no species ready to respond to the favorable conditions in March.

High temperature on April 5 was accompanied by rain and migration was not apparent until April 6 to 8 when there was an extensive movement. Another occurred on the 13th, while the high temperature of April 21 was followed by a wave on the 22d, which was resumed on April 25 after a cold rain. The greatest movements were April 29–May 1, May 3 and May 5.



of falling temperature with frost on the morning of May 12. The last May wave did not occur until the 19th.

In this season we have an example of the difficulty of characterizing an entire migration as early or late. The beginning of the movement was late, while most of the March dates of arrival were remarkably early; early April migrants were late, but the great movements at the close of the month brought conditions nearly to the normal, while the May migrants were phenomenally late.

Waves and Their Components.

Accepting the fact that the migratory movement advances by "waves" or "rushes,"—that is to say that the bulk of the migration at each locality occurs on certain nights or series of nights,—the question naturally arises: To what extent are the several "waves" in successive years composed of the same species?

A study of the migration curves will show that there are from eleven to fourteen prominent waves during the Spring, taking into consideration only those which show ten or more arrivals[4] in February and March, fifteen to twenty in April, and thirty to one hundred in May. These seem to me to be the only movements worthy to be styled waves, although some have used the term to indicate far less marked movements, while others use it only for the most extensive migratory flights.[5]

Selecting forty-seven common species for which we have the fullest data, and noting such migratory activity[6] as is indicated by each on the wave-days for the years 1904 to 1907, we find a remarkable correspondence in the species which make up each wave. And the same "wave" may be recognized through a number of years by its component species, though its date may vary considerably. Sometimes a movement may be interrupted by unsuitable weather and be resumed again later, making two apparent waves in one year which correspond to one in other years. Or when conditions are exceptionally favorable early in the season, the species which usually compose Wave II, for instance, may push forward and form part of Wave I; and although conditions at the normal time of occurrence of Wave II may be favorable there will be no movement, simply because all the species usually migrating at that time have passed on.

It seems then that certain species migrate together, advance stragglers of some accompanying the bulk movements of others, and that each species is ready for migration at approximately the same time each year, the exact date depending upon a favorable combination of meteorological conditions.

The following tables will show which of the forty-seven selected species composed the various waves for the four years for which we

---

[4] "Arrival" here has the same significance as explained on page 193.

[5] Cf. Twenty-five Years of Bird Migration at Ann Arbor, Michigan, by N. A. Wood, *Eighth Annual Report Mich. Acad. Sci.*

[6] Usually only the "first arrival" within the Philadelphia circle and the one or more marked bulk movements are considered, but sometimes when the first arrival was a very early straggler the second arrival is also noted.

have the fullest data. Many other less common species arrived on the various "wave-days," but their inclusion in the tables would only tend to confusion and would obscure the point that I wish to demonstrate. Where a species has been omitted in any year it is because it failed to arrive on one of the wave movements, or because the bulk movement was scattered and not concentrated on a "wave-day." The scarcity of such omissions, however, illustrates to what an extent the migration is concentrated on a comparatively small number of days.

"First arrival" in these tables denotes the first individual to be reported anywhere within the ten-mile circle.

WAVE I.

	1904. *March 5.*	1905. *March 8.*	1906. *February 22–24.*	1907. *March 9.*
First Arrivals	Red-winged Blackbird.	Red-winged Blackbird.	Red-winged Blackbird. Fox Sparrow (2d). Vesper Sparrow.	Red-winged Blackbird.
Bulk Movement.	Purple Grackle. Robin.	Purple Grackle. Robin.	Purple Grackle. Robin. Red-winged Blackbird. Fox Sparrow.	Purple Grackle. Robin.

WAVE II.

	1904. *March 8–10.*	1905. *March 10–12.*	1906.	1907. *March 14–16.*
First Arrivals.	Fox Sparrow (2d).	Fox Sparrow.	[Combined with Wave I this year.]	Fox Sparrow. Vesper Sparrow. Phœbe. Myrtle Warbler. Hermit Thrush.
Bulk Movement.	Red-winged Blackbird. Purple Grackle. Robin.	Red-winged Blackbird. Purple Grackle. Robin.		Red-winged Blackbird. Purple Grackle. Robin. Fox Sparrow. Phœbe.

WAVE III.

	1904. March 12–13.	1905. March 16.	1906. March 12.	1907.
First Arrivals.	Phœbe.	Phœbe.	Phœbe.	[Combined with Wave II this year.]
Bulk Movement.	Fox Sparrow. Red-winged Blackbird.	Fox Sparrow. Red-winged Blackbird.	Fox Sparrow.	

WAVE IV.

	1904. March 19–20.	1905. March 18–19.	1906. March 25.	1907. March 23–24.
First Arrivals.	Vesper Sparrow. Chipping Sparrow.	Vesper Sparrow. Chipping Sparrow.	Chipping Sparrow.	Chipping Sparrow. Towhee.
Bulk Movement..	Phœbe. Red-winged Blackbird.	Phœbe. Red-winged Blackbird.	Red-winged Blackbird.	Phœbe. Vesper Sparrow.

WAVE V.

	1904. March 26–27.	1905. March 26.	1906. April 6–8.	1907. March 29–30.
First Arrivals.	Towhee. Myrtle Warbler.	Towhee.	Towhee (2d). Myrtle Warbler. Hermit Thrush. Ruby-crown Kinglet. Yellow Palm Warbler. Brown Thrasher(2d). House Wren.	Towhee (2d). Hermit Thrush (2d). Ruby-crown Kinglet. Yellow Palm Warbler. Barn Swallow.
Bulk Movement..	Phœbe. Vesper Sparrow. Chipping Sparrow.	Phœbe. Vesper Sparrow. Chipping Sparrow.	Phœbe. Vesper Sparrow. Chipping Sparrow.	Phœbe. Vesper Sparrow. Chipping Sparrow.

Wave VI.

	1904. *April 2.*	1905. *April 1.*	1906.	1907.
First Arrivals.	Hermit Thrush. Ruby-crown Kinglet. Yellow Palm Warbler.	Hermit Thrush. Ruby-crown Kinglet. Myrtle Warbler.	[Included in Wave V.]	[Included in Wave V.]
Bulk Movement..	Chipping Sparrow.	Ruby-crown Kinglet.		

Wave VII.

	1904. *April 10 + April 17.*	1905. *April 9–11 + April 16.*	1906. *April 13.*	1907. *April 20–22.*
First Arrivals.	Barn Swallow. Chimney Swift. Brown Thrasher. Black-and-White Warbler. Maryland Yellow-throat.	Barn Swallow. Chimney Swift. Brown Thrasher. Catbird. Yellow Warbler. Yellow Palm Warbler.	Barn Swallow. Chimney Swift.	Barn Swallow. Chimney Swift. Black-and-White Warbler. Catbird. Water Thrush.
Bulk Movement..	Hermit Thrush. Yellow Palm Warbler. Ruby-crown Kinglet. Myrtle Warbler.	Hermit Thrush. Yellow Palm Warbler. Towhee.	Hermit Thrush. Yellow Palm Warbler. Ruby-crown Kinglet.	Hermit Thrush. Yellow Palm Warbler. Ruby-crown Kinglet. Myrtle Warbler.

Wave VIII.

1904.	1905.	1906.	1907.
April 23–26.	*April 22–25.*	*April 21–25.*	*April 26–28.*

First Arrivals—Nine species have arrived on this wave in at least three of the four years, *i.e.*, Scarlet Tanager, Yellow Warbler, Black-throated Green Warbler, Ovenbird, Water Thrush, House Wren, Catbird, Wilson's Thrush and Wood Thrush. Five others arrived in two out of the four seasons, *i.e.*, Rose-breasted Grosbeak, White-eyed Vireo, Redstart, Maryland Yellow-throat and Yellow-breasted Chat.

Bulk Movement—The bulk of this wave comprised the same seven species in each of the four years, *i.e.*, Chimney Swift, Barn Swallow, Black-and-White Warbler, Myrtle Warbler, Maryland Yellow-throat, Brown Thrasher and House Wren. To these are to be added the Yellow Warbler in 1904 and the Ovenbird in 1907.

Wave IX.

1904.	1905.	1906.	1907.
April 29–May 1 + May 3.	*April 29–30.*	*April 29–May 1.*	*May 1–3.*

First Arrivals—Six species arrived on this wave each year, *i.e.*, Baltimore Oriole, Kingbird, Red-eyed Vireo, Blue-winged Warbler, Magnolia Warbler, Parula Warbler, and in three of the four years Great Crested Flycatcher, Indigo-bird, Yellow-throated Vireo, Black-throated Blue Warbler.

Bulk Movement—Seven species were abundant during this wave in each of the four years, *i.e.*, Black-throated Green Warbler, Redstart, Water Thrush, Ovenbird, Catbird, Wilson's Thrush and Wood Thrush, and in three of the four the Yellow Warbler and Scarlet Tanager.

Wave X.

1904.	1905.	1906.	1907.
May 5–8.	*May 3 + 7.*	*May 5–6.*	*May 8 + 10–12.*

First Arrivals—Species usually arriving on this wave Chestnut-sided Warbler, Blackburnian Warbler, Canada Warbler, Black-poll Warbler, Wood Pewee, Hummingbird, Yellow-billed Cuckoo.

Bulk Movement—In all four years Baltimore Oriole, Wood Pewee, Great Crested Flycatcher, Indigo-bird, Rose-breasted Grosbeak, Scarlet Tanager, Red-eyed Vireo, White-eyed Vireo, Yellow-breasted

Chat, Chestnut-sided Warbler. In three of the four years Blue-winged Warbler, Black-throated Green Warbler, Black-throated Blue Warbler, Magnolia Warbler, Black-poll Warbler, Kingbird.

Wave XI.

1904.	1905.	1906.	1907.
May 10–11.	*May 12.*	*May 12-13.*	*May 19.*

Bulk Movement in all four years—Yellow-billed Cuckoo, Hummingbird, Wood Pewee, Magnolia Warbler, Blackburnian Warbler, Black-poll Warbler and Canada Warbler.

Six Years Records at Philadelphia.

The following tables present a summary of the arrival dates of the ninety species which are printed upon the schedules of the Delaware Valley Ornithological Club for the years 1902 to 1907, based upon the records of from twenty-five to thirty-five observers for each year, all located within ten miles of the center of Philadelphia.

Under "first arrival" is given the average date of the first observation reported by any of the observers, and also the earliest and latest first arrival for the six years under consideration. Under "bulk arrival" is given the date for each year when the species had been reported at half the stations, computed as explained on page 137, and also the average of these six dates. In some cases the data were too meager to warrant this computation, in which instances the dates are omitted and only first arrivals given. In a few species, marked by an asterisk, dates which obviously referred to winter residents have been rejected, while in the case of the Long-billed Marsh Wren, Pine Warbler and perhaps a few others the data are probably not sufficient to give accurate results, the species being rare or local.

	First Arrival.			Bulk Arrival.						
	Average	Extremes 1902–07		1902	1903	1904	1905	1906	1907	Average
Canada Goose, *Branta canadensis*	Mar. 4	Feb. 20	Mar. 14							
Green Heron, *Butorides virescens*	Apr. 21	Apr. 10	Apr. 30	Apr. 28	May 2	Apr. 29	Apr. 29	Apr. 30	May 3	Apr. 30
Night Heron, *Nycticorax n. nævius*	Mar. 29	Mar. 22	Apr. 10							
Spotted Sandpiper, *Actitis macularia*	Apr. 12	Apr. 7	Apr. 18	May 3	Apr. 26	Apr. 23	Apr. 22	Apr. 21	Apr. 28	Apr. 25
Solitary Sandpiper, *Helodromas solitarius*	Apr. 22	Apr. 14	Apr. 30							
Killdeer, *Oxyechus vociferus*	Mar. 2	Feb. 25	Mar. 5	..	......	Mar. 11	Mar. 17	Mar. 11	Mar. 16	Mar. 14
Dove, *Zenaidura macroura*	Mar. 7	Feb. 23	Mar. 15							
Osprey, *Pandion hal. carolinensis*	Mar. 30	Mar. 17	Apr. 5							
Turkey Vulture, *Cathartes aura*	Mar. 9*	Mar. 3	Apr. 13							
Yellow-billed Cuckoo, *Coccyzus americanus*	May 3	Apr. 30	May 8	May 12	May 8	May 10	May 7	May 6	May 11	May 9
Black-billed Cuckoo, *Coccyzus erythrophthalmus*	May 6	May 1	May 10	......	......	May 9	May 7	May 13	May 17	May 11
Kingfisher, *Ceryle alcyon*	Mar. 14	Mar. 3	Mar. 28	......	......	Mar. 20	Mar. 24	Apr. 7	Mar. 24	Mar. 26
Yellow-bellied Sapsucker, *Sphyrapicus varius*	Mar. 9	Feb. 17	Mar. 25	......	......	Apr. 5	Apr. 8	Apr. 13	Apr. 15	Apr. 10
Red-headed Woodpecker, *Melanerpes erythrocephalus*	Apr. 16	Apr. 1	May 8							
Flicker, *Colaptes auratus luteus*	Feb. 17	Feb. 8	Mar. 3	Feb. 24	Mar. 10	Mar. 13	Mar. 18	Mar. 27	Mar. 17	Mar. 13
Whippoorwill, *Antrostomus vociferus*	Apr. 27	Apr. 22	Apr. 30							
Night Hawk, *Chordeiles virginianus*	Apr. 30	Apr. 28	May 6	May 17	May 10	May 10	May 7	May 13	May 17	May 11
Chimney Swift, *Chætura pelagica*	Apr. 17	Apr. 12	Apr. 23	Apr. 22	Apr. 20	Apr. 25	Apr. 21	Apr. 18	Apr. 26	Apr. 22
Hummingbird, *Trochilus colubris*	May 3	Apr. 28	May 10	May 7	......	May 7	May 7	May 12	May 12	May 9
Kingbird, *Tyrannus tyrannus*	Apr. 29	Apr. 23	May 2	May 2	May 9	May 5	May 4	Apr. 30	May 5	May 4
Crested Flycatcher, *Myiarchus crinitus*	Apr. 29	Apr. 25	May 2	May 1	May 6	May 5	May 3	May 2	May 8	May 4
Phœbe, *Sayornis phœbe*	Mar. 13	Mar. 6	Mar. 16	Mar. 23	Mar. 15	Mar. 20	Mar. 19	Apr. 4	Mar. 17	Mar. 21
Wood Pewee, *Contopus virens*	May 3	Apr. 30	May 6	May 6	May 12	May 10	May 8	May 6	May 14	May 9
Acadian Flycatcher, *Empidonax virescens*	May 5	Apr. 29	May 13							
Least Flycatcher, *Empidonax minimus*	Apr. 28	Apr. 25	May 1	May 1	......	May 5	May 1	May 4	May 4	May 2
Bobolink, *Dolichonyx oryzivorus*	May 2	Apr. 30	May 6	May 9	May 9	May 8	May 9	May 3	May 11	May 8

	First Arrival.			Bulk Arrival.						
	Average	Extremes 1902–07		1902	1903	1904	1905	1906	1907	Average
Cowbird, *Molothrus ater*	Mar. 15	Mar. 1	Mar. 28	....	Mar. 23	Mar. 26	Mar. 23	Mar. 29	Mar. 22	Mar. 25
Red-winged Blackbird, *Agelaius phœniceus*	Mar. 3	Feb. 23	Mar. 9	Mar. 7	Mar. 5	Mar. 15	Mar. 16	Mar. 4	Mar. 15	Mar. 10
Meadow Lark, *Sturnella magna*	Feb. 6*	Feb. 4	Feb. 12	....	Mar. 3	Mar. 9	Mar. 16	Feb. 25	Mar. 16	Mar. 8
Orchard Oriole, *Icterus spurius*	May 1	Apr. 30	May 4	May 4	May 9	May 5	May 4	May 4	May 4	May 5
Baltimore Oriole, *Icterus galbula*	May 1	Apr. 30	May 2	May 4	May 7	May 5	May 3	May 3	May 10	May 5
Rusty Blackbird, *Euphagus carolinus*	Mar. 15	Mar. 12	Mar. 19							
Purple Grackle, *Quiscalus quiscula*	Feb. 22*	Feb. 13	Mar. 3	Feb. 28	Mar. 1	Mar. 8	Mar. 8	Feb. 22	Mar. 9	Mar. 3
Vesper Sparrow, *Poœcetes gramineus*	Mar. 16	Feb. 25	Mar. 24	Apr. 5	Mar. 31	Mar. 27	Mar. 26	Apr. 8	Mar. 24	Mar. 30
Savanna Sparrow, *Passerculus s. savanna*	Mar. 16	Mar. 3	Mar. 22							
Grasshopper Sparrow, *Coturniculus p. savannarum*	Apr. 21	Apr. 12	Apr. 23	Apr. 26	Apr. 26	May 1	Apr. 27	Apr. 29	Apr. 28	Apr. 28
Chipping Sparrow, *Spizella socialis*	Mar. 22	Mar. 18	Mar. 29	Mar. 30	Mar. 22	Apr. 4	Mar. 27	Apr. 7	Mar. 28	Mar. 29
Field Sparrow, *Spizella pusilla*	Mar. 4*	Feb. 20	Mar. 16	Mar. 25	Mar. 14	Mar. 25	Mar. 19	Mar. 11	Mar. 22	Mar. 19
Swamp Sparrow, *Melospiza georgiana*	Mar. 29	Mar. 16	Apr. 24							
Fox Sparrow, *Passerella iliaca*	Mar. 1	Feb. 20	Mar. 14	Mar. 8	Mar. 1	Mar. 12	Mar. 16	Feb. 24	Mar. 15	Mar. 8
Towhee, *Pipilo erythrophthalmus*	Mar. 21	Mar. 6	Apr. 3	Apr. 20	Apr. 17	Apr. 19	Apr. 19	Apr. 19	Apr. 20	Apr. 19
Rose-breasted Grosbeak, *Zamelodia ludoviciana*	Apr. 30	Apr. 26	May 2	May 4	....	May 6	May 7	May 4	May 11	May 6
Indigo-bird, *Passerina cyanea*	May 1	May 1	May 2	May 8	May 4	May 6	May 7	May 5	May 10	May 7
Scarlet Tanager, *Piranga erythromelas*	Apr. 28	Apr. 21	May 2	May 2	May 6	May 6	May 5	May 3	May 10	May 6
Purple Martin, *Progne subis*	Mar. 29	Mar. 16	Apr. 9							
Cliff Swallow, *Petrochelidon lunifrons*	Apr. 29	Apr. 23	May 5							
Barn Swallow, *Hirundo erythrogastra*	Apr. 10	Mar. 27	Apr. 16	Apr. 18	Apr. 24	Apr. 24	Apr. 23	Apr. 22	Apr. 26	Apr. 23
Tree Swallow, *Iridoprocne bicolor*	Apr. 8	Mar. 28	Apr. 12	Apr. 24	Apr. 24	Apr. 23	Apr. 23	Apr. 19	Apr. 21	Apr. 22
Bank Swallow, *Riparia riparia*	Apr. 14	Apr. 8	Apr. 22	....	Apr. 18	Apr. 24	Apr. 30	Apr. 15	Apr. 28	Apr. 19
Rough-winged Swallow, *Stelgidopteryx serrepennis*	Apr. 13	Mar. 30	Apr. 25	....	....	Apr. 24	Apr. 30	Apr. 14	Apr. 27	Apr. 19
Cedarbird, *Ampelis cedrorum*	Mar. 7	Mar. 4	Mar. 14							
Red-eyed Vireo, *Vireo olivaceus*	Apr. 30	Apr. 27	May 4	May 4	May 9	May 6	May 4	May 4	May 11	May 6

	First Arrival.			Bulk Arrival.						
	Average	Extremes 1902–07		1902	1903	1904	1905	1906	1907	Average
Warbling Vireo, *Vireo gilvus*	May 2	Apr. 30	May 6	May 4	May 6	May 7	May 7	May 5	May 9	May 6
Yellow-throated Vireo, *Vireo flavifrons*	Apr. 29	Apr. 25	May 1	Apr. 30	May 7	May 1	May 2	May 2	May 6	May 3
Solitary Vireo, *Vireo solitarius*	Apr. 24	Apr. 11	Apr. 28			Apr. 21	Apr. 30	Apr. 29	May 4	Apr. 29
White-eyed Vireo, *Vireo noveboracensis*	Apr. 27	Apr. 25	Apr. 28	Apr. 27	May 6	May 7	May 3	May 4	May 4	May 3
Black-and-White Warbler, *Mniotilta varia*	Apr. 18	Apr. 13	Apr. 22	Apr. 27	Apr. 26	Apr. 25	Apr. 27	Apr. 27	Apr. 27	Apr. 26
Worm-eating Warbler, *Helmitheros vermivorus*	Apr. 29	Apr. 27	May 3			May 3	May 6	May 6	May 11	May 9
Blue-winged Warbler, *Helminthophila pinus*	May 1	Apr. 28	May 4	May 3	May 9	May 7	May 3	May 3	May 11	May 6
Parula Warbler, *Compsothlypis americana*	Apr. 28	Apr. 25	May 1	May 2	May 6	May 4	May 3	May 3	May 8	May 4
Yellow Warbler, *Dendroica æstiva*	Apr. 24	Apr. 16	Apr. 28	Apr. 27	Apr. 30	May 3	Apr. 30	Apr. 30	Apr. 30	Apr. 30
Black-throated Blue Warbler, *Dendroica cærulescens*	Apr. 27	Apr. 24	May 1	May 3	May 3	May 3	May 6	May 3	May 5	May 4
Myrtle Warbler, *Dendroica coronata*	Mar. 29	Mar. 13	Apr. 10	Apr. 24	Apr. 22	Apr. 23	Apr. 23	Apr. 27	Apr. 26	Apr. 24
Magnolia Warbler, *Dendroica maculosa*	May 1	Apr. 28	May 2	May 8	May 7	May 9	May 7	May 3	May 11	May 7
Chestnut-sided Warbler, *Dendroica pensylvanica*	May 1	Apr. 27	May 5	May 3	May 5	May 10	May 7	May 4	May 10	May 6
Black-poll Warbler, *Dendroica striata*	May 6	May 4	May 10	May 11	May 14	May 9	May 8	May 7	May 17	May 11
Blackburnian Warbler, *Dendroica blackburniæ*	May 4	May 1	May 11	May 10	May 12	May 10	May 8	May 10	May 8	May 10
Black-throated Green Warbler, *Dendroica virens*	Apr. 28	Apr. 26	Apr. 30	May 1	May 1	May 3	May 6	Apr. 30	May 8	May 3
Pine Warbler, *Dendroica vigorsii*	Apr. 20	Apr. 13	Apr. 27							
Yellow Palm Warbler, *Dendroica p. hypochrysea*	Apr. 10	Mar. 25	Apr. 23	Apr. 25	Apr. 19	Apr. 15	Apr. 13	Apr. 13	Apr. 18	Apr. 17
Prairie Warbler, *Dendroica discolor*	May 1	Apr. 29	May 8							
Ovenbird, *Seiurus aurocapillus*	Apr. 26	Apr. 22	Apr. 28	Apr. 28	May 1	May 1	Apr. 30	Apr. 30	Apr. 30	Apr. 30
Water Thrush, *Seiurus noveboracensis*	Apr. 25	Apr. 21	Apr. 27	May 4	May 6	Apr. 30	May 3	May 3	May 5	May 3
Kentucky Warbler, *Oporornis formosa*	Apr. 30	Apr. 27	May 4	May 4	May 7	May 7	May 4	May 3	May 8	May 6
Maryland Yellow-throat, *Geothlypis trichas*	Apr. 21	Apr. 15	Apr. 26	Apr. 27	Apr. 30	Apr. 26	Apr. 28	Apr. 29	Apr. 28	Apr. 28

	First Arrival.			Bulk Arrival.						
	Average	Extremes 1902–07		1902	1903	1904	1905	1906	1907	Average
Yellow-breasted Chat, *Icteria virens*	Apr. 29	Apr. 22	May 3	May 4	May 6	May 3	May 6	May 5	May 10	May 5
Canada Warbler, *Wilsonia canadensis*	May 5	May 2	May 9	May 10	May 18	May 11	May 7	May 12	May 12	May 12
Redstart, *Setophaga ruticilla*	Apr. 25	Apr. 19	Apr. 29	May 3	May 6	May 2	Apr. 30	May 1	May 8	May 3
Catbird, *Galeoscoptes carolinensis*	Apr. 21	Apr. 15	Apr. 24	Apr. 26	May 1	Apr. 30	Apr. 30	Apr. 29	May 1	Apr. 29
Brown Thrasher, *Toxostoma rufum*	Apr. 1	Mar. 9	Apr. 22	Apr. 24	Apr. 24	Apr. 25	Apr. 22	Apr. 21	Apr. 27	Apr. 24
House Wren, *Troglodytes aëdon*	Apr. 21	Apr. 18	Apr. 25	Apr. 30	Apr. 25	Apr. 26	Apr. 25	Apr. 25	Apr. 29	Apr. 27
Long-billed Marsh Wren, *Telmatodytes palustris*	May 10	Apr. 30	May 15							
Ruby-crowned Kinglet, *Regulus calendula*	Apr. 2	Mar. 28	Apr. 7	....	Apr. 16	Apr. 11	Apr. 11	Apr. 14	Apr. 21	Apr. 12
Wood Thrush, *Hylocichla mustelina*	Apr. 24	Apr. 22	Apr. 26	Apr. 28	May 2	Apr. 30	Apr. 28	Apr. 29	May 1	Apr. 30
Wilson's Thrush, *Hylocichla fuscescens*	Apr. 26	Apr. 24	Apr. 30	May 2	May 1	May 1	May 1	May 3	May 5	May 2
Gray-cheeked Thrush, *Hylocichla aliciæ*	May 3	Apr. 27	May 8	....	....	May 13	May 9	May 15	May 12	May 12
Olive-backed Thrush, *Hylocichla ust. swainsoni*	Apr. 30	Apr. 22	May 3	....	....	May 5	May 6	May 6	May 11	May 7
Hermit Thrush, *Hylocichla g. pallasi*	Apr. 1	Mar. 14	Apr. 7	Apr. 17	Apr. 11	Apr. 13	Apr. 9	Apr. 13	Apr. 13	Apr. 13
Robin, *Merula migratoria*	Feb. 14*	Feb. 11	Feb. 22	Feb. 28	Mar. 3	Mar. 6	Mar. 8	Feb. 20	Mar. 13	Mar. 4
Bluebird, *Sialia sialis*	Feb. 17*	Feb. 11	Feb. 24	....	Mar. 2	Mar. 4	Mar. 6	Feb. 22	May 5	Mar. 2

MAY 5.

ARTHUR ERWIN BROWN, Sc.D., Vice-President, in the Chair.

Thirty-four persons present.

On the nomination of the Council, Profs. Henry F. Osborn, Amos P. Brown, Richard A. F. Penrose, Jr., Frederick Prime and the President of the Academy were appointed on the Hayden Memorial Committee.

The death of Henry B. Medlicott, a Correspondent, April 6, 1905, was reported.

DR. SPENCER TROTTER made a communication on points in the anatomy of the Apes, special attention being given to divergencies in the musculature. (No abstract.)

MAY 19.

ARTHUR ERWIN BROWN, Sc.D., Vice-President, in the Chair.

Thirty persons present.

JOHN W. HARSHBERGER, Ph.D., made a communication on the geographical study of bud opening in connection with isothermal lines. (No abstract.)

REVISION OF NORTH AMERICAN SPIDERS OF THE FAMILY LYCOSIDÆ.

BY RALPH V. CHAMBERLIN.

Table of Contents.

Introduction.

The *Lycosidæ* form one of the most successful of all families of spiders. Their common names of wolf and running spiders indicate their dominant traits. All live close to the earth, roaming freely and boldly, and with rare exceptions capturing their prey by the chase rather than by means of webs or other strategy. They are among the most familiar and widely distributed of spiders. The Piratas and most of the small and excessively active Pardosas keep close to the water, when alarmed running out freely over the surface, in adaptation to which action their tarsi are specially modified in the arrangement of hairs and bristles. The larger Lycosas may mingle their colors with those of the dried leaves and twigs of the woods, lurk beneath the stones of roadside and field, wander in the open or burrow in the sand of the seashore or the soil of the plain. Everywhere they are familiar; not because of large number of species, nor because of their bold open habits, but especially because of the excessive abundance of individuals resulting from successful adaptation to conditions widely available.

All true spiders depend upon living animals, mostly insects, for food. Since they ingest only the body juices of their prey, what seems at first an amazing quantity of insects is required to satisfy their nutritive needs. Most spiders have met this requirement through the development of instinct and skill, accompanied of course by those structural modifications necessary for their effective exercise, in the construction of webs. The line of divergence of the *Lycosidæ*, however, has been in the direction of capacity for taking prey by the chase. The high arched cephalothorax and the long stout legs plainly bespeak strength and speed. But strength and speed alone would be quite ineffective without the simultaneous development of the sensory system, to enable the spiders to detect and with some certainty to follow their prey. Such development has affected strongly the sight; other senses, excepting touch, being seemingly but feebly developed. This is manifest in the differentiations in size and arrangement of the eyes. It has been shown that the arrangement of the eyes is such as to make the animal aware of movements within its limit of vision in front, at the sides and through a considerable arc behind, the arc directly forward being covered particularly well. The eyes fall very clearly in three rows. The first row, situated across the lower part of the face, is composed of four small eyes placed in different planes; the second of two eyes, large in size and directed antero-laterally; the third of two medium-sized eyes situated farther back on the pars cephalica and directed latero-caudally. This arrangement of the eyes is apparently associated with the characteristic elevation of the pars cephalica. The high dorsally narrowed cephalothorax and the placement of the eyes in three distinct rows as described are features by which the *Lycosidæ* are usually to be detected at a glance. Other characters serving with those mentioned to distinguish members of this family are the three claws of the tarsi, the notching of the trochanters at the outer end beneath, and the excavation of the posterior piece of the superior lorum of the abdominal pedicel.

Most of the wolf spiders build no webs of any kind for ensnaring their prey. A few forms (*Sosippus, Hippasa*), however, construct sheet webs over stones and low bushes with central, funnel-like retreats, much like those of some *Agelenidæ*. In these web-constructing forms there is a strong development of the superior spinnerets, similar to that in the latter family.

The females without exception enclose their eggs in cocoons, which they carry about attached to their spinnerets until the young hatch. After hatching the young are carried about on the back of the parent until able to shift for themselves with some degree of safety. In making these cocoons the spiders first spin upon the ground a circular disk, which they enlarge usually until its diameter is about equal to the length of their bodies. A suitable scaffolding of threads is constructed preliminary to the spinning of the disk. After the basal disk is completed the spider presses out from the genital ducts upon the center of the disk a drop of viscid fluid, into which the eggs are allowed to fall. She then spins over the eggs a covering sheet, fastening its edges to the basal disk. The cocoon is then cut loose from its attachments by means of the chelicerae, the ragged edges are neatly taken up and fastened to the wall of the cocoon, and over the whole fresh threads are spun while the cocoon, held beneath the cephalothorax by means of the third legs, is rotated by cheliceræ and palps. The result is a neat egg-sac, lenticular in form and showing a distinct seam (*Pardosa*), or spherical in form and either with a less distinct seam at equator (*Pirata*) or without a seam evident (*Lycosa*).

As a rule the Lycosids born during any season pass the succeeding winter in the half-grown condition, not reaching maturity until the following summer or late spring. The smaller members of the family live but a single year, and during this time build no retreats for themselves. The larger Lycosas, however, are known to live for several years. Many of these build burrows, which they close upon the approach of winter by means of plugs or lids. These burrows may be mere shallow, nest-like excavations loosely lined with silk or may be deeper, more skilfully executed tunnels. In some cases a rampart or turret is built up about the opening of the burrow, apparently to prevent the drifting in of débris, etc. This rampart may be composed of particles of sand or earth, or of pieces of straw, grass or sticks, superposed and bound together by means of silk. The same burrow may be occupied by a spider for several seasons, the occupant remodelling the burrow if injured by accident, or enlarging it if outgrown (see *L. fatifera*, etc.).

The number of species and genera of *Lycosidæ* is very much smaller than would at first thought seem probable. These bold wanderers, with their strong, long legs, the black spines upon which standing out threateningly during excitement suggest their aggressiveness, spread out persistently in every direction. Isolation of any part of a species for a long time would be expected to be rare, and the establishment of distinct forms, therefore, so far as dependent upon this factor, infrequent. There are comparatively few species of wide distribution, rather than a large number of limited range. This wide range of species is accompanied naturally by a great deal of fluctuating variability in many of their features. A result has been a surprisingly large number of synonyms, consequent upon examinations of limited number of specimens from widely separated localities. For example, species that range from New England to the West and far South become lighter and lighter in coloration. In several species the brightly colored individuals that prevail in Texas would appeal to one at first as surely specifically distinct from the darker forms of the North. But all gradations are found when sufficient material is studied, especially in that from intermediate regions, while apparently no significant differences at all appear in less variable structural features. Important variations are discussed in detail in the present work under the respective species.

In this connection a main source of difficulty has been, indeed, the placing of too great reliance upon purely relative characters that undergo greater variation than has been recognized. Even in the treatment of genera this purely relative nature of the characters commonly used has left much room for diversity in opinion and usage. It is not, therefore, really surprising to find that genera accepted without question by one student are unhesitatingly denied by others. Some genera that have from time to time been proposed are clearly artificial, having, it would seem, been erected with a view to convenience rather than in an effort to express genetic relationship.

All of the characters that have been commonly used in separating, *e.g.*, *Pardosa* and *Lycosa*, somewhere become uncertain, the result having been many incorrect references of species. And so, also, is it with other genera. My own studies of the *Lycosidæ* long ago convinced me that the clearest and most definite characters for limiting not only the species but the genera of the *Lycosidæ* as well, are those presented in the copulatory organs. In the present contribution much reliance is placed upon these characters as indices of relationship. They have not previously been used in the definition of genera. It has been necessary to introduce a provisional terminology, perhaps sufficient for present descriptive purposes, for parts of the copulatory organs. Careful comparative studies on the morphology of the palpal organs of male spiders are much needed to give us a consistent general terminology.

As here considered the portion of the family *Lycosidæ* in the fauna of America north of Mexico includes eight genera: *Allocosa*, *Pardosa*, *Schizocosa*, *Lycosa*, *Trabea*, *Sosippus*, *Sosilaus* and *Pirata*. *Lycosa* is more comprehensive than the other genera and its species fall into a number of natural but mostly intergrading groups. Of these groups one *in part* corresponding to *Trochosa* of some authors is most divergent and compact. (See further under *Lycosa*.) Altogether, in the neighborhood of one hundred and fifty specific names have been erected for the forms under these genera; but of these not more than half are really "good." The species that I have been able to regard as distinct and recognizable are distributed among the genera as follows: *Trabea*, *Sosippus* and *Sosilaus*, each with one; *Allocosa*, five; *Schizocosa*, three; *Pirata*, nine; *Pardosa*, seventeen; *Lycosa*, thirty.

Of the material studied mention should be made first of the section of *Lycosidæ* in the rich collection of *Araneæ* at Cornell University, for the privilege of using which and for other unfailing courtesies I am deeply obliged to Prof. J. H. Comstock. The Cornell collection includes not only species from New York State and other parts of the North, but also a good representation of forms from the South and a number of species from the West. My own collection consists of specimens collected in California, Utah and New York by myself, and of a large number from many different localities obtained through others. Among those to whom it is a pleasure to make acknowledgments for specimens are the following: M. Simon, France (specimens from Florida); Rev. F. O. P. Cambridge, England; Mr. B. H. Guilbeaux, Louisiana; Miss Annie Jones, Georgia; Mr. A. M. Bean, Iowa; Mr. C. O. Crosby, New York; Mr. T. H. Scheffer, Kansas; Mr. G. W. Peckham, Wisconsin; Dr. O. M. Howard, Utah; Prof. T. H. Montgomery, Texas. For the loan of specimens and collections for study I owe my thanks to Mr. J. H. Emerton, Boston; Mr. Samuel Henshaw, of the Museum of Comparative Zoology, Boston; Prof. C. M. Weed, New Hampshire; Prof. John Barlow, Rhode Island; Mr. Charles Fuchs, of the California Academy of Sciences; Prof. M. T. Cook, Indiana; and Dr. W. M. Wheeler, of the American Museum of Natural History, New York.

For the privilege of studying the Marx collection in the U. S. National Museum and various types in his own private collection, I am much indebted to the courtesy of Mr. Nathan Banks.

List of Described North American Lycosidæ.

Genera.

Allocosa Bks.
Arctosa C. Koch = *Lycosa* Latr.
Aulonia Emerton (*aurantiaca*) = *Trabea* Simon.
Geolycosa Mtg. = *Lycosa* Latr.
Leimonia C. Koch = *Pardosa* C. Koch.
Lycosa Latr.
Pardosa C. Koch.
Pirata Sund.
Scaptocosa Banks = *Geolycosa* Mtg.
Schizocosa Chamb.
Sosilaus Simon.
Sosippus Simon.
Trabea Simon.
Trochosa C. Koch = *Lycosa*.

Species of Allocosa.

degesta Chamberlin.
evagata, sp. nov.
? *exalbida* Becker.
funerea (Hentz).
nigra (Stone) = *rugosa* (Keys.).
parva (Banks).
rugosa (Keyserling).
sublata (Montgomery) = *funerea* (Hentz).

Species of Lycosa.

albohastata Em.
antelucana Mtg. = *apicata* Bks.
apicata Bks.
arenicola Sc.
aspersa Hentz.
avara Keys.
babingtonii Bl. = *helluo* W.
baltimoriana Keys. (var.)
beanii Em.
brunneiventris Bks. = *kochii* Keys.
carolinensis H.
cinerea Fab.
coloradensis Bks.
crudelis Bks. = *helluo* W.
communis Em. = *erratica* H.
epigynata Mtg. = *gulosa* W.
erratica H.
exitiosa Bks. = *aspersa*.
fatifera H.
floridana Bks.
floridiana Bks.
frondicola Em.
fumosa Em.
grandis Bks.
gulosa W.
helluo W.
helvipes Keys. = *helluo* W.
inhonesta (Keys.) = *aspersa* H.
insopita Mtg. = *gulosa* W.
immaculata Bks. = *aspersa* H.
kochii Keys.
latifrons (Mtg.) = *fatifera* H.
lenta H.
lepida Keys. = *erratica* H.
littoralis H. = *cinerea* Fab.
maritima H. = *cinerea* Fab.
milberti W. = ? *carolinensis* W.
missouriensis Bks. = *fatifera* H.
modesta Keys.
modesta Th. = *frondicola* Em.
nidicola Em. = *helluo* W.
nidifex Mx. = *arenicola* Sc.
nigroventris Em. = *frondicola* Em.

oblonga Bks. = *aspersa* H.
perdita.
permunda Chamb.
pikei Mx. = *arenicola* Sc.
pudens Mx. = *frondicola* Em.
pictilis Em.
pilosa Gir. = *carolinensis* W.
philadelphiana W., invalid.
polita Em. = *rubicunda* Keys.
pratensis Em.
pulchra (Keys.). = *gulosa* W.
purcelli Mtg. = *gulosa* W.
propinqua Bl. = *erratica* H.
punctulata H.
quinaria Em.
riparia Hentz.
rubicunda Keys.
rufiventris Bks. = *avara* Keys.
ruricola H. = *lenta* H.
sepulchralis Mtg. = *modesta* Keys.
sagittata H. = *erratica* H.
scalaris Th. = *erratica* H.
scutulata Htz.
sayi W. = ? *helluo* W.
similis Bks = *helluo* W.
texana Mtg. = *carolinensis* W. (var.)
tigrina McC. = *aspersa* H.
vafra C. K. = ? *helluo* Walck.
vulpina Em. = *aspersa* H.

Walckenaer's Names of Species of Lycosa of the Abbott and Bosc Manuscripts.

(Described in Ins. Apt., Vol. 1.)

animosa.
avida.
discolor.
encarpata.
grossipes.
georgiana.
georgicola.
impavida.
infesta.
mordax.
suspecta.
triton.
vehemeris.

These names are all invalid, the descriptions having been based on the unpublished drawings of Abbott and Bosc.

Species of Pardosa.

albomaculata Em. = *grœnlandica* Th.
annulata Bks. = *saxatilis* Bl.
atra Bks.
banksi Chamb.
brunnea Em. = var. of *modica* Bl.
californica Keys.
canadensis Bl. = *milvina* H.
coloradensis Bks. = *sternalis* Th. (Jrs.).
distincta Bl.
dorsalis Bks. = *mackenziana* Keys.
dromoea Th. = *grœnlandica* Th.
emertoni Chamb.
flavipes Keys. = *milvina* Htz.
floridana Bks. = *banksi* Chamb., var.
fuscula Th. = *modica* Bl.
furcifera Th. = *modica* Bl.
glacialis Th. = *modica* Bl.
grœnlandica Th.
impavida Th. = *xerampelina* Keys.
indigatrix Th. = *grœnlandica* Th.
intrepida Marx = *grœnlandica* Th.
iracunda Th. = *grœnlandica* Th.
labradorensis Th.
lapidicina Em.
longispinata Tullg.
luteola Em. = *distincta* Bl.
littoralis Bks. = *banksii* Chamb.

mackenziana Keys.
mercurialis Mtg. = *lapidicina* Em.
milvina Htz.
minima Keys. = *saxatilis* H.
modica Bl.
mœsta Bks.
montana Em. = *xerampelina* Keys.
nigropalpis Em. = *milvina* H.
pallida Em. = *emertoni* Chamb.
parvula Bks. = *saxatilis* H. (var.)
pauxilla Mtg.
saxatilis Htz.
scita Mtg. = *milvina*.
sinistra Th. = *grœnlandica* Th.
sternalis Th.
tachypoda Th. = *xerampelina* Keys.
texana Bks. = *lapidicina* Em.
tristis Th. = *grœnlandica* Th.
uncata Th. = *mackenziana* Keys.
venusta Bks. = *lapidicina* (Jrs.).
xerampelina Keys.

Species of Pirata.

agilis Bks. = *montanus* Em.
aspirans Chamb.
bilobata (Tullg.).
elegans Stone = *montanus* Em.
exigua Bks. = *minuta*.
febriculosa Becker.
humicolus Montg.
insularis Em.
liber Montg. = *insularis* Em.
marxi Stone.
minuta Em.
montana Em.
montanoides Bks. = *insularis* Em.
nigromaculatus Montg. = *montanus* Em.
prodigiosa Keys.
piratica (Cl.) var. *utahensis*, new.
sedentarius Mtg. = *febriculosa* Beck.
wacondana Schef. = *febriculosa* (Beck.)

Species of Schizocosa.

bilineta (Emerton).
charonoides Mtg. = *saltatrix* H.
gracilis (Banks) = *saltatrix* H.
humilis (Banks) = *saltatrix* H.
ocreata (Hentz).
ocreata pulchra (Montg.) = *bilineata*.
relucens (Montg.) = *venustula* (Hentz).
rufa Keys. = *ocreata* Hentz (♀).
saltatrix
stonei Montg. = *ocreata* Hentz.
venustula (Hentz) = *saltatrix* H.
verisimilis (Montg.) = *saltatrix* H.

Species of Sosilaus.

spiniger Simon.

Species of Sosippus.

floridanus Simon.

Species of Trabea.

aurantiaca (Emerton).

The Family Lycosidæ.

Cephalothorax elongated, much longer than wide, attenuated anteriorly. The *pars thoracica* high and subprismatic, narrow above and oval in outline, with the posterior border truncate and concave at the middle; a distinct fine median sulcus which is rather long always present, as are also more or less distinctly impressed radiating striæ. *Pars cephalica* elevated and arched, distinctly separated from the *pars thoracica* by cervical furrows which unite at an angle at the median dorsal line, these more rarely indistinct above; *pars cephalica* with front truncated or more or less obtusely rounded. The face high, trapeziform or, less commonly, with the sides subparallel; in profile vertical, or at least very steep.

Eyes all of the diurnal type; always distinctly arranged in three rows, of which the first is composed of four eyes and is located upon the lower part of the face, the second composed of two eyes at the upper part of the face or semidorsal in position, and the third, also composed of two eyes, in a strictly dorsal position; eyes of the first row small and comparatively close together, in a straight, procurved or rarely recurved row, the lateral eyes on more or less evident tubercles and with their visual axes directed antero-ventrally; eyes of second row very large, occupying a transverse space, in most cases wider than that of the first row, less commonly of the same length or shorter, their visual axes directed antero-laterally; eyes of third row large, almost always more widely separated than those of the second row, with which they thus outline a trapeziform area (quadrangle of posterior eyes), their visual axes directed more or less caudo-laterally. *Clypeus* comparatively narrow, always narrower than the width of the area outlined by the first and second rows of eyes (quadrangle of anterior eyes).

Chelicera long and robust, always vertical in position in both sexes; at base a well-marked and rather large lateral condyle; both upper and lower margins of furrow armed, the upper with two or, more commonly, with three teeth, of which the median is much the largest, and the lower margin with from two to four stout conical teeth; posterior face always marked with a distinct oblique stria, along the inner side of which, especially in the middle region, is a well-developed, often dense, pilose band; upper margin of furrow bordered with a subdense pilose band or fringe.

Labium free; the ventral surface flat or, much more commonly, convex; more or less attenuated anteriorly, with front margin truncate or obtuse; from longer than wide to wider than long; much shorter than the endites. *Endites* longer than wide, more or less excavated within and fitting over the sides of the labium, externally rounded and never much narrowed at base; erect, never obliquely inclined; dorsal surface flat or a little concave; distally the supra-external border with a fine serrulate line or serrula; supero-internal border with a dense pilose band or scopula.

Sternum longer than wide; large, subcordiform, being truncated in front, rounded at the sides and attenuate to a point caudally.

Legs long or moderately long, the fourth longest, then the first, the third shortest in the great majority of cases; but there are exceptions in which the third legs are longer than the second, and others in which the second are longer than the first. The femora, tibiæ and metatarsi and usually also some or all of the patellæ armed with spines; the anterior tibiæ with three pairs of spines beneath, less commonly with two (*Pirata*), and sometimes with as many as five (*Sosilaus*); these and other spines of the anterior legs often much reduced and sometimes absent.

In some small species the tarsi are beneath, all simply and rather sparsely setose, but in most they are at least in part more or less provided with scopulæ composed uniformly of fine, flat lanceolate and slenderly pointed hairs, never of distally enlarged hairs; in the smaller species these scopulæ may be present only along the sides of the ventral faces of the anterior tarsi; but in the larger species (*Sosippus* and most Lycosas) the entire ventral surface of the anterior tarsi is densely scopulate, and the metatarsi are usually similarly or less densely scopulate, and the tibiæ are also sometimes scopulate distally; in these larger forms the posterior tarsi are scopulate, but have their scopulæ divided by a median line or band of setæ; never with dense fasciculæ at base of claws. Tarsi bearing three claws, of which the superior are strong and broad basally, and bear a series of teeth from five to seven, rarely more, in number, these being mostly confined to the basal half of the claws; the unpaired claw small, bent abruptly downward, almost always naked, rarely with a single tooth. Trochanters invariably notched or excavated at distal end beneath.

Superior *lorum* of the pedicel of the abdomen composed of two principal, very unequal pieces, of which the smaller posterior one is truncated or somewhat concave behind, and in front is notched or excavated for the reception of the angularly or roundly attenuated posterior part of the longer anterior piece; at each side of the principal plates is a slender, anteriorly attenuated piece.

Spinnerets six in number; the anterior ones short and relatively stout, contiguous or subcontiguous; the posterior more or less separated from each other, mostly more slender than the anterior and either of the same length or longer, composed of two articles, of which the second is short and rounded and usually subject to retraction within the first, or less commonly longer and conical (*Sosippus*); median pair slender, of moderate length.

Body clothed with simple *hair*, or more rarely with some of plumose type intermixed (*Sossipus* and some Pardosas).

Genital plate or *epigynum* of the female mostly simple; either a simple unfurrowed plate or a plate depressed or furrowed longitudinally and with the depressed area divided by a ridge-like elevation (*guide*), which in the large majority of cases extends laterally on each side at its posterior end. The transverse portion of the guide often (*Lycosa* sens. str.) distinctly more elevate than the septal portion immediately in front of it and extending on each side to behind the openings of the spermathecæ; median piece of guide posteriorly and the transverse pieces on anterior side with the upper free edges mostly more or less extended horizontally in plate-like expansions, which are usually narrow but may be wide (lateral plates or *alæ* of guide).

Palpus of the male long, differing uniformly from that of the most nearly related families (*e.g.*, *Pisauridæ* and *Agelenidæ*) in never having femur, patella, or tibia armed with any manner of process or apophysis. Tarsus or cymbium comparatively simple, boat-shaped; completely covering the bulb, the alveolus occupying usually not more than two-thirds of the ventral area; terminal part of the tarsus acuminate and bearing one, two, or rarely three mostly stout, always untoothed spines (transformed claws), occasionally unarmed. Bulb comparatively simple and compact; embolus only rarely exerted, in most lying upon a special fold (*lectus*) at front of the larger basal lobe or division, this fold in many with a lobe (*auricula*) extending forward in front of its exterior end; lobe of the conductor bearing one to several chitinous processes (*tenacula*); either an erect and conspicuous apophysis (*Pirata*) or transverse, and appressed; basal division of bulb bearing strongly chitinized fold or apophysis (*scopus*) in a median (*Pardosa*) or exterior position (*Lycosa*), or with such fold or apophysis absent or but weakly developed (*Pirata*), its absence or weak development being correlated with the absence of furrow and guide in the epigynum of the female; a chitinous plate or area (lunate area) at base of bulb practically always exposed, the area being of varying size in the different genera, but of quite constant relative extent and position in each.

The most simple and generalized condition is shown in *Pirata*.

Syn.—1817. *Citigradæ* Latr. (ad. max. part.), in Cuvier, Règne Animal, 3, p. 95.
1823. *Cursores* Sund. (ad. max. part.), Gen. Aran. Suec., p. 20.
1825. *Citigradæ* Latr. (ad. max. part.), Fam. Nat. de Règne Animal, p. 316.
1833. *Lycosides* Sund. (ad. max. part.), Comp. Arachn., p. 25.

1850. *Lycosides* C. Koch (ad. max. part.), Übersicht d. Arachn. Syst.
1852. *Venatores* Dolesch. (ad. max. part.), Syst. Verz. Oesten. Sp., p. 8.
1869. *Lycosoidæ* Thorell (ad. max. part.), On European Spiders, p. 188.
1876. *Lycosidæ* Simon (excl. *Dolomedes* and *Ocyale*), Arachn. France, 3, p. 223.
——. *Lycosoidæ* Keyserling (excl. *Dolomedes* and *Ocyale*), Verh. z. b. Ges. Wien, p. 610.
1877. *Lycosoidæ* Thorell, Bull. U. S. G. S. Terr., 3, p. 504.
1885. *Lycosidæ* Em. (excl. *Dolomedes*, *Oxyopes* and *Ocyale*), Trans. Conn. Acad. Sci., 6, p. 481.
1890 *Lycosidæ* Marx (excl. *Dolomedes* and *Ocyale*), Proc. U. S. N. M., 12, p. 560.
1892. *Lycosidæ* Banks (excl. *Pisauridæ*), Can. Entomologist, xxiv, p. 97.
1898. *Lycosidæ* Simon, Hist. Nat. Araign, 2, p. 317.
1903. *Lycosidæ* Comstock, Classif. of N. A. Spiders.
1905. *Lycosidæ* Banks, American Nat., p. 300, 318.

Key to North America Genera of Lycosidæ.

1. Anterior tibiæ armed beneath with five pairs of very long spines; anterior eyes subcontiguous, in a recurved row clearly longer than the second, ... Sosilaus.
   Anterior tibiæ armed beneath with less than five pairs of spines; anterior row of eyes straight or procurved, ... 2.
2. Lower margin of furrow of chelicera armed with four stout conical teeth, ... Sosippus.
   Lower margin of furrow of chelicera armed with two or three teeth, never with four, ... 3.
3. Anterior row of eyes very strongly procurved, the median eyes much farther from the lateral than from each other, Trabea.
   Anterior row of eyes not strongly procurved, the median eyes little or mostly not at all farther from the lateral than from each other, ... 4.
4. Cephalothorax glabrous or very nearly so, smooth and shining, dark in color and without definite light markings, Allocosa.
   Cephalothorax not glabrous, when but sparsely pubescent having a distinct light colored median stripe, ... 5.
5. Distal pair of ventral spines of anterior tibiæ never apical in position; cephalothorax with a median pale band enclosing in its anterior portion a dark V-shaped mark. (Epigynal plate unfurrowed, *i.e.*, without a guide; true scopus absent or but faintly indicated in male palpus), ... Pirata.
   Distal pair of ventral spines of anterior tibiæ apical in position; median pale band of cephalothorax when present not enclosing anteriorly a dark V-shaped mark. (Epigynum with a distinct guide; scopus well developed), ... 6.
6. Scopus median in position and more or less erect; guide of epigynum weakly or not at all developed anteriorly, the spermatheca opening into comparatively deep, open, basin-like foveæ, which when continued forward as furrows are distinctly less depressed anteriorly; labium wider than long with basal excavations short, ... Pardosa.
   Scopus exterior in position; guide of epigynum well developed

anteriorly; labium longer than wide with the basal excavations long. . . . . 7.

7. Transverse arms of guide divided from the distal end more or less mesally; auricula of lectus very long, reaching or nearly reaching the anterior margin of alveolus; the embolus distinctly elbowed at base of auricula; conductor conspicuously elevate and usually more or less produced into a horn-like process extending beyond front margin of alveolus, . SCHIZOCOSA.

Transverse arms of guide not divided from apex mesally; auricula of moderate size or small, not attaining front of alveolus; embolus evenly curving, not elbowed at base of auricula; conductor not conspicuously elevate or produced above into a horn-like process extending beyond front margin of alveolus, LYCOSA.

PARDOSA C. Koch, 1848.

(Subgenus sub LYCOSA, Die Arachn., Vol. 14, p. 100.)

Entire body densely clothed with pubescence. Anterior tibiæ armed beneath with three pairs of *spines*, of which the basal and median pairs are very long, much longer than the diameter of the joint, the third pair apical in position and reduced in size. Anterior row of *eyes* always shorter than the second and procurved; *eyes* small and subequal or with the median a little larger; median eyes nearly always a little farther from each other than from the lateral; clypeus high, twice as wide as the diameter of an anterior lateral eye; eyes of the second row large and divergent, situated at the outer angles of the face above, their diameter or more apart; quadrangle of posterior eyes trapeziform, wider behind than in front. *Labium* at least as wide as long, usually wider; basal excavation short, only very rarely more than one-fourth of the total length of labium. *Spinnerets* short, the posterior pair a little longer than the anterior, the apical segment being short and rounded. *Epigynum* with a distinct guide which is but weakly or not at all developed anteriorly; the openings of the spermatheca protected; the spermathecum on each side opening into a relatively large and deep fovea or pit, the furrows becoming narrower and shallower anteriorly. Posterior lobe of *male palpus* bearing a scopus in a median position; scopus more or less erect, free except at base where it has a spur or process on the exterior side; scopal fold low; when a true lectal fold is indicated never showing an auricle or forwardly directed lobe; lower furrow of conductor relatively extensive, bearing at its inferior margin a variously formed and often lobed or dentate tenaculum.

Syn.—1801. *Lycosa* Latreille (ad. part.), Nouv. Dict. Hist. Nat., 24, p. 135. 1832. *Lycosa* Hentz (ad. part.), Sill. J. Sci. Arts, 21, p. 106.

1842. *Lycosa* Hentz (ad. part.), J. Bost. Soc. N. H., 4, p. 228.
1848. *Lycosa* subg. *Leimonia* C. Koch, Die Arach., 14, p. 99.
——. *Lycosa* subg. *Pardosa* (nom. preocc.), *ibid.*, p. 100.
1875. *Lycosa* Hentz. (ad. part.), Sp. U. S., pp. 11 and 24.
1876. *Pardosa* Simon, Arachn. Fr., Vol. 3.
1876. *Lycosa* Keyserling (ad. part.), Verh. z. b. Ges. Wien., p. 610.
1877. *Lycosa* Thorell, Bull. U. S. G. S. Terr., 3, p. 504 *et seq.*
1885. *Pardosa* Emerton, Tr. Conn. Ac. Sci., 6, p. 494.
1898. *Pardosa* Simon, Hist. Nat. Araign., 2.
1902. *Pardosa* Montgomery (ad. part. max.), Proc. Ac. Sci., Phila., p. 536.
1903. *Pardosa* Comstock, Classif. of N. A. Spiders.
1904. *Pardosa* Chamberlin, Can. Ent., xxxvi, p. 176.

Pars cephalica moderately narrow, the sides steep, gently declined anteriorly; face elevated, its sides straight and very steep, subvertical. Quadrangle of posterior eyes one-fourth or more the length of the cephalothorax. Seen from above the posterior eyes are at most but very little more than their diameter removed from the margins of *pars cephalica* (Pl. VIII, fig. 2). *Chelicerœ* in the great majority of cases with but two teeth on the upper margin of the furrow, the lower margin with three, of which the third is usually much reduced (Pl. VIII, fig. 1). *Legs* long and especially the metatarsi and tarsi slender. Anterior tarsi scopulate, laterally the median ventral face occupied by a setose band (Pl. VIII, fig. 7), posterior tarsi simply setose; metatarsus of fourth leg relatively long, most commonly longer than the tibia + patella (especially so in ♂), more rarely of same length or a little shorter; tibia + patella of fourth legs always longer than the cephalothorax. The *color* markings frequently due in large part to the arrangement of the pubescence in spots and streaks without corresponding marks in the tegument, such markings, of course, being evident only in the living or dry specimens. The cephalothorax in this genus has always a more or less evident light median stripe of a characteristic dagger form. In nearly all species, although the markings may be much obscured in some, there is on the dorsum of the abdomen a pale basal mark which runs to a point near the middle, each side of the apex and also usually each side of the middle of which is an angular pale spot, having a dark dot at its center; posteriorly a series of such ocellate spots more or less united at the middle line into chevrons.

Spiders of small or less commonly of medium size, all characterized by excessive agility. The males are commonly smaller than the females; but do not differ much in coloration. As in *Lycosa* and other genera, however, the anterior legs of the male are often distinguished by some peculiar development of color structure.

Pardosas build no retreat, wandering about during the cocooning season as well as at other times. The cocoon is more or less lenticular in form, and shows a distinct seam about the equator, along which the break is made when the spiderlings issue to mount the parent. The cocoon is typically greenish-yellow or greenish-black, but only very rarely white. The individuals of this genus rarely live more than one year.

Key to Species of Pardosa.

Females.

1. Epigynal plate or area widest at anterior end, distinctly narrowing posteriorly; guide wider anteriorly than toward apex (Pl. XIV, fig. 3), ... *xerampelina* (Keys.).
   Not as above, ... 2.
2. Epigynum presenting each side of the guide posteriorly a sharply delimited, relatively small fovea as long as wide, the anterior region of epigynum scarcely depressed, ... 3.
   Not as above, ... 4.
3. Posterior foveæ angular in outline; posterior ends of lateral ridges separated by a distance much greater than their width; guide behind with transverse arms (Pl. XIII, fig. 5), . *sternalis* Th.
   Posterior foveæ smoothly rounded in outline; posterior ends of lateral ridges not farther apart than their diameter; guide without transverse arms (Pl. XIII, fig. 8), ... *atra* Bks.
4. Lateral furrows with the shallow anterior fossæ short and narrow, behind these deepening and abruptly widely expanding, becoming widest near middle of epigynum; septum of guide elevate, its more depressed tranverse arms extending into excavations in the inner face of the lateral ridges, ... 5.
   Not as above, ... 7.
5. Transverse arms of guide bending backwards, septum of guide widest at posterior end, becoming gradually narrower toward the anterior end, its sides substraight or but little curving (Pl. XIV, fig. 6), ... *grœnlandica* Th.
   Not so, ... 6.
6. Transverse arms of guide bending more or less forward; septum abruptly widest immediately behind region of anterior fossæ, from there narrowing to end (Pl. XV, fig. 3), *modica* var. *brunnea* Em.
   Transverse arms bending more strongly forward; septum widest behind the middle of its length, typically expanded into a broad plate-like form over the origins of tranverse arms which it usually in large part covers (Pl. XV, fig. 1), *modica* Bl. (type form).
7. Face of septum of guide abruptly expanded behind into a large nearly circular plate, the diameter of which is clearly greater than the length of the part of epigynum in front of it (Pl. XIV, fig. 1), ... *emertoni* Chamb.
   Not so . . . . 8.

8. Epigynal area wider than long, ... 9.
   Not so, ... 10.
9. Distinct lateral ridges enclosing posterior portion of guide both at sides and also behind except for short median space between ends of ridges (Pl. XV, fig. 8), ... *distincta* Bl.
   No enclosing ridges at sides or behind, guide extending completely over margins of plate of epigynum posteriorly (Pl. XIV, fig. 5), ... *californica* (Keys.).
10. Over anterior and median portion of epigynum a narrow and very shallow fossa passing behind into a large transversely elliptical depression which is completely occupied by the expanded guide, the lateral ends of which lie in excavations in the side ridges (Pl. XV, fig. 5), ... *mackenziana* (Keys.).
    Not so, ... 11.
11. Transverse arms of guide narrowest mesally, widening toward their outer ends (Pl. XIV, fig. 7), ... *lapidicina* Em.
    Not so, ... 12.
12. Lateral plates extending along guide for much of total length of epigynum, gradually narrowing in width anteriorly, . . . 13.
    Not so, the lateral plates mostly confined to transverse arms, abruptly narrowing and extending forward but a short distance on septal piece, ... 15.
13. Guide becoming very narrow toward its anterior end; outer margin of epigynum presenting a small abrupt shoulder on each side just below middle (Pl. XIII, fig. 9), . . *pauxilla* Mtg.
    Guide of moderate width at its anterior end, being much wider than the fossa at each side; outer margin of epigynum presenting no shoulder below middle (Pl. XIII, fig. 7), *banksi* Chamb.
15. Posterior foveæ clearly wider than long; septum of guide very narrow over middle region, at front end strongly expanding in fan-like form; front margin of anterior depression straight and moderately wide (Pl. XIV, fig. 9), ... *moesta* Bks.
    Not so, ... 16.
16. Sides of epigynum protruding into an angle in front of middle; no distinctly defined lateral ridges in middle region of sides, the sides gradually convexly rounding from middle to outer margin (Pl. XIII, fig. 1), ... *saxatilis* (H.).
    Sides of epigynum not angulate in front of middle; more or less distinct lateral ridges along middle region (Pl. XIII, fig. 3), *milvina* (H.).

The key to females above does not include *P. longispinata* (Tullg.) and *labradorensis* (Th.), of which specimens have not been examined by the author.

Males.

1. Scopus short and stout, not at all or but slightly longer than broad, ... 2.
   Scopus several times longer than broad, ... 7

2. Anterior depressed lobe of bulb separated into two furrows by an elevated narrow fold extending from above obliquely downward and outward, externally from its lower end being two uncate tenacula and at the corner opposite its upper end a lamellate, inflexed chitinous angle (Pl. XIV, fig. 8), . . . *lapidicina* Em.
   Not so, ... 3.
3. Anterior division of bulb presenting a large, trilobed thickening transversely across its upper border from base of embolus outward, the ends of lobes recurved over the furrow posteriorly from them (Pl. XIV, fig. 4), ... *californica* (Keys.).
   Not so, ... 4.
4. Embolus extending across bulb almost to outer side of alveolus (Pl. XV, fig. 4, var. *brunnea*; Pl. XV, fig. 2, type form), *modica* (Bl.).
   Apex of embolus scarcely extending beyond scopus, *grœnlandica* Th.
7. Scopus extending obliquely forward and outward quite to or some distance beyond margin of alveolus, ... 8.
   Not so, ... 10.
8. Scopus curving forward with convexity external and apex directed forward, ... *emertoni* Chamb.
   Not so, ... 9.
9. Embolus strongly bent into an S shape; scopal spur turned forward at apex (Pl. XIII, fig. 6), ... *sternalis* (Th.).
   Embolus but little curved, extending nearly straight transversely; scopal spur turned backward at apex (Pl. XIII, fig. 2), *saxatilis* (H.).
10. Scopus above bent outward and then strongly backward, becoming nearly parallel with basal part (Pl. XV, fig. 9), *distincta* Bl.
    Not so, ... 11.
11. Scopus dentate at apex; the spur nearly straight, subconical (Pl. XV, figs. 6 and 7), ... *mackenziana* (Keys.).
    Scopus not dentate at apex, ... 12.
12. Spur short and stout, abruptly turned posteriorly at apex into an acute hook (Pl. XIII, fig. 4), ... *milvina* (H.).
    Spur cylindrical, longer, ... *pauxilla* Mtg.

Males of the following species are either unknown or are too imperfectly known to the author to be included in the foregoing key: *atra*, *banksi*, *labradorensis*, *longispinata*, *moesta*, *xerampelina*.

Pardosa saxatilis (Hentz), 1844.

(J. Bost. Soc. N. Hist., p. 392, Pl. XVIII, figs. 9, 10.)

Female.—Sides of cephalothorax deep brown to black crossed with lighter radiating lines; a median reddish yellow band which anteriorly sends a short narrow process between eyes of the third row, behind which it abruptly widens, constricted midway between the eyes and the dorsal groove, behind which it is strongly narrowed, sides of band in region of median groove dentate; on each side a yellow supramarginal stripe usually divided by two or three dark cross-lines and limited below by a narrow black marginal stripe which is more or less broken into spots; clypeus yellow, with a triangular black spot below each anterior lateral eye, the apex of the spot being at the eye and the base on the front margin of the clypeus; the light part of cephalothorax in life clothed with dense white hair, that of the supramarginal stripes extending also over the black marginal lines, the light side stripes consequently appearing wider in live than in alcoholic specimens. *Cheliceræ* yellow, with some dusky markings. *Labium* and *endites* and *coxæ* of legs beneath yellow. *Sternum* black, usually with a narrow median pale line in front; often with a row of black dots along each lateral margin, and a central black stripe narrowed behind and anteriorly geminated by a pale line, elsewhere being yellow. *Legs* yellow with black annuli on all joints excepting the tarsi, the dark annuli of the femora wide and predominating over the yellow, those of the tibiæ of same width as the yellow bands, while those of the metatarsi are distinctly narrower. *Abdomen* blackish to dark gray above, sometimes of a greenish tinge; a yellow to brown lanceolate stripe at base having at each side of its apex a similarly colored angular spot with minute black dot at its center; on posterior portion of dorsum a series of light cross-marks, each formed by the lateral confluence of from two to four spots similar to those at sides of apex of basal stripe; dorsum elsewhere with many minute light dots; sides like lateral portions of dorsum but with the light dots larger; venter yellow to light reddish brown, with a row of irregular dark and partly confluent marks along each side and a short median row of similar marks behind the epigynum; in life the abdomen is densely clothed with gray and brown hair. *Spinnerets* light brown. *Epigynum* light brown, the posterior foveæ appearing as darker blackish spots.

Cephalothorax relatively higher in front than usual, highest at third eye row, from there slanting downward to the posterior declivity, concave at the dorsal groove, plane of quadrangle of posterior eyes not much declined. *Face* as high as the length of the cheliceræ or slightly higher, protruding above over its lower portion; sides slightly convex or straight, subvertical.

Anterior row of *eyes* of the usual length and curvature; anterior median eyes three-fourths their diameter apart, half as far from the lateral eyes, their diameter from eyes of second row; anterior lateral eyes three-fourths or more as large as the median, more than twice their diameter from the front margin of clypeus and than their diameter from eyes of second row; eyes of second row their diameter or a little more apart; quadrangle of posterior eyes more than one-fourth the length of the cephalothorax.

Labium wider than long (4.25 : 4); basal excavation one-fourth the total length; strongly attenuated anteriorly, the sides for most of length convexly rounded, becoming straight toward anterior angles; front margin slightly convexly rounded.

Legs with the metatarsus of the fourth pair clearly longer than the tibia + patella; tibia + patella of the first pair of the same length as the cephalothorax; first two pairs of spines of the anterior tibiæ very long and overlapping as usual; lateral scopulæ of anterior tarsi very thin.

Epigynum without distinctly defined lateral ridges in the median region; sides strongly angulate in front of middle; guide usually pointed just in front of posterior foveæ, between the anterior portions of which it is not concavely depressed as it is in *flavipes*, descending from the higher transverse ridge in a more nearly straight line than in the latter species. (Pl. XIII, fig. 1.)

Total length, 5 mm. Length of cephalothorax, 2.4 mm.; width, 1.8 mm.

Length of leg I, 7.3 mm.; tib. + pat., 2.4 mm.; met., 1.5 mm.
Length of leg II, 7 mm.
Length of leg III, 7 mm.
Length of leg IV, 10.5 mm.; tib. + pat., 3 mm.; met., 3.5 mm.

Male.—Darker than female and the light and dark markings more strongly contrasting; entire eye region black; supramarginal light stripes of cephalothorax often obscure; femora of first legs entirely black, those of second pair pale over most of ventral surface, the black of dorsal surface more or less interrupted with yellow; posterior femora with dark rings which are more broken or interrupted than in female; distal joints of all legs yellow, without any dark annuli. *Palpi* entirely black except the patellæ and the tips of the tarsi which are yellow or, in life, bright white.

Tibia of *palpus* a little longer than the patella, becoming thicker distally, tarsus as long as the two preceding joints together. *Scopus* resembling that of *milvina*, but reaching to or beyond the exterior side of the alveolus; lower border of the inferior furrow of anterior lobe developed at the exterior side into a dorsally concave, boat-shaped structure which at the exterior end is keeled and bears below a short rounded flap, the upper margin of the furrow with a strongly chitinized triangular process or tenaculum directed caudally toward the process of the inferior margin as in *milvina*. (Pl. XIII, fig. 2.)

Total length, 4.6 mm. Length of cephalothorax, 2.3 mm.; width, 1.9 mm.

Length of leg I, 7.1 mm.; tib. + pat., 2.5 mm.; met., 1.8 mm.

Length of leg II, 6.6 mm.

Length of leg III, 6.5 mm.

Length of leg IV, 10.3 mm.; tib. + pat., 3.1 mm.; met., 3.2 mm.

Syn.—1876. *Lycosa minima*, Keyserling, Verh. z. b. Ges. Wien, 26, p. 614.
1885. *Pardosa albopatella* Emerton, Trans. Conn. Ac. Sci., 6, p. 497, Pl. 94, figs. 2 to 2*b*.
1890. *Lycosa minima*, Marx, Proc. U. S. N. M., 12, p. 562.
——. *Pardosa albopatella*, Marx, *ibid.*, p. 565.
1890. *Pardosa albopatella*, Stone, Proc. Acad. Nat. Sci. Phila., 42, p. 431.
1891. *Pardosa minima*, Banks, Ent. News, 2.
1892. *Pardosa albopatella*, Marx, Proc. Ent. Soc. W., 2, p. 161.
1892. *Pardosa albopatella*, Banks, Proc. U. S. N. M., 44, p. 70.
——. *Pardosa annulata*, Banks, *ibid.*, p. 68, Pl. 1, fig. 41.
1895. *Pardosa minima*, Banks, J. N. Y. Ent. Soc., 3, p. 91.
1900. *Pardosa minima*, Banks, Proc. Acad. Nat. Sci. Phila., p. 539.
1902. *Pardosa albopatella*, Emerton, Common Sp. of U. S., p. 83, figs. 205–207.
1902. *Pardosa minima*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 571, Pl. 30, figs. 35, 36.

Type locality.—Alabama.

Known localities.—Illinois!, Massachusetts, Connecticut, Rhode Island!, New Hampshire!, District of Columbia!, Pennsylvania, New Jersey!, Alabama, Kansas!, Indiana.

While the males are easily distinguishable, the females of this species and of *milvina* are much alike both in general appearance and in the structure of the epigyna. Aside from the differences in the epigyna, which are difficult to state, the cephalothorax of *saxatillis* is relatively higher in front and slopes more decidedly caudally and the face protrudes above more strongly. There are constant differences in the proportions of the legs. The markings of *saxatilis* are finer.

Pardosa milvina (Hentz), 1844.

(Sub *Lycosa*, J. Bost. S. N. H., Vol. IV, p. 392, Pl. XVIII, fig. 8.)

Sides of cephalothorax deep brown to black; eye region deep black, a yellow to brown median band beginning as a rather narrow process at or behind third eye row, expanding a little posteriorly on each side and then again constricted in front of middle, expanding about dorsal groove and then narrowing again down posterior declivity; on each side a submarginal light band which in some is obscure anteriorly, but is usually distinct to clypeus in front; clypeus yellow or brown with a triangular black spot below each anterior lateral eye; sides of cephalothorax with brown pubescence, the light stripes with yellow, the clypeus with yellow and some white. *Chelicerœ* yellow to brown each with a short black median mark at base, clothed with whitish pubescence and sparse long brown bristles. *Endites, labium* and *coxœ* of legs yellow to brown.

Sternum usually black, often with a lighter median line in front, clothed with yellow or yellowish-white pubescence; sometimes lighter, dark brown or even yellow with or without dark spots. *Legs* yellow with dark rings on all joints except the tarsi, clothed with whitish and some short darker pubescence. *Abdomen* above at base with a yellow to reddish-brown stripe ending in front of middle; opposite apex of basal mark an angular pale spot with dark dot in center, and behind a series of transverse rows of similar spots more or less confluent transversely as usual; often a yellow line close to and parallel with the margin of the basal mark on each side; dorsum laterally black with numerous small yellow dots; dorsum clothed with brown and white pubescence, the white in part in angular spots at sides and in transverse lines between the pale marks of tegument; sides yellow with many spots and mottlings of brown or above of black, in life covered with pubescence in intermixed spots and streaks of white and brown; venter pale, rarely dark, densely clothed with light gray pubescence.

Spinnerets yellow or light brown.

Epigynum brown, darker, reddish at margins.

Face relatively high, nearly of same height as length of cheliceræ; sides nearly straight, subvertical. *Cephalothorax* high, the posterior declivity very steep, in profile nearly level from third eye row to posterior declivity, slightly depressed at median furrow, sides steep.

Anterior row of *eyes* much shorter than the second, only slightly procurved; anterior median eyes nearly three-fourths their diameter apart, evidently closer to the lateral eyes; anterior lateral eyes visibly smaller than the median, of usual distance from eyes of second row and from the front margin of clypeus; eyes of second row not quite once and a half their diameter apart. Quadrangle of posterior eyes more than one-fourth the length of the cephalothorax.

Labium a little wider than long (6.25 : 6); basal excavation more than one-fourth the total length of labium; sides substraight, strongly converging anteriorly; front margin slightly convex.

Legs slender; metatarsus of fourth pair of same length as tibiæ and patella together; spines of anterior tibiæ as usual; anterior tarsi with but very sparse scopulæ at sides, posterior tarsi setose and spinulose as usual.

Epigynum with more or less evident lateral ridges, margins usually not angulate in front of middle; septal piece of guide not pointed at front of foveæ, more depressed between foveæ than in *saxatilis*. See Pl. XIII, fig. 3.

Total length, 6 mm. Length of cephalothorax, 2.4 mm.; width, 2 mm.

Length of leg I, 9 mm.; tib. + pat., 2.3 mm.; met., 1.7 mm.

Length of leg II, 6.9 mm.

Length of leg III, 6.8 mm.

Length of leg IV, 10.3; tib. + pat., 3 mm.; met., 3 mm.

Male.—Darker in color than female, the *cephalothorax* often nearly entirely black, especially anteriorly, with the side stripes obscured and the median light mark not extending forward beyond front end of dorsal furrow. *Abdomen* often entirely black above, with light markings absent or but faintly indicated. Tarsus of *palpus* always black, the other joints often so, and always darkened by black pubescence.

Tibiæ of the *palpus* longer than the patella and distinctly broader, broadest anteriorly. Scopus long, bent outward above but not reaching margin of alveolus; basal spur short, bent down at apex, not covered; margin of inferior furrow of anterior lobe with a single short and stout tenaculum. (Pl. XIII, fig. 4.)

Total length, 5.2 mm. Length of cephalothorax, 2.8 mm.; width, 2.1 mm.

Length of leg I, 9.9 mm.; tib. + pat., 3.2 mm.; met., 2.4 mm.

Length of leg II, 9.4 mm.

Length of leg III, 8.9 mm.

Length of leg IV, 12.9 mm.; tib. + pat., 3.8 mm.; met., 4.2 mm.

Syn.—1871. *Lycosa canadensis*, Blackwall, Ann. Nat. Hist., Vol. VIII, pp. 430, 431.
1876. *Lycosa flavipes* Keyserling, Verh. z. b. Ges. Wien, 26, p. 616, Pl. 7, fig. 4.
1885. *Pardosa nigropalpis* Emerton, Trans. Conn. Acad., 6, p. 497, Pl. 48, fig. 3 to 3*b*.
1890. *Pardosa nigropalpis*, Marx, Proc. U. S. N. M., 12.
——. *Pardosa nigropalpis*, Stone, Proc. Acad. Nat. Sci. Phila., 42, p. 430.
1892. *Pardosa nigropalpis*, Banks, Trans. Acad. Nat. Sci. Phila., 44, p. 70.
——. *Pardosa pallida*, Banks (ad. part. in Coll. in Univ. Cornell), *ibid.*, p. 68.
——. *Pardosa nigropalpis*, Marx, Proc. Ent. Soc. W., p. 161.
1893. *Pardosa flavipes*, Banks, J. N. Y. Ent. Soc., 1, p. 125.
1894. *Pardosa flavipes*, Banks, op. cit., 3, p. 91.
1900. *Pardosa milvina*, Banks (ad. part. max), Proc. Acad. Nat. Sci. Phila., p. 539.
1902. *Pardosa nigropalpis*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 569, Pl. 30, figs. 32–34.
——. *Pardosa scita* Montgomery, *ibid.*, p. 573, Pl. 30, figs. 37, 38.
——. *Pardosa nigropalpis* Emerton Common Sp. of U. S., p. 83, figs 205–207.

Type locality—Alabama.

Known localities.—Maryland!, Illinois!, Massachusetts, Connecticut, Rhode Island!, New York!, District of Columbia!, Pennsylvania, Virginia, North Carolina!, Georgia!, Alabama!, Louisiana!, Mississippi!, Kansas!, Indiana!.

One of the commonest and most widely distributed of North American Pardosas. Specimens from the South are lighter than those from the North, the sternum being frequently yellow or white without marks, and at other times being covered in varying degrees with black dots, the dots in some covering entire sternum, except for the anterior median light stripe, and in others found only in a single row along each margin. In the same locality all gradations may be found between dark, typically colored individuals and the pale forms.

Pardosa pauxilla Mtg.

Female.—Sides of *cephalothorax* blackish brown or deep chocolate color; a rather wide yellow or pale brown band along each lateral margin extending forward to the clypeus which is of the same light color; eye region black; back of eyes a median dagger-shaped light brown stripe of usual character. *Chelicerœ* yellow. *Labium, endites* and *coxœ* of legs beneath yellow or yellowish brown. *Sternum* yellowish brown, blackish toward margins and with scattered black spots over the middle portion. *Legs* also yellow or yellowish brown with numerous dark annuli which are deep and distinct on the femora and tibiæ, but are less strong or sometimes indistinct on the metatarsi; of these annuli there are four on each femur and tibia and three on each metatarsis; each patella has a median annulus with indications in some of darkened ends. *Abdomen* with dorsum black to deep brown minutely dotted with yellow; at base a yellow lanceolate stripe with an angular spot each side of apex as usual, followed behind by a series of wide chevron-marks of the ordinary character; because of the extent of the yellow markings in some the dorsum appears to be occupied over its middle region from base to spinnerets by a yellowish band which narrows caudally and encloses rather indistinct dark markings; sides of abdomen dark like the lateral portions of dorsum, but the yellow dots larger, becoming more and more extended and confluent ventrally, finally passing into the immaculate yellow or yellowish white venter. *Spinnerets* pale brown. *Epigynum* reddish brown.

Anterior row of *eyes* of the usual relative length and curvature; anterior median eyes fully their diameter apart, much closer to the smaller lateral eyes, their diameter or a little more from the eyes of second row; anterior lateral eyes twice their diameter or a little more from the front margin of clypeus, their diameter from eyes of second row; eyes of second row one and one-fourth times their diameter apart; quadrangle of posterior eyes longer behind than in front in ratio of 9 : 7, considerably more than one-fourth as long as the cephalothorax (1 : 3.5).

Spines of tibiæ of *legs* and clothing of tarsi as usual.

Epigynum in shape roughly like a very wide-necked decanter, though more angular in outline; posterior foveæ not sharply limited, the lateral furrows gradually narrowing cephalad to a mere line at the anterior end, the sides bulging in correspondingly on each side; guide somewhat anchor-shaped with the transverse pieces relatively short and stout, the median piece with lateral plates along entire length, these continuously narrowing cephalad until the septum at its anterior end is very narrow. (Pl. XIII, fig. 9.)

Total length, 5 mm. Length of cephalothorax, 2.5 mm.; width, 1.8 mm.

Length of leg I, 7.2 mm.; tib. + pat., 2.6 mm.; met., 1.5 mm.

Length of leg II, 7 mm.

Length of leg III, 6.9 mm.

Length of leg IV, 10.6 mm.; tib. + pat., 3.2 mm.; met., 3.3 mm.

Male.—Considerably smaller than female. *Legs* yellow, entirely without rings or markings excepting the femora of the first two pairs which are black on the basal half, the black more or less interrupted by yellow laterally and below. *Palpi* entirely black, clothed with dense black hair. Median stripe of *cephalothorax* obscure. *Abdomen* entirely black without light markings in the tegument, but in life with a row of white spots formed of bunches of hair on each side behind, with narrow transverse lines of white hair extending between the spots; venter yellow with a dark median mark more or less dilated in front of the spinnerets, clothed with white hair. *Chelicera* black except along disto-mesal side, clothed with deep brown pubescence except distally where it is gray and longer.

Bulb of *palpal* organ very convex, protruding conspicuously from alveolus; *scopus* similar in form to that of *milvina*, but the basal spur cylindrical and relatively longer than in that species; there are considerable differences in the conductors of these two species.

Total length, 4.1 mm. Length of cephalothorax, 2.1 mm.; width, 1.3 mm.

Length of leg I, 5.2 mm.

Length of leg II, 5 mm.

Length of leg III, 5 mm.

Length of leg IV, 7.7 mm.; tib. + pat., 2.3 mm.; met., 2.6 mm.

Locality.—Austin, Texas !.

Pardosa banksi Chamberlin, 1904.

(Canadian Entomologist, Vol. XXXVI, p. 175.)

Female.—Eye region and sides of *cephalothorax* black or brownish black; on each side a distinct supramarginal yellow band which reaches to the clypeus in front; a less clearly marked median dagger-shaped band of brown along dorsum from posterior margin to the third eye row, this band but little wider than the lateral bands except at its expanded anterior end, where, however, its lateral portions are obscure; clypeus yellow, marked below each anterior lateral eye with a triangular black spot, the apex of which is at the eye, and the base upon the front margin of clypeus. *Chelicerœ* smoky yellow, with a dark line running down near the inner side and bending obliquely outward across the front face distally, there becoming indistinct; a black line along each margin of the lateral condyle. *Sternum* light brown with a black median lanceolate stripe which is divided anteriorly by a short yellow line. *Legs* clear yellow or pale brown of a greenish hue, or with faint traces of rings on the posterior ones, otherwise entirely without markings. *Abdomen* above black with a reddish yellow lanceolate stripe at base, with a similarly colored quadrate spot with black dot at center each side of apex, and a series of transverse yellow marks behind formed of similar spots united in pairs; an indistinct light mark joining the basal lanceolate stripe on each side near its base and another one joining it near the middle on each side, these marks formed of rows of small dots; sides of abdomen black like the dorsum except for a yellow spot or stripe in front below each antero-lateral angle; venter yellow with a brown spot enclosing spinnerets and a median dark line extending from this spot forward to the epigynum. Anterior *spinnerets* brown, the posterior ones more yellow. *Epigynum* light reddish brown.

Face as high as the length of the cheliceræ or very nearly so; sides straight and subvertical. *Cephalothorax* highest a little behind third eye row, from where in profile the dorsal line is straight to the posterior declivity.

Anterior row of *eyes* shorter than the second, of the usual relative length, gently procurved; anterior median eyes fully three-fourths their diameter apart, closer to the lateral eyes, a little more than their diameter from eyes of second row; anterior lateral eyes about three-fourths as large in diameter as the median, twice their diameter from front margin of clypeus, once and a third their diameter from eyes of second row; eyes of second row their diameter apart; quadrangle of posterior eyes a little wider in front than long, fully one-fourth the length of the cephalothorax.

Lower margin of furrow of *chelicerœ* with three teeth, of which the third is but little shorter than the first two; upper margin with *three* teeth of the relative proportions more common in the genus *Lycosa*.

Tibia + patella of fourth *legs* of same length as the metatarsus; tibia + patella of the first pair of legs shorter than the cephalothorax; spines of the anterior tibiæ of usual arrangement and proportions; all tarsi setose and spinulose, the anterior ones but thinly scopulate laterally.

Transverse piece of guide of *epigynum* of moderate length; septal piece evident forward to the anterior end of the epigynum, with well-developed lateral plates along its entire length, these being behind as wide as the transverse piece of guide and gradually and continuously narrowing anteriorly. (Pl. XIII, fig. 7.)

Total length, 5.5 mm. Length of cephalothorax, 2.7 mm.; width, 2.1 mm.

Length of leg I, 7 mm.; tib. + pat., 2.4 mm.; met., 1.5 mm.

Length of leg II, 6.8 mm.

Length of leg III, 6.7 mm.

Length of leg IV, 9.6 mm.; tib. + pat., 3 mm.; met., 3 mm.

Male.—"The male palpus from the side shows three black, rounded projections, the lower one the smallest." (Banks.)

Length, 5 mm.

Syn.—1896. *Pardosa littoralis* Banks, J. N. Y. Ent. Soc., 4, p. 192. (Nom. preocc.)

Type locality.—Long Island, N. Y. (Mill Neck).

Habitat.—Long Island (Mill Neck!, Sheepshead Bay!), Florida!.

Found in salt marshes. The type specimens were found in the marshes near Mill Neck in June. The description above is based on two females from Sheepshead Bay, taken in August, 1903, (C. R. Crosby).

Pardosa moesta Banks, 1892.

(Proc. Acad. Nat. Sci. Phila., 44, p. 70, Pl. 3, fig. 44.)

Female.—*Cephalothorax* dark reddish brown with radiating lines of black, a pale median band which becomes darker and more obscure anteriorly; entire eye region black; in some scarcely paler above lateral margins, in others (southern specimens) with a marginal pale stripe more or less evident on each side. *Clypeus* reddish yellow, the yellow area higher on each side. *Chelicerœ* reddish yellow; a blackish line bordering the condyle on each side, the two lines uniting at its lower end and extending down the front of the cheliceræ. *Endites* yellow. *Labium* dark brown, paler distally. *Coxœ* of legs beneath yellow. *Sternum black*. *Legs* reddish yellow; the femora marked with dark rings which are mostly incomplete below, above often more or less diffused, the annuli thus often more or less confluent dorso-laterally, especially on the front femora; patellæ and tibiæ also marked with incomplete dark rings, the first tibiæ darker than others, almost wholly black. *Abdomen* above black, densely minutely punctate with reddish yellow; dorsum with a faint basal spear-shaped stripe of a dusky reddish yellow color; sides of abdomen like the dorsum, but the light dots larger and more elongate; venter light reddish brown; a narrow, irregularly edged stripe or line of black on each side, the two converging caudad, and a similar stripe along median line behind the epigynum, this stripe running to a point posteriorly. *Epigynum* brown of a light reddish tinge.

Face with its sides straight and nearly vertical, the cheliceræ in length about one and one-fourth times longer than its height; face protruding above the eyes of the second row being borne at the ends of a bulging transverse ridge. *Cephalothorax* highest at the third eye row, in profile the dorsal line slopes gradually to the posterior declivity, but is gently concave at the dorsal groove.

First row of *eyes* much shorter than the second, not fully extending from center to center of eyes of second row, procurved in usual degree; anterior median eyes fully three-fourths their diameter apart, half as far from the lateral eyes, a little more than their diameter from eyes of second row; anterior lateral eyes three-fourths or more as large as the median eyes, twice their diameter from front margin of clypeus, one and one-third times their diameter from eyes of second row; eyes of second row their diameter apart; quadrangle of posterior eyes as wide in front as long, half as wide again behind as in front or nearly so, the cephalothorax only 3.5 times as long.

Lower margin of the furrow of the *chelicerœ* with three teeth, of which the first two are stout and subequal but the third much reduced; the upper margin of the furrow with two teeth of the usual proportions.

Legs with the metatarsus of the fourth pair longer than the tibia + patella; tibia + patella of the first pair of the same length as the cephalothorax; spines of anterior tibiæ of common form, the two first pairs very long and overlapping; tarsi with scopulæ on sides of anterior ones, the posterior simply setose and spinulose. *Labium* longer. wider than long, strongly attenuated anteriorly, the front margin subtruncate.

Epigynum with transverse piece of guide rather wide, the guide plates along its front side with the free margin wavy; the posterior foveæ wide and conspicuous; septal piece of guide low and narrow for most of length, extending to the anterior depression where it expands fan shape. (Pl. XIV, fig. 9.)

Total length, 5.7 mm. Length of the cephalothorax, 3 mm.; width, 2.2 mm.

Length of leg I, 8.8 mm.; tib. + pat., 3 mm.; met., 2.2 mm.

Length of leg II, 8 mm.

Length of leg III, 8 mm.

Length of leg IV, 13.1 mm.; tib. + pat., 4 mm.; met., 4.2 mm.

Male.—Unknown.

Type locality.—New York (Ithaca).

Known localities.—New York (Ithaca!, Lake Keuka!), District of Columbia!.

Specimens I have seen from Washington, D. C., are paler throughout than indicated in the description above, which is based on individuals from Ithaca and Penn Yan, N. Y., including one of the types. The species is in some respects much like *saxatilis*.

Pardosa sternalis (Thorell), 1877.

(Sub *Lycosa*, Bull. U. S. Geol. Surv. Terr., 3, p. 504.)

Female.—Sides of the *cephalothorax* and the dorsal eye area black; a median band of brown color of reddish caste beginning back of eyes and passing posteriorly over dorsal groove and narrowing down the posterior declivity to a line; the median band at its anterior end is nearly always bifurcate, the two slender divergent processes embracing between them a similarly colored spot, with which they are connected each by a narrow line; a light brown band along each lateral border, limited below posteriorly by a black marginal line and geminated for its entire length by a second black line; the lateral bands are continuous and attain the clypeus in front which is of the same color; median light stripe with some white pubescence, but with brown hair predominating for most of its length; sides with brown pubescence; marginal light stripes clothed above and below the geminating dark line with white pubescence, the dark lines with sparser brown hair. *Chelicera* reddish yellow or light brown, normally with a blackish line along the antero-mesal line of each chelicera, this line distally turning obliquely outward and reaching the outer side; clothed mostly with white hair except distally where brown hair and bristles are intermixed. *Labium* and *endites* light brown, paler at tips. *Coxæ* of legs beneath light brown. *Sternum* with ground color brown, mostly with a row of black spots along each lateral margin, and occupied over the middle region by a large black area divided by a median light line; sometimes the black area is much reduced and the yellow or brown color then predominates, but usually the black covers all but a rather narrow stripe toward each side and the mesal light line; subdensely clothed with long white or light gray hairs. *Legs* light brown, all joints except tarsi marked with black annuli which are close together on the proximal joints, which in consequence often appear very dark; the metatarsus has three well-separated dark annuli and appears paler like the tarsi; black rings of femora more or less broken ventrally. *Abdomen* above blackish; a very distinct yellow or pale brown lanceolate median stripe at base, with an obliquely placed yellow angular spot of usual type each side of apex, and behind a series of four or five similar and obliquely placed pairs of spots, the pairs more or less confluent mesally, into anteriorly pointed chevron-shaped cross-bands; a yellow mark each side of base of the median lanceolate stripe; dorsum for the most part covered with brown pubescence, but each side of lanceolate mark a row of spots formed by bunches of white hair, and behind but more widely separated two similar rows of lateral white spots with sometimes a median row of similarly formed white marks; sides below yellow or pale brown clothed with brown pubescence intermixed in spots and streaks with white, which becomes more abundant below and entirely clothes the venter; tegument of venter yellowish, sometimes with four rows of small brown dots which converge posteriorly. *Spinnerets* brown. *Epigynum* light reddish brown, darker marginally.

Sides of *face* steep, but little rounded and slanting outward below; moderate in height, the chelicerae once and a half as long as its height or nearly so. Dorsal line of *cephalothorax* nearly straight and level to the posterior declivity.

Anterior row of *eyes* considerably shorter than the second, reaching but little beyond centers of eyes of the latter, slightly procurved; anterior median eyes fully their diameter apart, half so far from the but slightly smaller lateral eyes, their diameter or slightly less from eyes of second row; anterior lateral eyes not fully twice their diameter from front margin of clypeus, rather more than their diameter from eyes of second row; eyes of second row their diameter apart; quadrangle of posterior eyes one-fourth the length of the cephalothorax.

Upper margin of furrow of *chelicerœ* with *three* teeth as in *Lycosa;* lower margin with three teeth, of which the median one is stoutest and some longest, the first well separated from it but the third contiguous with it at base, the latter tooth reduced but not so much as in most Pardosas. *Labium* clearly wider than long (6.5 : 6); basal excavation one-fourth the total length; strongly attenuated anteriorly, the sides straight or toward the middle weakly concave, anterior margin truncated or very slightly convex.

Legs with tibia + patella of fourth pair of same length as the metatarsus; tibia + patella of the first legs of same length or a little shorter than the cephalothorax; tarsi clothed as usual; spines of anterior tibiæ as usua. (Pl. VIII, figs. 7 and 9.)

Epigynum pentagonal in form, its anterior portion triangular; posterior foveæ relatively small, abruptly depressed, each roughly pentagonal in shape with the longest side along the septal piece of guide; lateral ridges behind narrow, converging but rather widely separated behind, not bent abruptly inward toward each other as in *atra.* (Pl. XIII, fig. 5.)

Total length, 7 mm. Length of cephalothorax, 3 mm.; width, 2.3 mm.
Length of leg I, 8.1 mm.; tib. + pat., 2.8 mm.; met., 1.9 mm.
Length of leg II, 8.1 mm.
Length of leg III, 9 mm.
Length of leg IV, 12.1 mm.; tib. + pat., 3.7 mm.; met., 3.7 mm.

Male.—Cephalothorax darker than in the female, the median band obscure and usually not at all evident except caudally and about the dorsal furrow; lateral pale bands narrower and more obscure and the marginal dark line or stripe wider. *Chelicerœ* black or brownish black except distally and along the mesal surface. *Sternum* entirely black. *Abdomen* above entirely black, showing no markings; venter dusky brown to gray black; pubescence, as also of cephalothorax, as in female. *Legs* with femora above black or nearly so except distal, also usually paler beneath; more distal joints of two anterior pairs of legs pale, with faint annuli or entirely unmarked, the corresponding joints on the posterior legs darker but also with markings faint. *Palpi* entirely black except the patellæ which are light brown.

Tibia of *palpus* a little longer than the patella and stouter distally. Scopus very long, curving obliquely forward and outward quite across the bulb. (Pl. XIII, fig. 6.)

Total length, 5.5 mm. Length of cephalothorax, 3 mm.; width, 2.1 mm.

Length of leg I, 8.7 mm.; tib. + pat., 3 mm.; met., 2.2 mm.

Length of leg II, 8.3 mm.

Length of leg III, 8.3 mm.

Length of leg IV, 11.4 mm.; tib. + pat., 3.5 mm.; met., 3.5 mm.

Syn.—1890. *Lycosa sternalis*, Marx, Proc. U. S. N. M., 12, p. 563.
1894. *Pardosa sternalis*, Banks, J. N. Y. Ent. Soc., 2, p. 51.
1894. *Pardosa coloradensis* Banks (at least ad. part. magn.), J. N. Y. Ent. Soc., 2, p. 51.
1895. *Pardosa coloradensis* Banks, Ann. N. Y. Acad. Sci., 8, p. 429 (Jrs.).
1895. *Pardosa luteola*, Banks, but not Emerton, *loc. cit.*
1904. *Pardosa sternalis*, Chamberlin, Can. Ent., pp. 147 and 175.

Type locality.—Colorado.

Known localities.—Colorado!, Utah!, Idaho!, Kansas!, Iowa!.

A strongly marked species very common in the West.

Specimens of *coloradensis* Bks. in Mr. Banks' collection, which he kindly permitted me to study, are the not fully mature individuals of the species above described.

Pardosa atra Banks, 1894.

(J. N. Y. Ent. Soc., Vol. 2, p. 52.)

Female.—*Cephalothorax* brownish black, lighter brown along the middle, and with a few indistinct paler marks at borders especially behind, not rarely a pale transverse stripe entirely across the posterior margin; eye region deep black; median light band constricted in front of dorsal groove, becoming anteriorly very dark or obscure. *Cephalothorax* with median band and side marks in life clothed with whitish or light gray pubescence, the hair elsewhere dark brown; the entire eye region with numerous long dark bristles which project forward. *Cheliceræ* blackish, reddish brown distally. *Labium* and *endites* deep brown to blackish. *Sternum* black. *Coxæ* of legs beneath brown suffused with blackish. *Legs* blackish, paler distally; the femora with a few mottlings of reddish brown, the other joints indistinctly or obscurely annulate with the same color; legs densely pubescent and with numerous long erect black bristles. Dorsum of *abdomen* black; a paler reddish-brown spear-shaped mark at base; the basal stripe contiguous at its apex with a large pale spot on each side, these spots with the characteristic black dot at center; posteriorly two rows of similar spots which are confluent at the mesal line in pairs, thus forming a series of wide chevron-formed marks; dorsum at sides with rather large reddish brown dots or spots, the entire dorsum often appearing reddish brown covered over with an irregular network of black; sides similar to lateral portions of dorsum but light color more abundant venter of abdomen brown except along sides where are some irregular black marks. *Epigynum* and *spinnerets* fuscous.

Face of average height and shape.

First row of *eyes* but slightly procurved, much shorter than the second; anterior median eyes about their diameter apart, only half so far from the lateral eyes, of usual distance from eyes of second row; anterior lateral eyes situated as usual; eyes of the second row more than their diameter apart, half as far again from the eyes of the much wider third row; quadrangle of posterior eyes not entirely one-fourth as long as the cephalothorax.

Labium much wider than long (8.25 : 6.5); basal excavation very short, scarcely more than one-sixth the length of the labium; labium anteriorly strongly attenuated, sides rounded just above basal notch, but above nearly straight for most of length; antero-lateral angles widely rounded; front margin gently widely incurved. (Pl. VIII, fig. 3.)

Legs with the tibia + patella of the fourth pair of the same length as the metatarsus; tibia + patella of the first pair clearly shorter than the length of the cephalothorax; spines of anterior tibiæ of usual form and arrangement; tarsi of anterior pairs with thin scopulæ at sides.

Epigynum a strongly chitinized suboval area which is truncate behind; the posterior foveæ relatively small, circular, deep and abruptly delimited; lateral ridges bent inward toward each other behind, the space between their ends occupied by the posterior end of the short clavate guide which separates the foveæ; the anterior and greater area of the epigynum scarcely depressed each side of the median line. (Pl. XIII, fig. 8.)

Total length, 9 mm. Length of the cephalothorax, 3.8 mm.; width, 2.9 mm.

Length of leg I, 9.8 mm., tib. + pat., 3.3 mm.; met., 2 mm.

Length of leg II, 9.7 mm.

Length of leg III, 9.6 mm.

Length of leg IV, 13.4 mm.; tib. + pat., 4 mm.; met., 4 mm.

Type locality.—Colorado.

Known localities.—Colorado!, Utah!.

In some respects this species is like *grœnlandica*. The cephalothorax is smaller with the head narrower and more elevated. It is also darker and its markings are less distinct. The epigynum seems constant in its form and is easily distinguished from that of *grœnlandica*. The median piece of guide at times is similarly somewhat elevated anteriorly.

Pardosa emertoni Chamberlin, 1904.

(Can. Entomologist, Vol. XXXVI, p. 175.)

Cephalothorax with a deep brown longitudinal band enclosing the eyes of each side and extending to the posterior end of cephalothorax, the two leaving between them and also along each border a yellow band, the two dark bands and the three yellow bands being of approximately the same width; each marginal band is bisected posteriorly by a dark supramarginal line; the median band often of a reddish tinge; the lateral dark bands united in front across the face, enclosing the eyes of the first and second rows, the median pale band narrowing and ending in a point between the second and third eye rows; marginal bands continuous in front with the yellow clypeus; in life the yellow bands covered with white pubescence, which extends also from median band forward between eyes to clypeus; sides of cephalothorax covered with brown pubescence. *Cheliceræ* yellow, with sparse white hair and long dark brown bristles. *Labium* brown. *Endites* and *coxæ* of legs beneath yellow. *Sternum* yellow, with four rows of black spots which converge posteriorly, the two inner rows uniting posteriorly into a single line; clothed with white hair. *Legs* yellow to brown; the femora above dark, blackish, or with blackish streaks, but pale beneath; tibiæ and tarsi of posterior pairs sometimes darkened; clothed with white pubescence and some sparser dark hairs. *Abdomen* with a black band across the anterior face which extends backward on each side across the antero-lateral angle as a narrow stripe which reaches to the spinnerets, the two black stripes leaving a wide reddish yellow median band which is widest in front; in the basal portion of the dorsal yellow band are two black lines or rows of black dots which meet in a point at the middle forming thus a spear-shaped outline; behind the dorsal band is more or less indistinctly divided by narrow transverse lines into segments which contain each two minute black dots; sides of abdomen pale yellow with numerous small black spots which are more scattered ventrally and which are absent from a spot beneath each antero-lateral angle; venter pale or whitish yellow with two rows of black spots converging from the genital furrow to the spinnerets; abdomen with the dark bands and spots clothed with brown hair, elsewhere densely clothed with white hair which gives its color to the abdomen in life or when dry. *Spinnerets* yellow. *Epigynum* yellow, darker marginally.

Cephalothorax highest between eyes of second and third rows, concave between eyes of third row and the posterior declivity. Face high, as high as the length of the cheliceræ which are small and narrowed distally.

First row of *eyes* much shorter than the second, hardly or not quite extending from center to center of the eyes of the latter row, a little procurved; anterior median eyes three-fourths their diameter apart, somewhat closer to the smaller lateral eyes; anterior lateral eyes twice their diameter from front margin of clypeus, once and a half their diameter from eyes of second row; anterior median eyes more than their diameter from eyes of second row; eyes of second row some less than once and a half their diameter apart; quadrangle of posterior eyes rather more than one-fourth the length of the cephalothorax.

Labium evidently wider than long (5.75 : 5); basal excavation about one-fifth the total length of labium; labium in front of excavations broadly cordate, the sides converging to a rounded point in front (Pl. VIII, fig. 6), in middle region substraight but above convexly curving to the middle point.

Legs slender, metatarsus longer than tibia + patella of the fourth pair; the two latter joints together clearly longer than the cephalothorax; tibia + patella of first legs of nearly same length as the cephalothorax; spines and scopulæ of usual character.

Septal piece of the guide of the *epigynum* in front rather narrow with sides subparallel, but posteriorly abruptly and widely expanded into a circular lobe which covers over most of the caudal portion of the epigynum. (Pl. XIV, fig. 1.)

Total length, 6.3 mm. Length of cephalothorax, 2.9 mm.; width, 2.1 mm.

Length of leg I, 8.8 mm.; tib. + pat., 3 mm.; met., 2 mm.

Length of leg II, 8.6 mm.

Length of leg III, 8.2 mm.

Length of leg IV, 12.4 mm.; tib. + pat., 3.8 mm.; met., 4 mm.

Male.—Male palpi black distally; front legs and head darker than in the female, but otherwise there is not much difference between them.

The scopus of the palpal organ is very long and wide and curved obliquely outward across the bulb.

Syn.—1885. *Pardosa pallida* Emerton, Trans. Conn. Acad. Sci., 6, p. 496, Pl. 49, figs. 3 to 3c. (Nom. preocc. by *P. pallida* Walck., 1837.)
1890. *Pardosa pallida*, Marx, Proc. U. S. N. N., 12, p. 565.
1892. *Pardosa pallida*, Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 68.
1903. *Pardosa pallida*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 653, Pl. 29, fig. 3.

Type locality.—New Hampshire.

Known localities.—New Hampshire!, Massachusetts, Connecticut, New York!, District of Columbia!, Ontario!, Manitoba!.

Pardosa distincta (Blackwall), 1846.

(Ann. and Mag. Nat. Hist., Vol. XVII, pp. 32, 33.)

Female 6 mm. long; light yellow with brown markings.

The *cephalothorax* has two wide brown longitudinal stripes united at the front of the head where they are nearly black, and a fine dark line each side next the legs. The sides of the *abdomen* are brown, with a very distinct light spot over the dorsal vessel, and a row of transverse light spots behind. The *sternum* is brown with a light spot in the middle. The abdomen is light beneath with a narrow brown stripe half its length on each side. The *epigynum* is bright orange brown, and the front pair of spinnerets are black. The *legs* are spotted with brown, the spots sometimes grouped in rings; the tibiæ are the darkest parts of the legs.

The *epigynum* has the guide short and wide, but this part is transparent and the overlapping sides are not easily seen, so that it appears narrow. (Pl. XV, fig. 8.)

In the male the *cephalothorax* and *abdomen* are darker, and the *legs* lighter except at the base, where the upper sides of the coxæ and part of the femora are darker than in the female. The head and palpi are black, with the patella and tibia a little lighter on top and probably having some light hairs when alive.

The male palpi are large, the tarsus being about as long as tibia and patella. The palpal organ is dark colored and projects a little from the bowl of the tarsus. The basal hook is rounded in the middle and curves in a hook toward the base. (Pl. XV, fig. 9.)

This species is about the same size and color as *P. pallida* Emerton of New England. The sternum is dark with a light median stripe on its front half, while in *pallida* the sternum is light with four dark lines or rows of spots converging behind. In the males the palpi, mandibles and maxillæ are darker than in *pallida*. The epigynum resembles that of *pallida*, but is shorter and wider. The male palpi have the scopus short and turned down at the point, while in pallida it is long and slender, and extends across the whole width of palpus. (Emerton.)

Syn.—1894. *Pardosa luteola* Emerton, Trans. Conn. Acad., Vol. 9, p. 427, Pl. 3, fig. 7.

Locality.—Canada.

Pardosa californica Keyserling, 1887.

(Verh. z. b. Ges. Wien, 37, p. 483, Pl. 6, fig. 44.)

Female (type).—Sides of *cephalothorax* dark brown, the eye region black; a median light yellowish brown band of the usual dagger shape, produced anteriorly as a tongue-like process between the eyes of the third row, this process divided by a median black line produced backward from in front; behind the third eye row the median band is abruptly extended laterally on each side, the widened region being nearly though not fully as wide as the third eye row, the band then again abruptly narrowed until but half so wide, continuing of this width about the dorsal furrow, then passing down the posterior declivity and narrowing to an acute point near the posterior margin; on each side a marginal light band which extends for the entire length and attains the clypeus in front, the band interrupted and sometimes obscured by brown spots; clypeus pale, but with a triangular black spot below each anterior lateral eye, the apex of the spot, as usual, being upward and contiguous with the black surrounding the eyes.

Chelicerœ light reddish yellow; each at base with a black mark or line which passes obliquely outward and distally, and with a larger mark parallel with the first beginning at the inner side near the middle and running obliquely outward and distally. *Labium* and *endites* with yellow background, which in each case is nearly covered over by a central black area. *Sternum* yellow with a large black spot on each side extending from the middle to the front margin, leaving the median area yellow; behind with numerous minute dark dots. *Coxœ* of legs beneath smoky yellow. *Legs* reddish yellow, all joints except the tarsi with rather heavy black rings, these rings being incomplete on the femora along the postero-inferior face except at the distal end. *Palpi* colored like legs, but annuli less heavy. *Abdomen* above and on the sides black with numerous minute reddish yellow dots; dorsum at base with a reddish-yellow spear-shaped stripe reaching caudad to the middle; near each lateral margin of the basal stripe toward the front is a row of two or three black spots, and each side of its apex is an obliquely placed angular light spot enclosing a central black spot; on the posterior portion of dorsum a series of several chevron-marks, each seemingly formed by the coalescence at the mesal line of two black centered, angular light spots such as found each side of apex of the basal mark; venter yellow, darker about the sides and caudad and with a median dark stripe as wide as epigynum in front, but narrowing to a truncate end behind and not reaching to the spinnerets. *Epigynum* light reddish brown.

Sides of *face* nearly straight, steep but not vertical, in height considerably shorter than the length of the chelicerœ.

Anterior row of *eyes* much shorter than the second, not extending more than between the centers of eyes of the latter, gently procurved;

anterior median eyes more than three-fourths their diameter apart, about two-thirds as far from the scarcely smaller lateral eyes, fully their diameter from eyes of second row; anterior lateral eyes twice their diameter from front margin of clypeus, slightly more than their diameter from eyes of second row; eyes of second row their diameter apart; quadrangle of posterior eyes as wide in front as long, wider behind than in front in the ratio of 4 : 3, some more than one-fourth as long as the cephalothorax.

Chelicerœ with furrows armed below as usual with three teeth, of which the middle is a little longest, the third not very much reduced; the upper margin with *three* teeth of which the first is minute.

Tibia + patella of fourth *legs* of same length as the metatarsus; tibia + patella of first pair of same length as the cephalothorax; legs of fourth pair four times as long as the cephalothorax; tarsi as usual in the genus, those of the first two pairs of legs being scopulate laterally, those of the posterior pairs simply setose; tibiæ of first and second pairs of legs with three pairs of spines below as is normal, the two first pairs of these very long and overlapping; all tarsi straight or nearly so.

Epigynum presenting no distinct lateral ridges posteriorly; lateral plates of the guide very wide, extending laterally to or nearly to the ends of the transverse piece and nearly as wide in front as behind, covering over nearly completely the posterior half of the epigynal area. (Pl. XIV, fig. 5.)

Total length, 6.8 mm. Length of cephalothorax, 2.9 mm.; width, 2.1 mm.

Length of leg I, 8.4 mm.; tib. + pat., 2.9 mm.; met., 1.9 mm.

Length of leg II, 8 mm.

Length of leg III, 8 mm.

Length of leg IV, 12.1 mm.; tib. + pat., 3.6 mm.; met., 3.6 mm.

Male (type).—*Cephalothorax* in color drab brown, with the head region black; a narrow and short, inconspicuous median stripe over the dorsal groove but not distinguishable in front of it, narrowing behind as in female, not reaching posterior margin; marginal pale bands nearly as in the female but obscured anteriorly. *Clypeus* not pale, black like head region. *Labium* and *endites* blackish, pale distally. *Sternum* nearly as in female. *Palpi* entirely black. *Legs* yellow, the femora with inconspicuous black marks above, other joints with dark circular lines about bases of the spines but otherwise unmarked. *Abdomen* much as in female but with the markings much obscured.

Scopus of palpal organ short and blunt, much as in *lapidicina*; anterior margin of conductor much thickened, presenting three fleshy lobes with apices projecting backward over the furrow.

Syn.—1890. *Pardosa californica*, Marx, Proc. U. S. N. M., 12.
1904. *Pardosa californica*, Chamberlin, Canadian Ent., p. 146.

Type locality.—California.

Known localities.—California!, Utah!.

This is a common *Pardosa* on the Pacific Coast. Specimens from Utah are lighter colored than those which I have seen from California (including Keyserling's types, described above, which have of course darkened in the alcohol). In the Utah specimens the lateral yellow stripes are wide, with the upper margin sinuous and with a black line along the lower, a somewhat indistinct and irregular black line dividing the stripes longitudinally; endites yellow; labium and sternum brown, the latter usually not showing the black markings as described above for the type; chevron-marks of dorsum containing each from two to four black dots, as if formed by the confluence of as many light, black-centered dots; sides gray black with numerous minute brown dots; venter immaculate light gray or with a few small dark dots back of epigynum and at each side; spinnerets pale yellow. *Cephalothorax* in life clothed with light gray and brown hair, the sides with brown, the median band especially posteriorly with gray, and the lateral stripes with gray except along the geminating dark line, the median stripe in front with brown and gray pubescence intermixed. *Chelicerae* with light gray hair and long brown bristles. *Sternum* and *legs* with light gray hair, the latter with longer brown bristles. *Abdomen* clothed above with chiefly light brown hair, light gray or white hair in spots on each side and forming some transverse lines posteriorly, scattered longer dark brown bristles; sides of abdomen with brown and gray pubescence intermixed in streaks and spots; venter with hair unmixed gray.

Pardosa lapidicina Emerton, 1885.

(Trans. Conn. Acad., 6, p. 494, Pl. 48, figs. 5 to 5c.)

Female.—Sides of the *cephalothorax* black; a lighter, though sometimes indistinct or even obscure median band of dark reddish brown color which begins as a narrow process between the posterior eyes, behind the third eye row abruptly widens and is constricted in front of dorsal furrow, at the caudal end of which it is strongly narrowed, its margin more or less dentate; on each side, at least posteriorly, a row of supramarginal light spots which are sometimes obscured, but in others are long and distinct; eyes surrounded with black; *labium* black, not paler than sides of cephalothorax; sides of cephalothorax clothed densely with rather long gray or brownish gray to blackish pubescence, which quite conceals the light markings of the tegument and gives the cephalothorax a uniform grayish black appearance. *Chelicerœ* reddish brown to reddish yellow, usually with a black median mark at base, clothed densely with white pubescence, with sparse longer dark brown bristles. *Endites* yellow or light brown, paler apically, often dusky. *Labium* deeper colored than endites, dark brown to black. *Sternum* black, clothed subdensely with short whitish or light gray pubescence. Legs yellow to brown; on all joints except the tarsi with black annuli which are broadest proximally, being on the femora often confluent below and laterally, leaving light spots only above; the *legs* have usually a bluish or greenish-gray hue proximally, especially on ventral surface. *Abdomen* with tegument above and over sides bluish black, a black-margined lanceolate mark at base above, followed on each side behind by a row of irregular pale spots; the median region behind, in some with, but in others without, irregular light chevron-marks, enclosing the characteristic dark spots, in some pale specimens entire dorsum and sides with many light spots, irregularly connected above into a network; venter light brown, of bluish to greenish gray cast, rarely black, in some a dark median band behind spinnerets; dorsum and sides covered with brown and grayish pubescence, the venter with grayish.

Face moderately high, the sides substraight and very steep, nearly vertical.

First row of *eyes* much shorter than the second, but little procurved; anterior median eyes fully three-fourths their diameter apart, evidently closer to the lateral eyes, than which they are slightly larger; anterior lateral eyes, as usual, twice their diameter from front margin of clypeus, their diameter from eyes of second row; eyes of second row about once and a quarter their diameter apart; quadrangle of posterior eyes one-fourth as long as the cephalothorax, a little wider in front than long. *Chelicerœ* armed as typical for the genus, having two teeth above and three below with the third reduced. *Labium* wider than long in ratio of about 9 : 8.25; basal excavation one-fourth total length, strongly attenuated anteriorly; the front margin nearly straight, slightly incurved mesally.

Legs long and slender; metatarsus of fourth pair longer than tibia + patella of same pair; spines below on anterior tibiæ as usual; scopulæ of typical form.

Epigynum with the guide inversely T-shaped, the median piece pointed anteriorly and not extending into front portion of depression, which is thus undivided; transverse arms widest distally; lateral plates of guide very narrow. (Pl. XIV, fig. 7.)

Total length, 9.3 mm. Length of cephalothorax, 3.7 mm.; width, 3 mm.

Length of leg I, 13.1 mm.; tib. + pat., 4.8 mm.; met., 3.5 mm.
Length of leg II, 12.5 mm.
Length of leg III, 12.8 mm.
Length of leg IV, 7.3 mm.; tib. + pat., 5.3 mm.; met., 5.5 mm.

Male.—Color much as in female but darker and the markings more obscure; the legs often almost entirely black, showing no annulations except distally or none at all. Tarsus of palpus black, as also the femur and often the tibia, the patella lighter. Smaller than female.

Tibia of *palpus* with sides substraight, enlarging from base to apex, clearly narrower than the tarsus. Scopus very short, about as broad as long, distally rounded and a little uncate at exterior side; spur usually in front concealed by fold; embolus short, extending but little beyond middle; conductor divided into two open furrows by a narrow chitinous ridge extending obliquely downward and outward, the posterior margin of the exterior furrow with two short, uncate tenacula close together or in part overlapping. (Pl. XIV, fig. 8.)

Total length, 6 mm. Length of cephalothorax, 3 mm.; width, 2.3 mm.
Length of leg I, 10.1 mm.; tib. + pat., 3.3 mm.; met., 2.9 mm.
Length of leg II, 10.2 mm.
Length of leg III, 10.4 mm.
Length of leg IV, 13.6 mm.; tib. + pat., 4.3 mm.; met., 4.4 mm.

Syn.—1892. *Pardosa lapidicina*, Marx, Proc. Ent. Soc. W., 2, p. 161.
——. *Pardosa lapidicina*, Banks, Proc. Acad. Nat. Sci. Phila., p. 68.
——. *Pardosa obsoleta* Banks, *ibid.*, p. 71, Pl. 3, fig. 45.
——. *Pardosa venusta* Banks, *ibid.*, p. 69, Pl. 1, figs. 42, 42*a*.
1894. *Pardosa lapidicina* Emerton, Trans. Conn. Acad. Sci., 9, p. 428.
1902. *Pardosa lapidicina* Emerton, Common Sp. U. S., p. 78, figs. 186, 187, 188.
1903. *Pardosa lapidicina*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 652, Pl. 29, figs. 6, 9.
1904. *Pardosa mercurialis* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 270, Pl. XIX, figs. 20, 21.
——. *Pardosa texana* Banks, J. N. Y. Ent. Soc., p. 115, Pl. V, fig. 4.

Type locality.—Massachusetts and Connecticut.

Habitat.—Massachusetts, Connecticut, Rhode Island!, Canada, New York!, New Jersey!, District of Columbia!, Pennsylvania, Indiana!, Iowa!, Kansas!, Arkansas!, Texas!.

A very familiar species in the Northern States, found among stones along streams and also to some extent remote from water in dry places. Its general dark gray color blends well with the color of the stones among which it lives. Specimens from the West and South are commonly much lighter than specimens from the Northeast, and in them the marginal spots on the cephalothorax form a band except for narrow dark cross-lines; the legs are more conspicuously annulate, the light rings contrasting more strongly with the dark. As other species having the same range as *lapidicina* undergo similar changes in brightness of color, and especially since the light form of *lapidicina* and all intermediate forms are not rare in the North, the Western specimens of this *Pardosa* ought not to be granted rank as separate species or variety. Type specimens of *venusta* Bks. that I have seen are not fully adult, and agree perfectly with immature specimens of *lapidicina*.

Pardosa xerampelina (Keyserling), 1876.

(Sub *Lycosa*, Verh. z. b. Ges. Wien, 26, p. 622, Pl. 7, fig. 8.)

Female.—Sides of *cephalothorax* and eye region black or deep brown; clypeus light brown; no distinct lateral light stripes, but sometimes a few obscure light spots above margin on each side posteriorly; a median reddish brown band which is widest about the dorsal groove, behind which it is strongly and more or less abruptly narrowed, the light median band mostly dull and inconspicuous; in life the cephalothorax is clothed along sides and on head and over median band behind by whitish pubescence, the other parts clothed with brown and black hair. *Chelicerœ* reddish brown, each with a short longitudinal yellowish stripe above or at middle. *Labium* and *endites* brown, paler at tip. *Sternum* dark reddish brown to blackish brown, an obscure median pale line anteriorly; clothed with light gray pubescence. *Coxœ* of legs beneath brown. *Legs* yellow to brown; all joints excepting the tarsi ringed with black; the femora dorsally are distinctly darker than the other joints; clothed with brown and light gray pubescence, the gray over the light parts, the brown over the darker. *Abdomen* above black or nearly so; a lanceolate basal mark of brown; basal stripe joined at two points on each side near its apex by the ends of a V-shaped mark the apex of which is directed laterally; posteriorly a series of light transverse more or less chevron-shaped markings; all markings of dorsum more or less faint; sides of abdomen and part of the venter about the spinnerets black, the venter elsewhere being light brown; abdomen clothed above with brown pubescence with a row of small spots of whitish hair along each side; venter of abdomen clothed with light gray pubescence. *Spinnerets* brown. *Epigynum* brown, with the depression showing as a distinctly darker V-shaped figure with apex caudal.

Face high, the chelicerœ but little longer than its height; sides of face substraight, steep but a little slanting outward from above downward.

Dorsal line of cephalothorax in profile straight in front of the dorsal furrow, at which it is but slightly depressed.

Anterior row of *eyes* shorter than the second in the usual degree, only slightly procurved; anterior median eyes four-fifths their diameter apart, much closer to the but slightly smaller lateral eyes, their diameter from eyes of second row; anterior lateral eyes fully twice their diameter from front margin of clypeus, once and a half their diameter from eyes of second row; quadrangle of posterior eyes one-fourth as long as the cephalothorax.

Margins of furrow of *chelicerœ* armed as usual. *Labium* wider than long, strongly attenuated, anteriorly truncated or a little concave.

Legs with tibia + patella of the fourth pair shorter than the metatarsus; tibia + patella of the first pair shorter than the cephalothorax; spines of anterior tibiæ as usual, the first two pairs long and overlapping; tarsi clothed in the common manner.

Epigynum clearly wider in front than posteriorly; guide widest anteriorly narrowing caudally, the transverse arms of guide short, the guide plates extending to their ends; lateral ridges but weakly elevated. (Pl. XIV, fig. 3.)

Total length, 8 mm. Length of cephalothorax, 3.7 mm.; width, 2.6 mm.

Length of leg I, 10.2 mm.; tib. + pat., 3.3 mm.; met., 2.3 mm.

Length of leg II, 9.5 mm.

Length of leg III, 9.3 mm.

Length of leg IV, 14 mm.; tib. + pat., 4 mm.; met., 4.3 mm.

Male.—Smaller than the female but differing but little in coloration. "The male palpi are long and the joints scarcely enlarged." (Pl. XIV, fig. 4.)

Small specimens are 5 mm. long.

Syn.—1877. *Lycosa impavida* Thorell, Bull. U. S. Geol. Sur. Terr., Vol. 3, p. 513.
1878. *Lycosa tachypoda* Thorell, Am. Nat., June, 1878.
1885. *Pardosa montana* Emerton, Trans. Conn. Acad. Sci., 6, p. 498, Pl. 49, figs. 5, 5*a*.
1890. *Lycosa xerampelina*, Marx, Proc. U. S. N. M., 12.
——. *Lycosa impavida*, Marx, *ibid.*.
——. *Lycosa tachypoda*, Marx, *ibid.*
——. *Pardosa montana*, Marx, *ibid.*
1892. ? *Pardosa montana*, Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 70.
1894. *Pardosa tachypoda*, Emerton, Trans. Conn. Acad. Sci., 9, p. 427, Pl. 3, figs. 6, 6*a*.
1895. *Pardosa impavida*, Banks, Ann. N. Y. Acad. Sci., Vol. 8, p. 430.
1902. *Pardosa tachypoda* and *montana*, Emerton, Common Sp. of U. S., p. 81, figs. 193 to 196.
1902. *Pirata procursus* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 583, Pl. 30, fig. 48.

Type locality.—Illinois.

Known localities.—New Hampshire!, Massachusetts, Illinois, Colorado!, Utah!, New York?, Pennsylvania, Canada.

Essentially a Northern and mountain species. It is not uncommon in Canada and in the White Mountains of New England, but does not occur commonly more southward. It also ranges south from Canada along the Rocky Mountains, and is common in Colorado and Utah.

Pardosa grœnlandica (Thorell), 1872.

(Sub *Lycosa,* Ofvers. af. Vet. Akad. Forh., 29.)

Female.—*Cephalothorax* black or nearly so; a lighter, brown median band beginning only a little in front of dorsal furrow, passing over the latter and then narrowing to a line on the posterior declivity; from the front of the median band a horn-shaped yellow mark extends outward and forward on each side toward the corresponding eye of the third row, which, however, it does not reach; more rarely these horn-like marks are obscure or quite absent; a row of three or less commonly four curved light marks above the margin of each side; hair of cephalothorax long, brown and light gray or whitish intermixed, the whitish hair more or less unmixed with brown on the clypeus, the light supramarginal marks and on the median light area behind. *Cheliceræ* reddish-yellow or brown above and black distally, the lighter color often reduced to a few spots; clothed with short light gray hair and longer brown bristles. *Labium* and *endites* brown, lighter at tips. *Sternum* black, clothed with gray hair. *Coxæ* of legs beneath brown. *Legs* brown, mostly of a reddish hue; all joints, excepting tarsi, with distinct black annulations; clothed with brown and whitish hair, chiefly over the dark and light parts respectively. *Palpi* brown; femora ringed with black; patellæ unmarked; tibiæ black at proximal end and the tarsi black at tips. *Abdomen* above black or blackish brown, the tegument either entirely without light markings or with a lanceolate basal mark of reddish-brown color; each side of this mark at its base may be a spot of the same color, as also an obscure smaller spot each side of apex behind; more rarely there may be distinguishable posteriorly a number of obscure light spots more or less confluent in pairs; abdomen covered above with brown hair, with bunches of white hair forming a row of white spots along each side; sides of abdomen above like the dorsum, below light brown with numerous darker, reddish-brown or rust-colored spots usually connected into a continuous network; sides covered with brown and white hair intermixed in streaks and spots and quite concealing the tegument and its markings; venter brown, with in most a median and on each side a lateral stripe of reddish-brown or rust color behind genital furrow, these stripes formed by a close network; venter clothed with white hair. *Spinnerets* brown, the anterior ones frequently darker or even blackish. *Epigynum* reddish brown.

Cheliceræ rather long for a *Pardosa*, once and a fourth or more times as long as the height of the *face*; sides of face nearly straight, steep.

Anterior row of *eyes* much shorter than the second, slightly procurved; anterior median eyes their diameter apart or nearly so, rather less than half as far from the lateral eyes, their diameter from eyes of second row; anterior lateral eyes but slightly smaller than the median, twice their diameter from front margin of clypeus and their diameter from eyes of second row; eyes of second row a little more than their diameter apart; quadrangle of posterior eyes one-fourth the length of the cephalothorax.

Cheliceræ with the lower margin armed with three teeth of usual proportions, the upper with two. *Labium* as wide as long or slightly wider (8 : 7.8); basal excavation about one-fourth or slightly more the length of the labium; strongly attenuated anteriorly; the sides rounded below but straight or substraight above; front margin straight or very slightly incurved.

Legs with the metatarsus of the fourth pair longer than the tibia + patella; tibia + patella of the first pair of the same length as the cephalothorax; spines of tibiæ as usual; tarsi clothed as common in the genus.

Epigynum somewhat flask- or decanter-shaped, being narrow in front but widely rounded behind; lateral furrows narrow and shallow in front, widely expanded behind; septum high, narrow in front and more or less clavately widening caudally, higher than the transverse arms, which are dark in color, more or less rounded above and bent backward distally, their ends fitting into excavations in the lateral ridges. (Pl. XIV, fig. 6.)

Total length, 10.5 mm. Length of cephalothorax, 4.2 mm.; width, 3.7 mm.

Length of leg I, 13 mm.; tib. + pat., 4.2 mm.; met., 3 mm.

Length of leg II, 12.5 mm.

Length of leg III, 12.8 mm.

Length of leg IV, 17.6 mm.; tib. + pat., 5.4 mm.; met., 5.8 mm.

Male.—Color in general as in the female though rather darker; *palpi* entirely black and black-haired or with the patella paler above; *legs* darker than in female, the light markings being more reduced. The *cephalothorax* is a little longer than the tibia + patella of the first legs. *Legs* a little longer relatively than in the female.

Palpi thick and short; patella as long as the tibia which is gradually dilated distally; tarsus as long as the two preceding joints taken together. The scopus is short and blunt, its basal spur straight.

Total length, 9.5 mm. Length of cephalothorax, 4.5 mm.; width, 3.5 mm.

Length of leg I, 13 mm.

Length of leg II, 13 mm.

Length of III, 13.5 mm.

Length of leg IV, 17.75 mm.; tib. + pat., 5 mm.

Syn.—1877. *Lycosa tristis* Thorell, Bull. U. S. G. Surv. Terr., Vol. 3, No. 2, p. 510.
——. *Lycosa indigatrix* Thorell, *ibid.*, p. 512.
——. *Lycosa iracunda* Thorell, *ibid.*, p. 514.
——. *Lycosa sinistra* Thorell, *ibid.*, p. 517.
1878. *Lycosa dromæa* Thorell, Am. Nat., June.
1885. *Pardosa albomaculata* Emerton, Trans. Conn. Acad. Sci., 6, p. 495, Pl. 48, figs. 3 to 3*b*.
1890. *Lycosa grœnlandica, tristis, indigatrix, iracunda, sinistra*, Marx, Proc. U. S. N. M., 12, pp. 562, 563.
——. *Pardosa albomaculata*, Marx, *ibid.*, p. 565.
1894. *Pardosa grœnlandica*, Emerton, Trans. Conn. Acad. Sci., 9, p. 423, Pl. 4, figs. 1 to 1*f*.
——. *Pardosa indigatrix* and *iracunda*, Banks, J. N. Y. Ent. Soc., 2, pp. 51 and 52.
1895. *Pardosa grœnlandica* and *tristis*, Banks, Ann. N. Y. Acad. Sci., 8, p. 430.
1902. *Pardosa albomaculata* or *grœnlandica*, Emerton, Common Sp. of U. S., p. 79, figs. 189, 190.

Type locality.—Greenland.

Known localities.—Greenland, Canada!, New England (White Mountains)!, Colorado!, Utah!.

"Bare rocks on the upper part of the White Mountains, running very rapidly and dodging under stones at slight alarm" (Emerton).

A boreal species. Common in the mountains of Utah and Colorado.

Pardosa modica (Blackwall), 1846.

(Ann. and Mag. Nat. Hist., Vol. XVII, p. 33.)

Female.—*Cephalothorax* deep brown or black marked by two lateral and a median longitudinal pale stripe; eye region deep black; median stripe reddish brown, widest just behind third eye row, narrowed and constricted at the front end of the dorsal groove and again immediately behind it, geminated in front of the groove by a median black line; lateral pale stripes supramarginal, narrow, reaching to the clypeus in front which is likewise pale; pale stripes clothed with white hair, the dark parts with brown. *Chelicerœ* yellowish to brown over front face, darker at tips and along a narrow stripe extending down the mesal face and turning obliquely outward below; also a dark line along exterior face. *Labium* and *endites* brown, usually darker toward base. *Coxœ* of legs beneath brown. *Sternum* brown, with a black stripe or row of black spots each side of the median line and a narrower black line or row of small spots along each lateral margin; sometimes entirely black; clothed with grayish white hair. *Legs* brown; femora marked above and beneath with several longitudinal black lines or narrow stripes and with cross-marks on the sides; tibiæ above with a transverse black band at the proximal end, and with a median longitudinal black line extending from this to the distal end, and also with a similar black line along each lateral face; the basal black band on posterior tibiæ usually half as wide as the length of the joint, narrow on anterior ones; at least the posterior patellæ with a median longitudinal black line above and a similar one at each side; metatarsi especially of the posterior pairs with a more indistinct median dorsal line, the posterior ones also usually annulate with dark; the femora appear evidently darker than the more distal joints and the posterior legs darker than the anterior. *Abdomen* above brownish black; a basal lanceolate stripe of reddish-brown color; a series of transverse lines behind of same color, usually more indistinct, these marks formed of two rows of converging spots as is usual; sides of abdomen reddish brown mostly spotted with black; venter light brown, often with two dark lines close together along the median line and gradually converging caudad; sometimes a similar dark line at each side; at other times the venter is brown without markings or with dark spots at the sides; in life the abdomen is clothed above over the dark parts with dark brown hair, the light lanceolate basal mark covered with whitish hair, and a number of transverse lines of similar light hair behind with or without a row of small white spots along each side of them. *Epigynum* dark brown. *Spinnerets* dark brown to black.

Cephalothorax of moderate height or rather low; in profile highest at the third eye row, the dorsal line from there to the posterior declivity nearly straight, gradually slanting, depressed each side of the dorsal groove. *Chelicerœ* about once and a fourth as long as the *face* is high; sides of face nearly straight, slightly slanting from the vertical.

Anterior row of *eyes* of the usual relative length and curvature; anterior median eyes their diameter apart or nearly so, much closer to the lateral eyes; anterior lateral eyes smaller than the median, a little more than their diameter from eyes of second row, twice their diameter from front margin of clypeus; eyes of second row their diameter apart; quadrangle of posterior eyes one-fourth the length of the cephalothorax, as wide in front as long.

Teeth of the margins of the furrow of the *chelicerœ* of the typical arrangement and form. *Labium* of the same width as length or nearly so; labium about four and a half times longer than its basal excavation; attenuated as usual; sides above straight; front margin straight.

Legs with the tibia + patella of the fourth pair a little longer than the metatarsus or sometimes of the same length; tibia + patella of the first legs evidently shorter than the cephalothorax; spines of tibiæ and clothing of tarsi as usual.

The *epigynum* in its general form resembles that of *grœnlandica*; the septal piece of guide is more abruptly depressed anteriorly, usually widened into a quadrangular form at front of the wide foveæ and then clavately widening caudally; transverse arms of guide more conspicuous, strongly bent forward at their ends; posterior ends of lateral ridges more widely separated. (Pl. XV, figs. 1 and 3.)

Total length, 9 mm. Length of cephalothorax, 4 mm.; width, 3 mm.

Length of leg I, 9.5 mm.; tib. + pat., 3.3 mm.; met., 1.7 mm.

Length of leg II, 9.2 mm.

Length of leg III, 9.2 mm.

Length of leg IV, 13.7 mm.; tib. + pat., 4.2 mm.; met., 4 mm.

Male.—Coloration similar to that in female but darker; the median band of cephalothorax obscured in front of the dorsal groove; lateral light stripes narrow and indistinct or obscured; light markings of the abdomen indistinct.

Tibia of *palpus* of about the same length as the patella but evidently stouter, enlarged distad; sides of patella, seen from above, parallel; tarsus very broad, one and three-fourth times as broad as the tibia, ovate, acutely pointed. Palpal organ very similar to that of *grœnlandica*, but the embolus is relatively longer and there are differences in the conductor, etc. (Pl. XV, figs. 2 and 4.)

Total length, 8 mm. Length of cephalothorax, 4 mm.; width, 3.2 mm.

Length of leg I, 10.4 mm.; tib. + pat., 3.6 mm.; met., 2.1 mm.

Length of leg II, 10.5 mm.

Length of leg III, 10.1 mm.

Length of leg IV, 12 mm.; tib. + pat., 4.2 mm.; met., 43 mm.

Syn.——. *Lycosa glacialis* Thorell. Ofvers. af. Vet. Akad. Forh., 29. 1875. ? *Lycosa furcifera* Thorell Proc. Bost. Soc. N. Hist., 17, p. 499.

——. *Lycosa fuscula* Thorell, *ibid.*, p. 501.
1877. *Lycosa concinna* Thorell, Bull. U. S. G. Surv. Terr., 3, p. 506
1878. *Lycosa glacialis* Thorell, Am. Nat., June.
1885. *Pardosa brunnea* Emerton, Trans. Conn. Acad. Sci., 6, p. 495, Pl. 48, figs. 4 to 4*b* (variety).
1890. *Lycosa glacialis, concinna, fuscula* and *furcifera*, Marx, Proc. U. S. N. M., 12.
——. *Pardosa brunnea*, Marx, *ibid.*, p. 565.
1892. *Pardosa brunnea*, Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 70.
1894. *Pardosa glacialis*, Emerton, Trans. Conn. Acad. Sci., 9, p. 424, Pl. 4, figs. 2 to 2*i*.
——. *Pardosa brunnea* Emerton, *ibid.*, p. 425, Pl. 4, figs. 2*g*, 2*h*.
——. *Pardosa concinna*, Banks, J. N. Y. Ent. Soc., 2, p. 51.
1895. *Pardosa concinna*, Banks, Ann. N. Y. Acad. Sci., 8, p. 429.
1896. ? *Pardosa brunnea*, Banks, J. N. Y. Ent. Soc., 4, p. 192.
1902. *Pardosa glacialis*, or *brunnea*, Emerton, Common Sp. U. S.

Type locality.—Canada.

Known localities.—Greenland!, Canada!, Colorado, Utah!, Idaho, Oregon, Massachusetts, Connecticut, New Hampshire!.

Var. brunnea.—Emerton now believes his *brunnea* to be a synonym of *modica* (*glacialis*). All the specimens I have had the opportunity of examining from New England, however, present small differences both in epigynum and in the male palpus from specimens of *modica* from Greenland and Canada. But the species is subject to much variation; and it is uncertain whether the New England forms can be maintained more than tentatively as a distinct variety. (Pl. XV, figs. 3 and 4.)

This species is abundant in Greenland, Canada, Colorado and Utah.

Pardosa labradorensis (Thorell), 1875.

(Sub *Lycosa*, Proc. Bost. Soc. Nat. Hist., 17, p. 502.)

Female.—*Cephalothorax* brownish black with three rather narrow longitudinal bands covered with whitish hair, the middle one reaching to the pars cephalica, truncated and geminated anteriorly, narrowing backwards, the lateral bands supramarginal, continuous, rather uneven in the upper margin. *Cheliceræ* dull yellowish or ferruginous brown. *Labium* blackish, with pale apex. *Endites* dark yellowish brown, their *palpi* of the same color, the femoral joint with blackish longitudinal streaks and spots. *Sternum* black. *Legs* of a dark and dull yellowish brown, the femora with dark streaks and spots above and on the sides, limiting above two large oblong pale spots divided longitudinally by a fine black line; the patellæ and tibiæ have each three blackish longitudinal lines. *Abdomen* brownish, with traces of a short white band at the anterior margin of the dorsum. *Epigynum* ferruginous. *Spinnerets* blackish.

Cephalothorax rather long and narrow, with the sides of the pars cephalica almost perpendicular.

The anterior row of *eyes* but very slightly, scarcely perceptibly, curved forwards, its central eyes of the same size as (at least not greater than) the laterals, and somewhat more distant from each other than from the lateral eyes; eyes of the second series separated by an interval not much (about one-fourth) greater than their diameter.

Cheliceræ narrow, but slightly convex longitudinally; their length is greater than the height of the face and the length of the patellæ. *Labium* with slightly rounded apex.

Seen from the under side the anterior *tibiæ* show four pairs of spines, the third pair belonging to the sides of the joint.

The *epigynum* forms no deep fovea, as in *P. fuscula, ex.gr.*, the elevated area shows, when the hair is rubbed off, a system of short furrows and impressions rather difficult to describe, and forming a large oblong figure, rather narrow in its anterior half, then dilated gradually with rounded sides, and truncated behind; the anterior part, which is divided from the posterior by a large but not deep transverse depression, shows two longitudinal parallel furrows, the anterior apices of which are rounded; the narrow interval between these furrows is pointed anteriorly, and has in the middle a very fine longitudinal furrow; the posterior broad part of the epigynum shows on each side a deep, oblique, incurved, crescent-formed fovea; the space between these foveæ is triangular, with the apex directed backward, and divided by a deep middle longitudinal furrow.

Total length, 6.5 mm. Length of cephalothorax, 3.25 mm.; width, 2.25 mm.

Length of leg I, 8.75 mm.

Length of leg II, 8 mm.

Length of leg IV, 13 mm.; tib. + pat., 3.75 mm.

Male.—A male thought to belong to this species differs by the *cephalothorax* being of a purer black, with the lateral bands less distinct. The *legs*, which have the same markings as in the female, are of a clearer yellowish-brown color than in that sex, but darker at the base; the coxæ are black above and blackish beneath, the thighs also blackish on the under side towards the base; the tarsi are yellowish brown scarcely black at the extreme apex (as in the female). The palpi are very dark yellowish brown (the tibial joint almost black) with black lines, and the tarsal joint quite black; the tibial joint is thickly clothed with black hair; also the other joints are black-haired. The *abdomen* has a very distinct narrow band at base covered with whitish hair; venter blackish.

The patella of the *palpus* is somewhat longer than broad, cylindrical;

tibia scarcely longer than the patella but broader, being slightly and gradually dilated toward the apex; the tarsus is as long as the two preceding joints together, almost pear-shaped. The genital bulb is very high at the base on the under side, this elevated part being obliquely truncated and emarginate on the outer side; it shows in front a large fovea, from which issues a very short and coarse obtuse tooth directed obliquely forward and outward, and bearing at its base a longer and narrower pointed black tooth directed outward and curved backward and downward; this latter tooth lies almost concealed in the fovea; in the middle of the outer margin of the bulb a strong, pointed, downwardly directed black tooth is visible; close to the anterior side of its posterior elevated portion is a transverse spine-like costa (embolus); the anterior lower part of the bulb shows on the outer side two pale appendages or narrow lobes.

Total length, 6.5 mm. Length of cephalothorax, 3.25 mm.; width, 2.25 mm.

Length of leg I, 8.75 mm.

Length of leg II, 8.5 mm.

Length of leg IV, 11.75 mm.; tib. + pat., 3.25 mm.

(From Thorell.)

Habitat.—Strawberry Harbor (♀) and Square Island (♂), Labrador. The female was captured July 28; the male also in July. "This species greatly resembles *P. fuscula*; but it is smaller, with the sides of the head more perpendicular, the interval between the two largest eyes is smaller, and the form of the vulva is quite different. *P. labradorensis* is a *Pardosa* C. Koch, while *fuscula* (and *furcifera*) appear to belong to *Leimonia* C. Koch." (Thorell.)

In general coloration, proportions and structure, and especially in the structure of the ♂ palpus, this form is certainly very close to *modica*, and it may prove not to be anything different. It is possible that the differences in the epigynum, which Thorell thinks considerable, may be due to the type of *labradorensis* being not entirely adult, the epigynum of immature specimens of *modica* which I have seen seeming largely to agree with the description of that of *labradorensis* given as above by Thorell.

Pardosa mackenziana (Keyserling), 1876.

(Sub *Lycosa*, Verh. z. b. Ges. Wien, 26, p. 621, Pl. 7, fig. 7.)]

Female.—*Cephalothorax* with a light median reddish-brown band as broad anteriorly as the eye area or nearly so, usually broken a little way back of its anterior end by a transverse dark stripe, behind which the band continues of a uniform width over the median groove and then narrows down the posterior declivity, sometimes sending off a process from each side just in front of the posterior margin; sides of cephalothorax black, with or without an indistinct short light colored supramarginal stripe posteriorly, with sometimes one or two light spots anteriorly; this marginal band when present conspicuous; eye region entirely black; clypeus brown. *Cheliceræ* bluish brown, a wide black stripe crossing the face of each obliquely from the inner face outward, leaving a paler tip and a paler portion above it. *Labium* and *endites* brown, with the tips paler. *Sternum* black, an obscurely lighter median line in front, such as occurs in *milvina*. *Coxæ* of legs beneath light brown. *Legs* strongly marked with deep brown or black annulations alternating with rings of yellow or light brown, the latter rings much narrower on femora and tibiæ, of the same width as the black ones on the metatarsus; the tarsi clear yellow or light brown or the anterior ones sometimes also obscurely annulate. *Abdomen* above black, with a lanceolate mark of red-brown at base and a series of transverse light marks behind, each of the latter being composed of mostly four confluent black-centred spots of same color; the transverse marks frequently obscure; sides of abdomen black, minutely spotted with brown, the spots large below; venter brown to gray. *Spinnerets* brown. *Epigynum* brown, of same hue as venter inconspicuous.

Face but little lower than the length of the cheliceræ; sides straight and vertical or nearly so.

First row of *eyes* much shorter than the second, procurved; anterior median eyes their diameter or more apart, closer to lateral eyes which are of equal size; anterior lateral eyes twice their diameter from front margins of clypeus, their diameter or a little more from eyes of second row; anterior median eyes their diameter from eyes of second row; eyes of second row about their diameter apart; quadrangle of posterior eyes rather more than one-fourth the length of the cephalothorax.

Margins of furrow of *cheliceræ* armed as usual. *Labium* of same width as length or very nearly so (1 : 1 to 7.25 : 7); basal excavation longer and shallower than usual, but less than one-third the length of labium; sides widely rounded below, straight above, front or anterior margin truncate or slightly indented at middle.

All tarsi spinulose beneath, the spinules arranged on all in two rows; the lateral scopulæ of anterior pairs very sparse or scarcely evident.

Depressed area of epigynum anteriorly very narrow; the posterior area wide, almost completely filled by the expanded guide which presents lateral plates along transverse arms in front and externally; the ends of arms extending into excavations in side walls. (Pl. XV, fig. 5.)

Total length, 6.5 mm. Length of cephalothorax, 3 mm.; width, 2 mm.

Length of leg I, 9.2 mm.; tib. + pat., 3.1 mm.; met., 2 mm.

Length of leg II, 8.7 mm.

Length of leg III, 8.6 mm.

Length of leg IV, 12.2 mm.; tib. + pat., 4 mm.; met., 3.7 mm.

Male.—Color of *cephalothorax* and abdomen as in female. Mandibles blackish with dusky brownish-yellow streaks. *Labium* and *endites* also blackish. The female joint of the palpi is brownish yellow with black spots and streaks especially toward the base; patella joint yellowish brown, the tibiæ black on sides and pale brownish above, covered with black hair; tarsal joint black and black-haired, pale at apex. *Legs* brownish yellow, the thighs black beneath, except at apex, and with distinct blackish rings above; the following joints less distinctly ringed. (Thorell.)

The tibial joint is a little broader and, at least when seen from the side, slightly longer than the patellar joint, gradually but very slightly thickened toward the apex; the tarsal joint is fully as long as the two preceding joints together, about double as broad as the tibial joint, nearly ovate, but strongly narrowing toward apex, very convex. For structure of bulb see Pl. XV, figs. 6 and 7.

Total length, 6 mm. Length of cephalothorax, 3 mm.; width, 2.5 mm. (nearly).

Length of leg I, 10 mm.

Length of leg II, 9.5 mm.

Length of leg III, 9.5 mm.

Length of leg IV, 14 mm.; tib. + pat., 3.5 mm.

Syn.—1877. *Lycosa uncata* Thorell, Bull. U. S. G. S. of Terr., 3, p. 508.
1894. *Pardosa dorsalis* Banks, J. N. Y. Ent. Soc., 2, p. 51.
1894. *Pardosa uncata*, Emerton, Trans. Conn. Acad. Sci., 9, p. 425, Pl. 3, figs. 8 to 8*f*.

Type locality.—Mackenzie River.

Known localities.—Colorado!, Utah!, Idaho, Canada.

Pardosa longispinata Tullgren, 1901.

(Bih. till sv. Vet.-Akad. Handl., Band 27; Ofd. IV, No. 1, p. 23.)

Female.—Cephalothorax dark brown, clothed with short adpressed and long black upturned bristly hairs, with a white middle-band.

squarish in the cephalic part and as broad as the area of eyes, on the pars thoraica narrow; the eye area nearly black; at the margins broad white bands; the margin black. *Cheliceræ* clothed with long bristly hairs. *Endites* and *labium* light yellow brown. *Sternum* light brown with long light hairs. *Legs* pale brown with dark rings. *Abdomen* brown, clothed with black and white short hairs without distinct markings; the venter light grayish.

Cephalothorax a little shorter than the length of tibia + patella of fourth legs and the breadth shorter than the length of tibia of the fourth pair of legs. Front row of eyes distinctly procurved, the central eyes largest and the interspace between the central eyes about equal to their diameter and longer than the space between the lateral eyes. The distance from the lateral eyes to the margin of the clypeus and to the eyes in the middle row about thrice their diameter. The eyes of the middle row very large and the interspace between them longer than their diameter. The interspace between the middle and the posterior eyes broader than the diameter of the middle eyes. *Cheliceræ* a little longer than the face, very tapering at the apex and clothed with long bristly hairs, a little narrower than the femur of first pair. Tibia of first pair of legs below with 2, 2, 2 spines; these and other spines very long.

Total length, 4.2 mm. Length of cephalothorax, 2.5 mm.; width, 1.8 mm.

Length of leg I, 7.3 mm.

Length of leg IV, 10 mm.

(Description rearranged from the original.)

Locality.—Florida. One single adult female from Lake Leonore in Orange County.

This tiny *Pardosa* is not known to me at first hand. It is certainly a very unusual form, if it be true that the "distance from the lateral eyes to the margin of the clypeus and to the eyes in the middle row is about *thrice* their diameter," a statement much to be questioned.

Genus **SCHIZOCOSA** Chamberlin, 1904.

(Canadian Entomologist, Vol. XXXVI, p. 177.)

Entire body densely clothed with pubescence; the cephalothorax with a light median band as wide anteriorly as the eye area and either with or without submarginal pale bands. Spines of anterior tibiæ in number and arrangement like those of *Pardosa* and *Lycosa*, in length varying between those of these two genera. Anterior row of eyes considerably shorter than the second, clearly procurved, more strongly than usual in *Pardosa* or *Lycosa*; anterior median eyes larger than the lateral, of nearly same distance from each other as from the lateral eyes; clypeus narrow, the anterior lateral eyes at most their diameter or but little more from the front margin of clypeus, the same distance or considerably farther from the eyes of second row; eyes of second row large, less than their diameter apart; quadrangle of posterior eyes evidently wider behind than in front. Cheliceræ as in *Lycosa*, the third tooth of the inferior margin of the furrow usually reduced. Labium distinctly longer than broad, the basal notch one-third its total length. Posterior spinnerets short, scarcely or not at all longer than the anterior. Epigynum with a distinct guide which is elevate and well developed anteriorly as in *Lycosa*; the transverse arms of guide double, being divided from their exterior ends mesally to a varying distance; lateral furrows not widening anteriorly. (See figs. of Pl. XVI.) Male palpus with a scopus exterior in position presenting two processes as in *Lycosa*; exposed area of lunate plate small; conductor conspicuously produced above, usually into a horn-like elevation of varying size; superior margin of inferior furrow presenting, more or less externally from its middle, a short and pointed, basally wide, plate-like tenaculum which is curved downward distally; a second, shorter tenaculum farther externally and anteriorly; auricula of lectus very long, extending forward along conductor and attaining or nearly attaining front margin of alveolus; embolus distinctly and more or less angularly elbowed at base of auricula. (See figs. of Pl. XVI.)

Syn.—1842. *Lycosa*, Hentz (ad. part. *ocreata* and *venustula*), J. Bost. S. N. H., IV, p. 228.
1875. *Lycosa*, Hentz (ad. part. cit.), Sp. of U. S., p. 24.
1876. *Lycosa*, Keyserling (ad. part. *ocreata* and *rufa*), Verh. z. G. Wien, p. 610.
1885. *Pardosa*, Emerton (ad. part. *bilineata*), Trans. Conn. Acad. Sci., VI, p. 491.
1892. *Pardosa*, Banks (ad. part. *gracilis*), Proc. Acad. Nat. Sci. Phila., p. 70.
1902. *Lycosa*, Montgomery (ad. part. *ocreata pulchra*, *relucens* and *verisimilis*), Proc. Acad. Nat. Sci. Phila., p. 536.
——. *Pardosa*, Montgomery (ad. part. *solivaga*), *loc. cit.*
1904. *Lycosa*, Montgomery (ad. part.), Proc. Acad. Nat. Sci. Phila., p. 276.

Pars cephalica truncated in front, its sides moderately rounded and sloping, the face rather high, its sides slanting in varying degrees, sometimes approaching the *Pardosa* type more and sometimes the *Lycosa*. The quadrangle of posterior eyes in length averaging one-fourth the length of the cephalothorax, being thus longer than in *Lycosa*. The *legs* are long and moderately stout, inclining to be slender distally; the anterior tarsi scopulate, at least laterally, the posterior tarsi setose below; the tibia and patella of the fourth legs taken together are always considerably longer than the cephalothorax. The median light band of the cephalothorax widens uniformly from behind forward to the eyes; it is constricted in front of dorsal groove, but otherwise its margins are nearly straight. The *abdomen* in all is marked above by a broad light band which is nearly or fully as wide as the dorsum and which extends over its entire length from base to spinnerets; this band enclosing at base a lanceolate outline, and behind in some also a series of transverse angular lines of varying degrees of distinctness; sides of abdomen dark in color, black at least across anterior lateral angles; venter pale.

Spiders of medium or small size. The males are but little different in size from the females, but are sometimes characterized by having the tibiæ of the front pair of legs darkened in color and densely clothed with long black hair which stands out in brush-like form.

The cocoon is spherical, without any seam at equator, and is white in color.

KEY TO SPECIES.

Females.

1. Sternum yellow, with two dark lines or rows of dark spots converging posteriorly, ... *bilineata* (Emerton).
   Sternum dark, not marked as in *bilineata*, ... 2.
2. Septal piece of guide very broad immediately in front of transverse arms, narrowing anteriorly where it is not sinuous or bent; the median piece between anterior and posterior divisions of arms very narrow, much narrower than the septum in front of arms (Pl. XVI, fig. 1); sternum usually black except marginally, *ocreata* (Hentz).
   Septal piece of guide sinuous or bent near anterior end; median piece between anterior and posterior divisions of arms wide, wider than septum in front of transverse arms (Pl. XVI, fig. 4); sternum usually reddish brown, ... *saltatrix* (Hentz).

Males.

1. First tibiæ clothed with dense black hair standing out in brush-like form, ... 2.
   First tibiæ not so clothed, ... *saltatrix* (Hentz).
2. Legs yellow, without dark annuli or markings, *bilineata* (Emerton).
   Legs annulate with dark, ... *ocreata* (Hentz).

Schizocosa ocreata (Hentz), 1844.

(Sub. *Lycosa*, J. Bost. Soc. Nat. Hist., IV, p. 391, Pl. XVIII, fig. 5.)

Female.—Sides of the *cephalothorax* brownish black; median band reddish yellow, anteriorly passing forward broadly between eyes of third row and nearly reaching second, more or less divided at front end by a black median line or pointed process; eyes surrounded with black; on each side considerably above margin a narrow, wavy light line which does not extend forward upon the pars cephalica, this line often obscure; clypeus reddish yellow, crossed beneath each anterior lateral eye by a black mark or spot which is often confluent with its fellow across the middle, thus leaving the clypeus pale only laterally; light bands of cephalothorax in life clothed densely with white or light gray pubescence. *Cheliceræ* reddish brown, often dusky, except at distal ends, and marked by black lines. *Endites* brown, the *labium* darker, usually blackish except at tip. *Sternum* usually black or nearly so, paler along borders, especially caudo-laterally; sometimes paler reddish brown. *Coxæ* of legs beneath light brown. *Legs* reddish brown, paler distally, all joints except the tarsi with dark annulations, the annulations of the femora broader and deeper, commonly more or less confluent, especially the anterior pairs, the annulations of the other joints often indistinct. Sides of *abdomen* above dark, a black band passing from the front face backward across each antero-lateral angle and breaking up behind into numerous streaks and spots; the dorsum covered for entire length by a broad light brown band of often reddish tinge, the band usually constricted in front of middle; within the light band at base a lanceolate outline which bifurcates at its apex and is followed behind by a series of chevron-lines; lower part of sides of abdomen light brown, marked with small black spots; the venter light brown, either immaculate or with a median, and at each side a lateral, row of dark spots behind the furrow of the lung slits. *Epigynum* and *spinnerets* brown. Face moderately high, two-thirds as high as the length of the chelicerae, its sides moderately steep. First row of eyes considerably shorter than the second, distinctly procurved, the median three-fourths their diameter apart, nearly the same distance from the three-fourths as large lateral eyes; anterior lateral eyes their diameter, or slightly more, from front margin of clypeus, very little farther from eyes of second row, eyes of second row not fully their diameter apart; quadrangle of posterior eyes about one-fourth the length of the cephalothorax. *Chelicera* armed as usual. *Labium* longer than wide, the basal notch very long, more than one-third the total length of labium; sides above straight and strongly converging, the front margin straight, not at all curved. *Legs* long, the distal joints rather slender; tibia + patella of first legs of same length as the cephalothorax; anterior tibiæ armed beneath as usual, the first two pairs of spines long, nearly as in *Pardosa*, the first overlapping the second; anterior tarsi with scopulæ at sides; a median ventral setose band, the posterior tarsi not at all scopulate being simply setose.

Septal part of guide of *epigynum* very broad, occupying much of epigynal depression, narrowest at anterior end; the transverse arms deeply divided, the median piece very narrow. (Pl. XVI, fig. 1.)

Total length of small female, 7.4 mm. Length of cephalothorax, 4.3 mm.; greatest width, 3.2 mm.

Length of leg I, 11.3 mm.; tib. + pat., 4.3 mm.; met., 2.1 mm.

Length of leg II, 10.7 mm.

Length of leg III, 10.3 mm.

Length of leg IV, 15 mm.; tib. + pat., 4.6 mm., met., 4.4 mm.

Male.—Coloration in general as in female. The tibiæ of first *legs* very densely clothed for entire length with long black hairs which stand out straight from joint; often of a greenish tinge. *Legs* longer than in female; tibia + patella of first legs longer than cephalothorax; spine of anterior tibia shorter than in female.

Tibia of *palpus* fully as wide as long, sides convex, widest at middle, much wider than the patella which is little shorter and widens from base distally, its sides straight; tarsus wider than the tibia, of same length as tibia and patella taken together. Lunate area very small, basal in position, its convexity external; horn of conductor very long, extending much beyond front margin of alveolus, bent at an angle below its middle; principal tenaculum situated at middle, unequally bidentate; lesser tenaculum bent upward at distal end, situated below antero-exterior angle; auricle gradually attenuated apically. (Pl. XVI, fig. 5.)

Length of large specimen, 8.6 mm. Length of cephalothorax, 4.6 mm.; width, 3.9 mm.

Length of leg I, 14.2 mm.; tib. + pat., 5 mm.; met., 3.3 mm.

Length of leg II, 13.3 mm.

Length of leg III, 13.1 mm.

Length of leg IV, 1.8 mm.; tib. + pat., 5.5 mm.; met., 5.3 mm.

Syn.—1875. *Lycosa ocreata* Hentz, Spid. of U. S., p. 33, Pl. 4, fig. 5.
1876. *Lycosa ocreata*, Keyserling, Verh. z. b. Ges. Wien, Vol. XXVI, p. 611, Tab. VII, fig. 5 (male).
——. *Lycosa rufa* Keyserling, *ibid.*, p. 613, Tab. VII, fig. 2 (female).
1885. *Lycosa ocreata*, Emerton, Trans. Conn. Acad. Sci., VI, p. 491, Pl. XLVIII, figs. 6, 6*a*, 6*b*.
1890. *Lycosa ocreata* Hentz, Marx, Proc. U. S. N. M., XII, p. 562.
——. *Lycosa rufa* Keyserling, Marx, *ibid.*, p. 563.
——. *Lycosa ocreata*, Stone, Proc. Acad. Nat. Sci. Phila., Vol. 42, p. 427.
1892. *Lycosa ocreata*, Banks, *op. cit.*, Vol. 44, p. 66.
——. *Lycosa ocreata*, Marx, Proc. Ent. Soc. W. II p. 160.

——. *Lycosa ocreata*, Fox, *ibid.*, p. 269.
1893. *Lycosa ocreata*, Banks, J. N. Y. Ent. Soc., I, p. 125.
1896. *Lycosa ocreata*, Banks, *op. cit.*, IV, p. 192.
1898. *Lycosa ocreata*, Simon, Hist. Nat. Araign., II, p. 330.
1900. *Lycosa ocreata*, Banks, Proc. Acad. Nat. Sci. Phila., p. 538.
1902. *Lycosa ocreata*, Emerton, Common Sp. of U. S.
——. *Pardosa solivaga* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 574, Pl. XXX, fig. 39.
——. *Lycosa stonei* Montgomery, *ibid.*, p. 546, Pl. XXIX, figs. 9 and 10.
1904. *Schizocosa ocreata*, Chamberlin, Can. Ent., XXXVI, p. 176.
——. *Lycosa ocreata*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 288.

Type locality.—North Carolina.

Known localities.—North Carolina!, Virginia, District of Columbia!, Alabama, Louisiana, Ohio, Illinois, Kansas!, Connecticut, New York!.

Hentz, in speaking of the occurrence of this species in North Carolina, says that it "is not rare in meadows near water." It is found in similar locations in New York State. Emerton states that in New Haven, Conn., it is "common in open woods among dead leaves. Adult about June 1."

Schizocosa saltatrix (Hentz), 1844.

(Sub *Lycosa*, J. Bost. Soc. Nat. Hist., IV, p. 387, Pl. XVII, fig. 7.)

Females.—Sides of *cephalothorax* deep brown, in life densely clothed with black intermixed with brown pubescence, a wide median band of usual form which is of reddish tinge anteriorly, extending forward between eyes of third row and there geminated by a fine dark line which extends back over pars cephalica towards dorsal groove; a supramarginal light line on each side which sometimes attains and sometimes does not attain the clypeus in front, the border below these lateral stripes more or less broken by transverse light lines; median and lateral light stripes densely clothed with white intermixed with yellowish pubescence. *Chelicerœ* dark brown clothed with short yellowish gray pubescence, which is not dense, and longer black bristles; the fringe of the superior margin of the furrow grayish. *Endites* yellowish brown, lighter at tips. *Labium* brown, darker than endites. *Sternum* beneath brown or reddish brown, the former often showing a lighter median line or stripe, clothed in life with gray or whitish intermixed with black pubescence. *Coxœ* light brown to yellow, always paler than the sternum. *Legs* yellow to light reddish-brown, with numerous narrow though often indistinct dark rings (occasionally quite absent), which become fewer and often wider distally, the annuli of femora not so heavy and not confluent as in *ocreata*. Nearly entire dorsum of abdomen pale brown, often of a pale reddish in life, grayish from the pubescence which is light brown intermixed with spots of gray, line at base a dark lanceolate outline, forked at apex and followed by a series of chevron-lines as in *ocreata*; these in life broadened behind by lines of white hair, a black spot over each anterior lateral angle extending a short distance condad, and usually a triangular black spot more or less constricting the median band towards the middle, the sides elsewhere with many dark spots, in life streaked and spotted with patches of white pubescence; venter pale brown to greenish yellow, in life densely clothed with white pubescence, the tegument often marked along each side with a row of small black dots curved convexly outward and converging posteriorly, a double median dark stripe sometimes present behind epigynum. Epigynum and spinnerets light brown.

Face moderate in height, less than two-thirds as high as the length of the cheliceræ, the sides moderately rounded and standing outward below, more so than in *ocreata*.

Anterior row of *eyes* shorter than second by twice the diameter of a lateral eye, well procurved. Anterior lateral eyes their diameter from front margin of clypeus, slightly farther from eyes of second row less than their diameter apart; cephalothorax 4.5 times longer than quadrangle of posterior eyes.

Cheliceræ armed as usual, the middle tooth of inferior margin longest, the third considerably reduced. *Labium* longer than broad (not quite 8.7) basal notch one-third the length of labium; sides of labium below but slightly convex, subparallel, above straight or nearly so, distinctly and considerably converging; anterior margin moderately wide, concurved at middle; gently convexly rounded at sides.

Legs long and rather stout; the metatarsi of the fourth legs moderately slender; two first pair of spines of anterior tibiæ of moderate length, rather shorter than in *ocreata*. Anterior tarsi and also except basally being divided by a wide median setose band.

Septal piece of guide of *epigynum* of but moderate width, a little or sometimes considerably wider anteriorly than posteriorly, the transverse arms divided normally but little more than half way to their mesal ends, the incisions connected by a furrow; posterior divisions of transverse arms depressed, on each side with distal end bent sharply forward. (Pl. XVI, fig. 4.)

Total length, 9 mm. Length of cephalothorax, 4.7 mm.; width, 3.8 mm.

Length of leg I, 12.5 mm.; tib. + pat., 4.5 mm.; met., 2.3 mm.

Length of leg II, 11.7 mm.

Length of leg III, 11.5 mm.

Length of leg IV, 15.8 mm.; tib. + pat., 5 mm.; met., 4.5 mm.

Male.—Colored like female, the anterior legs not specially modified, cheliceræ clothed with yellow and greenish pubescence. Legs considerably longer than in female, tibiæ + patella of first pair clearly longer than the cephalothorax.

Tibiæ of palpus a little longer and much thicker than the patella, nearly as wide as tarsus, sides more straight than in *ocreata*; tarsus as long as two preceding joints together. Exposed part of lunate area very small, situated at base and with convexity external; horn of conductor broad at base, conical; principal tenaculum external from middle, the lesser tenaculum at antero-exterior angle of conductor, small, bent a little downward apically; auricle of lectal fold bluntly and abruptly rounded apically. For other features see Pl. XVI, fig. 2.

Total length, 8.8 mm. Length of cephalothorax, 4.7 mm.; width, 3.9 mm.

Length of leg I, 16 mm.; tib. + pat., 5.4 mm.; met., 3.5 mm.

Length of leg II, 13.7 mm.

Length of leg III, 13.4 mm.

Length of leg IV, 19 mm.; tib. + pat., 5.8 mm.; met., 5.8 mm.

Syn.—1844. *Lycosa venustula* Hentz, J. Bost. Soc. Nat. Hist., IV, p. 392, Pl. XVIII, figs. 6 and 7.
1875. *Lycosa saltatrix* Hentz, Sp. of U. S. (Burgess Ed.), p. 28, Pl. 3, fig. 7.
——. *Lycosa venustula* Hentz, Sp. of U. S., p. 33, Pl. 4, figs. 6, 7.
1892. *Lycosa humilis* Banks, Proc. Acad. Nat. Sci. Phila., Vol. 44, p. 65, Pl. III, fig. 36.
——. *Pardosa gracilis* Banks, Proc. Acad. Nat. Sci. Phila., Vol. 44, p. 70, Pl. 1, fig. 50.
1902. *Lycosa relucens* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 542, Pl. 29, figs. 5, 6.
——. *Lycosa charanoides* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 544.
——. *Lycosa verisimilis* Montgomery, *ibid.*, p. 548, Pl. 29, figs. 11, 12.
1903. *Lycosa charanoides* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 646, Pl. XXIX, fig. 7.
——. *Lycosa verisimilis* Montgomery, *ibid.*, p. 647.
1904. *Schizocosa venustula* (Hentz), Chamberlin, Can. Ent., XXXVI, p. 176.
——. *Lycosa charanoides* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 286.
——. *Lycosa relucens* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 292.

Type locality.—Alabama.

Known localities.—Alabama, North Carolina!, Georgia!, Louisiana!, Mississippi!, Texas!, District of Columbia!, Pennsylvania, Kansas!, New York!.

Hentz states that males of this species were common in Alabama in April, but that he did not find females. So also, it may be noted, all but a few of the specimens of rather extensive collections of this species, made at several places in the South in the early spring of 1903, which I have examined are males. The marking of the venter of the abdomen figured by Hentz is strongly developed in some individuals, obscure or absent in others. In size and general coloration this species is much like *ocreata*, except as to the first legs of the males; and it has also approximately the same geographical range.

Schizocosa bilineata (Emerton), 1885.

(Sub *Pardosa*, Trans. Conn. Acad. Sci., VI, p. 496, Pl. 49, figs. 3 to 3*b*.)

Female.—Sides of *cephalothorax* dark reddish brown clothed with deep brown pubescence. A wide median yellow stripe of the usual form, darker, more reddish, in front of dorsal groove, extending between eyes of third row as usual; not geminated or only so for very little distance at front, usually a darker reddish line extending backward from inner side of each eye of third row, the two uniting in front of median groove; the band clothed in gray and light brown pubescence which is darker anteriorly; a narrow supramarginal stripe each side reaching to clypeus in front, the dark band below this stripe often more or less broken into spots by light cross-lines; some light radiating cross-lines from median stripe; eyes surrounded with black, the black extending across clypeus below each anterior lateral eye. *Cheliceræ* brown, a gray-brown pubescence and longer black bristles. *Endites* yellow or light brown. *Labium* darker, brown to blackish. *Sternum* light brown or yellow, a row of dark spots each side of the middle, the two converging and meeting posteriorly, the margins also sometimes darker, clothed with grayish pubescence. *Coxæ* of legs yellow. *Legs* yellow, somewhat darkened distally, entirely without dark annuli or other markings. Abdomen above light brown, enclosing at base a dark lanceolate outline ending at middle, and with behind on each side a row of several black spots, which are connected in pairs by narrow and often indistinct dark transverse lines; the dorsum densely clothed with light brown or gray-brown pubescence; a deep brown or black spot over each anterior lateral angle, the sides elsewhere also dark from the many dark spots which are often more or less arranged in rows, covered with brown pubescence, intermixed with gray in spots and streaks; venter yellow, covered with gray pubescence, with normally four dark longitudinal lines, all converging from furrow of lung slits toward the spinnerets. *Spinnerets* yellowish or pale brown. *Epigynum* pale brown with darker margins.

Face moderately high, a little more than two-thirds as high as the length of the cheliceræ; sides scarcely convex, very steep, much as in *Pardosa*.

First row of eyes much shorter than the second, considerably procurved; anterior median eyes hardly their radius apart, about same distance from the lateral or but slightly farther; anterior lateral eyes as large as median or very nearly so, rather less than their diameter from front margin of clypeus, a little more than their diameter from eyes of second row; eyes of second row not their diameter apart, quadrangle of posterior eyes one-fourth as long as the cephalothorax; posterior eyes seen from above close to lateral margin of pars cephalica as in *Pardosa*.

Labium longer than wide in ratio of 4.6 : 4; basal notch one-third as long as labium; sides rounded below, straight and moderately converging above; anterior margin truncate, not at all curved. *Legs* of moderate length, short, not very slender distally; metatarsus of fourth legs as long as cephalothorax; tibia + patella of first leg shorter than cephalothorax; spines of anterior tibiæ moderately long and slender, the first pair a little overlapping the second; anterior tarsi with well developed scopulæ which are scarcely or but imperfectly divided, the posterior tarsi not at all scopulate, simply setose.

Septal piece of guide of *epigynum* broad, narrowest adjacent to transverse arms, distinctly widening anteriorly; the anterior branch of transverse arms of each side conspicuously enlarged distally, making the total width of the transverse arms conspicuously less adjacent to septum than extad. (Pl. XVI, fig. 3.)

Total length, 7.2 mm. Length of cephalothorax, 3.3 mm.; width 2.4 mm.

Length of leg I, 8.6 mm.; tib. + pat., 3 mm.; met., 1.7 mm.

Length of leg II, 8.2 mm.

Length of leg III, 8.2 mm.

Length of leg IV, 11.6 mm.; tib. + pat., 3 mm.; met., 1.7 mm.

Male.—General coloration like that of female; tibiæ of first legs densely clothed for entire length with a brush of long black hair as in *ocreata*. Anterior lateral eyes but about half their diameter from front margin of clypeus, smaller than median; eyes of second row scarcely more than three-fourths their diameter apart.

Tibia of *palpus* longer and broader than the patella, of nearly same breadth from base to apex; tibia + patella a little longer than tarsus; the latter clearly wider than the tibia (3.25 : 2.5); the alveolus relatively large, the sides low and the bulb protruding; conductor high and rounded above at the exterior end, but no distinct horn-shaped process; principal tenaculum rather small, bluntly rounded apically; auricle of lectus very long, attaining or extending beyond front margin of alveolus.

Total length, 5.3 mm. Length of cephalothorax, 3 mm.; width, 2.2 mm.

Length of leg I, 8.7 mm.; tib. + pat., 3.2 mm.; met., 2 mm.

Length of leg II, 7.8 mm.

Length of leg III,

Length of leg IV, 10.6; tib. + pat., 3.4 mm.; met., 3.2 mm.

Syn.—1890. *Lycosa ocreata* Stone, but *nec* Hentz, Proc. Acad. Nat. Sci. Phila., Vol. 42, p. 427.
1892. *Pardosa bilineata*, Marx, Proc. Ent. Soc. W., Vol. 2, p. 161
1895. *Pardosa bilineata*, Banks, J. N. Y. Ent. Soc., Vol. 3, p. 91.
1902. *Lycosa ocreata pulchra* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 540, Pl. 29, figs. 3, 4.
1904. *Schizocosa bilineata* (Hentz), Chamberlin, XXXVI, p. 176.
——. *Lycosa bilineata* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 290.

Type locality.—Connecticut.

Known localities.—Connecticut, New York!, New Jersey, Pennsylvania, District of Columbia!, Illinois, Kansas!.

The Genus **LYCOSA** Latreille, 1804.

(Nouv. Dict. Hist. Nat., 24, p. 135.)

Entire body densely clothed with pubescence. Anterior tibiæ armed beneath with three pairs of *spines* which are shorter than the diameter of the joint or at most but little longer, the third pair apical in position and smaller (Pl. IX, fig. 8). Anterior *eyes* in a row shorter than, of same length as or longer than the second, either procurved or straight, or rarely a little recurved, eyes equidistant or with the median a little farther from each other than from the lateral, the lateral usually a little smaller than the median; anterior lateral eyes mostly their diameter or but little more from front margin of clypeus, only rarely once and a half their diameter and never more, the same distance or farther from eyes of second row; eyes of second row large, less than their diameter apart; quadrangle of posterior eyes trapeziform, evidently wider behind than in front. *Labium* longer than wide, or at least never wider than long; either attenuated anteriorly or, less commonly, with sides subparallel; basal excavation long, in most fully one-third or more the total length (Pl. IX, figs. 7 and 9). *Spinnerets* short, the posterior ones not longer than the anterior, their apical segment indistinct. *Epigynum* in typical forms with a strongly developed guide, of which the septal piece is distinct and well formed anteriorly, its transverse arms not divided; openings of the spermatheca protected, leading into narrowed channels, the lateral furrows from these widening anteriorly, and at the front usually conspicuously wider than behind (see, *e.g.*, figs. of Pl. XVII); in some the foveolæ subcircular, not thus elongate and widening conspicuously anteriorly (group *Trochosa*). Bulb of male palpus bearing at front of basal lobe a strongly chitinized special fold or scopus which is essentially exterior in position; scopus presenting two processes; viewed directly from below the inner of these appears usually as a more or less retrorse, barb-like process, but in some (group *Trochosa*) longer and strongly salient, the basal portion mostly more or less concealed by a basal fold which leaves only the apical, exterior portion visible in ventral aspect; median rim of conductor bearing one, or sometimes two, mostly slender and simple tenacula; a lectal fold well developed, an auricle of varying size, but always smaller than in *Schizocosa*. See, *e.g.*, figs. of Pl. XVII.

1832. *Lycosa* Hentz (ad. part. max.), Sill. J. Sci. and Arts, 21, p. 106.
1842. *Lycosa* Hentz (ad. part. max.), J. Bost. Soc. N. H., 4, p. 228.
1848. *Lycosa* (ad. part.), *Arctosa* and *Trochosa*, C. Koch, Die Arachniden, 14, pp. 94–98.
1869–70. *Tarentula* and *Trochosa* Thorell, On European Spiders, p. 192.
1875. *Lycosa* Hentz (ad. part. max.), Sp. U. S., pp. 11 and 24.
1876. *Lycosa* Simon (ad. part. max.), Arcahn. Fr., 3, p. 233.
——. *Tarentula* and *Trochosa* Keyserling, Verh. z. b. Ges. Wien, p. 610.
1877. *Tarentula* Thorell, Bull. U. S. G. S. Terr., 3, p. 520.
1885. *Lycosa* Emerton, Trans. Conn. Acad. Sci., 6, p. 482.
1890. *Tarentula*, *Trochosa* and ad. part. *Lycosa* Marx, Proc. U. S. N. M., 12.
1898. *Lycosa* Simon (ad. part. max.), Hist. Nat. Araign., 2.
1902. *Lycosa* (ad. part. max.), Proc. Acad. Nat. Sci. Phila., p. 536.
1903. *Lycosa* Comstock, Classif. of N. A. Spiders.
1904. *Lycosa* Chamberlin, Can. Entomologist, Vol. XXXVI, p. 176.
——. *Lycosa* (ad. part.), Montgomery, Proc. Acad. Nat. Sci. Phila., p. 276.
——. *Trochosa*, Montgomery (ad. part), *ibid.*, p. 300.

Pars cephalica moderately elevated; in front truncate to more or less obtuse; its lateral margins either a little converging anteriorly or parallel; sides rounded outward below; face moderately high, trapeziform, evidently widening downward; in profile either vertical or sloping forward from top to the base of cheliceræ (Pl. IX, fig. 5). Quadrangle of posterior *eyes* in most but one-fifth or less the length of the cephalothorax. Seen from above, the eyes of second and third rows are much more than their diameter from lateral margins of the pars cephalica (Pl. IX, fig. 2). *Cheliceræ* long and robust, in length at least one and one-half times the height of the face; upper margin with three teeth of the usual proportions, or the first one rarely absent; lower margin with three stout teeth which are subequal, or with the third sometimes reduced, or else with two stout equal teeth (Pl. IX, figs. 1 and 3).

Legs robust, the distal joints usually not slender as in *Pardosa*. Tarsi and usually also metatarsi of anterior legs scopulate and with the scopulæ undivided (Pl. IX, fig. 4), the posterior tarsi scopulate at sides, being divided along the median ventral face by a setose or setose and spinulose band (Pl. IX, fig. 6). Metatarsus of fourth legs shorter than tibia + patella of same pair in most cases, rarely the metatarsus the longer more especially in males. Tibia + patella of last legs sometimes a little longer than and sometimes of same length as or, as in the great majority of cases, shorter than the cephalothorax.

Spiders of large or medium size, including the largest forms of the family. There is much variation in coloration, although in the several groups of species the same system or pattern of markings is more or less evident. Most of the larger North American species show a decided tendency to have the ventral surface of the body black in whole or in considerable part, such seeming indeed to be the tendency in large *Lycosidæ* everywhere. The body of the males is in most cases smaller than that of the females, with the legs proportionately much longer and with their several joints of proportionately different lengths.

Lycosas make a white spherical cocoon which only exceptionally shows a seam about its equator, the tissue being normally smooth and homogeneous. The smaller species carry the cocoons about as do the Pardosas, which they resemble also in building no retreats. The larger species, however, during the cocooning season are sedentary. Practically all of these larger species make nests or burrows of some kind, these varying greatly in form and depth. Some of the burrows are deep and have the openings surrounded by a rampart or turret formed of sticks and leaves or of bits of dirt cemented together with silk (*e.g.*, *fatifera*, *arenicola*, *carolinensis*). Other species excavate only shallower pits or nests beneath stones or logs, and surround these excavations with a low rampart of earth or sticks, etc., and which they may occupy only during the cocooning season (*e.g.*, *helluo*).

The genus *Lycosa* as here considered is divisible into a number of groups; but for the most part these are found more or less closely to intergrade when a sufficient number of species are taken into consideration. The most aberrant and distinct of these groups, so far as concerns the American species, is that containing many of the forms referred to *Trochosa* C. K. (*avara* Keys., *gosiuta* new, *cinerea* Fab., *rubicunda* Keys., etc.). The material representing this group that I have been able to study (American forms only) has not been sufficiently extensive and complete to enable me to determine fully the characteristics and value of the group, and therefore the propriety or advantageousness of its separation generically. The forms studied differ from typical Lycosas among other features in having the epigyna as wide as or wider than long with the guide more or less strongly arched at middle, and with the lateral depression, relatively wide and short, tending to subcircular; the lateral ridges commonly low at middle (Pl. XX, fig. 2, *avara;* Pl. XX, fig. 6, *cinerea*). In the male palpal organ the proximal limb of scopus is more strongly developed, being more or less elongate and bent out vertically as a conspicuously salient process (Pl. XX, fig. 1, *avara*). Some but not all species in the group have the stout spine, normally present above at proximal end of the tibiæ of the third and fourth legs in *Lycosa*, replaced by a very elongate, basally stout bristle clearly stouter at base than surrounding hairs, spine-like, but distally gradually extending into a long fine awn. Through some forms of this group a close approach is made to *Allocosa*, which may ultimately have to be withdrawn into the present genus.

Key to Species of Lycosa.

1. Venter of abdomen black in front of genital furrow and in a spot at base of spinnerets, elsewhere pale brown, . *coloradensis* Bks.
   Not so, ... 2.
2. Lower margin of furrow of chelicera armed with but two teeth, . 3.
   Lower margin of furrow armed with three teeth, ... 4.
3. Anterior lateral eyes their diameter from front margin of clypeus, *kochii* (Keys.).
   Anterior lateral eyes once and one-half their diameter from front margin of clypeus, ... *beanii* Em.
4. No spine at all above on tibiæ of legs III and IV, ... 5.
   Spine at middle or both at middle and at proximal end on tibiæ of legs III and IV, ... 6.
5. Dorsum of abdomen with a distinct median dark band along its entire length; light median band on cephalothorax, *arenicola* Sc.
   Dorsum of abdomen without such a dark band; cephalothorax without distinct markings, ... *fatifera* Htz.
6. No true stout spine at base above on tibiæ of legs III and IV, replaced by a basally stout, apically slender and pointed, elongate bristle, ... 7.
   A true robust spine at base above on tibiæ of legs III and IV, 10.
7. Tibia + patella of legs IV less than 3 mm. long, *floridiana* (Bks).
   Tibia + patella of legs IV near 4 mm. long or longer, ... 9.
9. Eyes upon a black patch; legs not marked with dark annuli, *cinerea* Fab.
   Eyes not upon a black patch; legs marked with dark annuli, *rubicunda.*
10. Cephalothorax with a light median longitudinal stripe which is very narrow or line-like anteriorly and which extends forward to or between eyes of second row, ... 11.
    Cephalothorax either without a median band or with a band which is as wide or nearly as wide as the third eye row, . . . 18.

11. Legs strongly banded with black, or if, annulations are indistinct, legs entirely black, ... 12.
Legs yellow or light brown, not at all annulate or with a few dark markings on femora, ... 13.
12. Anterior row of eyes as wide as or a little wider than the second, *aspersa* H.
Anterior row of eyes shorter than the second, . . . *riparia* H.
13. Males, ... 14.
Females, ... 18.
14. Cephalothorax near 10 mm. in length (leg IV not more than 3.25 times as long as cephalothorax), ... *permunda* Chamb.
Cephalothorax under 7.5 mm. in length (leg IV 3.7 or more times as long as cephalothorax), ... 15.
15. Tibia + patella I longer than tibia + patella IV, . *grandis* Bks.
Tibia + patella I shorter than tibia + patella IV, . *helluo* W.
16. Leg IV less than three times the length of cephalothorax, *permunda* Chamb.
Leg IV more than three times the length of cephalothorax, . . 17.
17. Abdomen beneath and the sternum immaculate pale yellow, clothed with yellow hair, ... *grandis* Bks.
Sternum mostly black or nearly so and clothed largely with black hair; abdomen beneath mostly with numerous dark dots and sometimes nearly black, ... *helluo* W.
18. Dorsum of abdomen marked along its entire length by a distinct median dark band, ... 19.
Abdomen not so marked, ... 20.
19. Sternum yellow or light brown; dorsal dark band of abdomen, usually with margins behind dentate or else enclosing along each side a series of small oblique light spots, . . . *scutulata* H.
Sternum black; dorsal band of abdomen with margins always straight and not dentate or enclosing light spots behind, *punctulata* H.
20. Cephalothorax entirely without light bands or spots either at middle or along sides, ... 21.
Cephalothorax with at least a median lighter band or spot, . 22.
21. Sternum and coxæ of legs and usually entire venter of abdomen black; both ends of tibiæ of legs beneath black, . *carolinensis* W.
Sternum light to reddish brown, not black; venter of abdomen not black either in whole or in part, ... *quinaria*.
22. Tibiæ of fourth legs black at both ends beneath, other tibiæ and legs elsewhere unmarked excepting faint brown cross-bars on femora (sternum and venter of abdomen entirely black), *apicata* Bks.
Not so, ... 23.
23. Legs pale brown and entirely without darker markings; venter behind genital furrow black, rarely a pale central spot, *lenta* H.
Legs similar, but patellæ and often distal end of tibiæ black beneath; anterior femora above and posteriorly with fine longitudinal dark lines, posterior femora with faint dark spots; venter as for preceding, . . . *lenta* var. *baltimoriana* (K.).

Not as for *lenta* or its variety, ... 24.

24. All tibiæ black at both ends beneath and the femora black beneath at distal end; large, the cephalothorax 10 mm. or more in length. *carolinensis* W.

Tibiæ and femora not banded thus at ends only beneath; cephalothorax less than 10 mm. long, ... 25.

25. Females, ... 26.

Males, ... 34.

26. Lateral depressed areas of epigynum wide, subcircular, not elongate in the usual way, ... 27.

Epigynum not so, ... 28.

27. Guide bearing a short blunt median process posteriorly; ends of transverse arms not extending forwards freely to or beyond middle of lateral depression or fovea (Pl. XIX, fig. 2), *avara* (Keys.).

No such short median process posteriorly on guide; ends of transverse arms of guide extending forward uncovered to beyond middle of depressed fovea (Pl. XIX, fig. 4), *avara* var. *gosiuta* new.

28. Guide of epigynum inversely T-shaped, the transverse arms relatively slender, ... 29.

Guide enlarged at posterior end, but not inversely T-shaped or anchor-shaped, ... 33.

29. Septum of guide strongly widening from base of transverse arms to anterior end, where it extends entirely or nearly across the median depression, ... 30.

Not so, ... 31.

30. Confining walls of epigynum very wide anteriorly (Pl. XXI, fig, 3), *pratensis* Em.

Not so, the epigynum much like that of *helluo* (Pl. XVII, fig. 1), *floridana* Bks.

31. Transverse piece of guide extending entirely across or almost entirely across epigynum behind, some longer than median piece, scarcely confined by side ridges at ends (Pl. XVIII, fig. 4), *frondicola* Em.

Transverse piece of guide not so long, distinctly confined by ridges at ends, ... 32.

32. Septum widest at its anterior end; lateral walls thick; epigynum as a whole rather wider than long, ... *modesta* Keys.

Not so, septum widest toward middle part of its length, transverse arms usually excavated at ends above; epigynum as a whole roughly triangular, being much narrowed anteriorly (Pl. XVII, fig. 3), ... *erratica* H.

33. Enlarged end portion of guide roughly triangular in shape with the apex behind (Pl. XIX, fig. 8), ... *pictilis* Em.

Expanded end of guide not so shaped, widest behind, where it is truncate (Pl. XXI, fig. 7), ... *gulosa* W.

34. Anterior row of eyes shorter than the second, ... 35.

Anterior row of eyes as long as or longer than the second, . 40.

35. Median pale band of cephalothorax strongly widening anteriorly, passing each side of the eyes and reaching to the clypeus, the full width of which it embraces, ... *albohastata* Em.
Median pale band of cephalothorax not thus in front wider than and enclosing eye area, ... 36.
36. Embolus curving out ventralwards and forward, resting only its apical part obliquely across the auricle (Pl. XXI, fig. 4), *gulosa* W.
Not so, ... 37.
37. Median pale stripe strongly bulging between third eye row and anterior end of dorsal groove, being much wider than third eye row; at front of furrow abruptly narrowed to the width of third eye row, its sides then subparallel to posterior declivity, *pictilis* Em.
Median pale band of cephalothorax not so formed, . . . 38.
38. Dorsum of abdomen with a median light band extending to spinnerets behind, where it ends in a point, enclosing at base a dark lanceolate mark, or with the latter sometimes absent, *erratica* H.
No such distinctly limited light band on dorsum of abdomen, 39.
39. Venter mostly black, ... *modesta* (K.).
Venter brown to yellowish, ... *avara* (K.).
40. Venter with a wide irregularly edged black band extending from epigynum to spinnerets and sometimes embracing entire width of abdomen, ... *frondicola* Em.
Venter with no such broad black band, ... *pratensis* Em.

Lycosa helluo Walckenaer, 1837.

(Insect. Apt., I, p. 337.)

Female.—Cephalothorax deep brown, a narrow light colored median pale stripe which anteriorly becomes line-like and extends forward between the eyes, this median stripe in life covered with light brown pubescence which continues as a median line between the eyes and to the front margin of the clypeus; in most a short curved light line behind each eye of third row and close to the median line; a wider similarly colored and clothed light supramarginal stripe on each side, this stripe usually not distinguishable in front of third eye row; eyes enclosed in black; dark parts of cephalothorax clothed with brown and black hair intermixed, the black most abundant over, and giving its deeper color to, the upper parts of the sides along the borders of the median pale stripe and the area about the eyes. *Chelicerae* black or brownish black, the lateral condyles red at base and black below; clothed with a short yellowish pubescence with some longer, gray-black bristles intermixed, the latter being more numerous distally and forming the dense fringe along the superior margin of the furrow. *Labium* and *endites* black, brown at distal ends. *Sternum* and *coxae* of legs beneath black or brownish black, subdensely clothed with blackish hair, the longer ones of which appear lighter distally. *Legs* yellow or light brown, of usually a distinctly greenish tinge, becoming darker with age; femora paler beneath; in adults in most cases entirely without any dark annuli or other markings or with some narrow, mostly faint darker-cross marks on the femora above (for young specimens *vid.* note *infra.*); clothed with short appressed fine hairs of yellow, and longer black hairs; scopulæ black. *Abdomen* dark brown; above with a black median basal mark which widens from its base to its middle, where it projects on each side in a pointed angle or line, and then narrows to its apex which bifurcates, sending a narrow pointed line caudo-laterally on each side, the margins of the stripe deeper colored than central portion; a short distance back of the apex of the basal mark is a black angular or chevron-shaped transverse mark; and following this behind over the posterior part of dorsum is a series of light brown or yellow chevron-lines, each of which terminates at each of its ends in a circular spot of the same color; each light chevron-line bordered in front by a black line of similar form; lateral part of dorsum mixed black and brown, a large black spot over each antero-lateral angle; sides mostly dark brown with many small spots of yellow and of black; lower parts of sides and the venter brown to yellow with numerous small dots of black, less commonly immaculate, and at other times almost entirely black; abdomen densely clothed with black and yellow hair intermixed, the one predominating on the dark markings, the other on the light. *Spinnerets* brown. *Epigynum* dark reddish brown.

Face rather low, its sides convex and strongly oblique; pars cephalica not elevated above pars thoracica, the dorsal line but little sloping from the third eye row to the posterior declivity, not depressed at middle.

Anterior row of *eyes* nearly as long as the second, a little procurved; anterior median eyes distinctly larger than the lateral, less than their radius apart, about an equal distance from the lateral eyes; anterior lateral eyes separated from the front margin of the clypeus by once and a third their diameter, or little more, the same distance from eyes of second row; eyes of second row three-fourths their diameter apart; cephalothorax 5.5 to 6 times as long as the quadrangle of posterior eyes.

Chelicerae with margins of furrow armed as usual, the first tooth of the inferior margin often with its lower part concealed by a marginal keel extending from base of claw. *Labium* longer than wide (9.5 : 8.75); basal excavations one-third the total length; sides rounded below, above nearly straight, converging to the front margin which is widely truncate or slightly incurved mesally. *Legs* long and stout, tibia + patella of fourth legs distinctly longer than the cephalothorax, the latter being a little longer than tibia + patella of first legs; tarsi of first legs a little curved, those of second legs more slightly so; patella of first legs unarmed; patella of second legs with a single spine on anterior side; spines of anterior tibiæ as usual; both tarsi and metatarsi of three anterior pairs of legs scopulate; scopulæ of third and fourth pairs divided.

Epigynum somewhat oval in outline, with posterior end truncate; guide inversely T-shaped, the septal part enlarging at or above its middle; guide plates widest on transverse arms, narrowing and fading out at middle of septum; furrows broad anteriorly, narrowed strongly behind by the abrupt bulging in of the lateral tubercles. (Pl. XVII, fig. 1.)

Total length, 19.5 mm. Length of cephalothorax, 8.2 mm.; width, 6.8 mm.

Length of leg I, 22.8 mm.; tib. + pat., 8 mm.; met., 4.5 mm.

Length of leg II, 20.2 mm.

Length of leg III, 19.3 mm.

Length of leg IV, 27.8 mm.; tib. + pat., 9 mm.; met., 7.8 mm.

Male.—Much smaller than the female with relatively longer legs. *Cephalothorax* above and *legs* nearly as in the female or lighter. *Sternum* usually more brownish, often divided by a median light line; clothed with long light gray hair. *Coxæ* of legs beneath light brown like the other joints of legs. *Abdomen* colored above as in the female; lower portion of sides and the venter lighter yellow or grayish brown, immaculate or nearly so. *Palpi* yellowish brown, the tarsus darker.

Viewed from above, the tibia is scarcely longer than the patella and is of the same thickness; the tarsus equalling the length of the two preceding joints together; apical portion of tarsus long, seen from below very gradually attenuated, not acute apically. Tenaculum long and slender, projecting ecto-distally, a smaller but similar secondary tenaculum mesally from this and commonly in part or whole concealed. For further structure of bulb see Pl. XVII, fig. 2.

Total length, 11.2 mm. Length of cephalothorax, 5.7 mm.; width, 4.2 mm.

Length of leg I, 17.8 mm.; tib. + pat., 6.1 mm.; met., 4.1 mm.

Length of leg II, 15.8 mm.

Length of leg III, 13.9 mm.

Length of leg IV, 21.2 mm.; tib. + pat., 6.6 mm.; met., 6.1 mm.

Syn.—1837. ?*Lycosa sayi* Walckenaer, Insect. Apt., 1, p. 337.
1846. *Lycosa babingtoni* Blackwall, Ann. and Mag. N. H., 17, p. 30.

1848. ?*Lycosa vafra* (C. Koch), Die Arachn., 14, p. 135, Pl. 490, fig. 1365.
1876. *Trochosa helvipes* Keyserling, Verh. z. b. Ges. Wien, 26, Pl. 7, figs. 35, 36, and Pl. 8, fig. 37.
1885. *Lycosa nidicola* Emerton, Tr. Conn. Acad. Sci., 6, p. 482, Pl. 46, figs. 1 to 1*d*.
1890. *Lycosa babingtoni*, Marx, Proc. U. S. N. M., 12, p. 561.
——. *Lycosa helluo*, Marx, *ibid.*, p. 562.
——. *Lycosa nidicola*, Marx, *ibid.*, p. 562.
——. *Lycosa nidicola*, Stone, Proc. Acad. Nat. Sci. Phila., 42, p. 424.
1891. *Lycosa babingtoni*, Banks, Ent. News, 2, p. 193.
1892. *Lycosa nidicola*. Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 64.
——. *Lycosa similis* Banks, *ibid.*, p. 64, Pl. II, fig. 30.
——. *Lycosa crudelis* Banks, *ibid.*, p. 66, Pl. 3, fig. 37.
——. *Lycosa nidicola*, Marx, Proc. Ent. Soc. W., 2, p. 160.
——. *Lycosa nidicola*, Fox, *ibid.*, p. 269.
1895. *Lycosa babingtoni*, Banks, J. N. Y. Ent. Soc., 3, p. 91.
——. *Lycosa babingtoni*, Banks, Ent. News, 6, p. 205.
1898. *Lycosa babingtoni*, Banks, Proc. Cal. Acad. Sci., p. 268.
1900. *Lycosa babingtoni*. Banks, Proc. Acad. Nat. Sci. Phila., p. 538.
1902. *Lycosa helluo*, Banks, Proc. Acad. Nat. Sci. Phila., p. 586.
——. *Lycosa nidicola* Emerton, Common Sp. U. S., p. 69, figs. 166, 167.
——. *Lycosa nidicola*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 559, Pl. 29, figs. 23, 24.

Type locality.—New York.

Known localities.—Massachusetts, Connecticut, Rhode Island!, New Hampshire!, New York!, Pennsylvania, New Jersey, Maryland, District of Columbia!, Alabama, North Carolina, Georgia, Louisiana, Texas!, Mississippi, Ohio, Indiana!, Illinois!, Iowa!, Kansas!, Colorado, Utah!.

One of the commonest and most widely distributed species, which is subject to much variation in size and in depth of coloration. Because of the abundance of this species it will be well to indicate the color differences presented by partly grown individuals. These have the sternum yellow with a narrow black stripe each side of middle line, the two converging and uniting in front of posterior margin, and also a row of small black dots along each lateral margin; the legs with numerous annulations which are present on all joints except tarsi, with sometimes indications of a median one on these; cephalothorax and abdomen above nearly as in adults; venter yellow with black dots minute.

The female *L. nidicola* builds a shallow excavation or nest under logs and stones along roadsides and in the woods. She lines the nest with silk and often surrounds it with a low rampart of earth or of sticks and leaves. They are frequently met with in these nests with their cocoons in early summer.

Lycosa grandis Banks, 1894.

(J. N. Y. Ent. Soc., p. 49.)

Female.—Coloration and pattern of markings as in *helluo*, but lighter throughout. Median pale stripe of cephalothorax clothed with golden brown pubescence with some gray behind and brown at middle part intermixed; sides clothed with brown and golden brown pubescence intermixed; lateral pale stripes with mostly light gray pubescence, less of brown. *Legs* clear yellowish, the two first pairs of legs darker, more reddish brown distally. *Sternum* and coxæ of legs beneath yellowish brown, like legs, clothed, like the legs also, with grayish yellow intermixed with longer black hairs. *Abdomen* much lighter than in typical Eastern form of *helluo*; dorsum with the typical markings, but these paler and less distinct; the venter pale yellow without markings of any kind, clothed with yellow pubescence. *Epigynum* reddish black. *Spinnerets* pale brown.

Structure and *proportions* and the relations of the *eyes* as in *helluo*. *Epigynum* agreeing in detail with that of *helluo* (Pl. XVII, fig. 1). A specimen from Baja California gave the following measurements:

Total length, 24 mm. Length of cephalothorax, 10.2 mm.; width, 8 mm.

Length of leg I, 25.9 mm.; tib. + pat., 9.8 mm.; met., 5 mm.

Length of leg II, 24 mm.

Length of leg III, 23.7 mm.

Length of leg IV, 33.8 mm.; tib. + pat., 11 mm.; met., 9.6 mm.

Male.—Lighter than the female. *Chelicerœ* pale yellow with light gray or whitish pubescence which is moderately long. *Palpi* pale yellow, the tarsus not darker; tarsus clothed with dense white hair, which occurs also less densely upon the tibia; the patella and femur clothed with yellow hair with some white more sparsely intermixed. *Sternum* and *coxæ* of legs pale yellow, these and the *legs* clothed with light yellow gray pubescence with some black hairs intermixed. *Abdomen* with basal dark mark as usual; middle region of dorsum yellowish, clothed with gray-yellow and brown pubescence intermixed, with on each side behind a row of about six spots of white hair; venter yellow with light gray pubescence.

Tibia + patella of first legs longer than tibia + patella of fourth ones. Tarsus of *palpus* shorter than the two preceding joints together. Structure of palpal organ agreeing in detail with that of *helluo* (Pl. XVII, fig. 2).

A male from Lower California gave the following measurements:

Total length, 14.2 mm. Length of cephalothorax, 7.6 mm.; width, 6.1 mm.

Length of leg I, 27.2 mm.; tib. + pat., 9.8! mm.; met., 6.3 mm.

Length of leg II, 22.9 mm.

Length of leg III, 22.2 mm.
Length of leg IV, 30.3 mm.; tib. + pat., 9.2! mm.; met., 8.8 mm.

Syn.—1895. *Lycosa grandis* Banks, Ann. N. Y. Acad. Sci., 8.
1898. *Lycosa grandis* Banks, Proc. Cal. Acad. Sci.

Type locality.—Colorado.

Known localities.—Colorado; Baja California!.

So far as I have determined, tibia + patella of fourth legs of the male in Eastern specimens of *helluo* is longer than tibia + patella of first pair or sometimes, in *large specimens*, of the same length, whereas the reverse is seen to be true in *grandis*. But as the relative lengths of these two pairs of joints varies in *helluo* and apparently with the size of the individual, the increased relative length of tibia + patella of the first pair, and in fact of the entire first leg, may not be of much significance. The agreement between *helluo* and *grandis* is thus close excepting in color and size, and it might therefore be more proper to place the latter as a variety under the former.

Lycosa floridana Banks.

(Trans. Am. Ent. Soc., XXIII, p. 72.)

Female.—*Cephalothorax* with a median light colored longitudinal band which anteriorly is geminated and is nearly as wide as the eye area, with on each side a narrow supramarginal light brown stripe which is discontinuous, being broken into four or more parts. *Chelicerœ* dark reddish brown. *Sternum* brown, with a black mark along middle. *Legs* brown, with the distal joints darker, blackish brown; femora above with some rather obscure black marks. *Coxœ* brown, all with a black, very distinct line along front face. *Abdomen* above black; sides and lateral part of venter blackish over a yellow ground, mixed yellow and black; venter yellow.

Cephalothorax low, its dorsal line straight and but slightly slanting from the third eye row to the posterior declivity, which is short and steep. *Face* in height more than half the length of the chelicerœ, sides slanting moderately outward from above downward.

Anterior row of *eyes* shorter than the second, rather strongly procurved.

Chelicerœ armed as usual.

Epigynum relatively small, .8 or .9 mm. long; in form and structure very similar to that of *helluo*, but the septum of guide broader and more strongly expanded anteriorly, where it almost extends across the entire depressed area.

Length, 14.2 mm. Length of cephalothorax, 6 mm.; width, 4.3 mm.
Length of leg I, 13 mm.; tib. + pat., 6 mm.; tarsus, 2.1 mm.
Length of leg II, 11.7 mm.
Length of leg III, 11 mm.
Length of leg IV, 15.6 mm.; tib. + pat., 7 mm.; tarsus, 3 mm.
Locality.—Florida!.

Lycosa apicata Banks, 1904.

(Journ. N. Y. Ent. Soc., p. 114, Pl. V, fig. 13.)

Female.—*Cephalothorax* brown, marked with a median paler band as wide anteriorly as the third eye row, between the eyes of which it extends in a tongue-like process forward, this narrower process in life clothed with white hair; the median band constricted at the dorsal groove and extending from there down the posterior declivity as narrower stripe; on each side beginning mesally from the eye of the third row a dark line extends posteriorly through the median pale band to the point of its constriction where it unites with the dark of the sides; a narrow, anteriorly interrupted, supramarginal pale stripe with dentate margin. *Chelicerœ* deep chestnut or reddish black. *Labium* and *endites* reddish black, the former a little paler apically. *Sternum* and *coxœ* of legs beneath black. *Legs* light brown; the femora with darker markings which are more distinct on the posterior pairs; tibiæ of fourth legs black at each end beneath, the metatarsi sometimes also darkened distally; legs elsewhere without evident markings. *Abdomen* above light brown or yellowish; a dark, black-edged, spear-shaped mark which is laterally dentate and blunt or forked at its posterior end; the spear-mark followed posteriorly with a series of dark chevron-shaped transverse marks, which may be separated by corresponding transverse marks of white hair, the chevrons commonly confluent laterally with dark mottlings at the sides and thereby with each other, in other cases confluent mesally with each other and with the basal mark; sides of abdomen above with spots and streaks of brown, pale below; venter entirely black.

Cephalothorax highest at the third eye row, the dorsal line as seen in profile from there a little sloping and nearly straight to the posterior declivity. *Face* relatively low, its sides moderately slanting outward from above below.

Anterior row of *eyes* clearly shorter than the second, a little procurved; anterior median eyes less than their radius apart, about the same distance from the lateral eyes, which are smaller than the median. *Eyes* of the second row less than their diameter apart.

Patellæ of first and second pairs of *legs* armed in front with a short spine. Tibia + patella of first legs about equalling the cephalothorax in length; tibia + patella of fourth legs clearly longer than the cephalothorax and also longer than the metatarsus of same legs.

Cheliceræ armed as usual, the three teeth of lower margin stout.

The *epigynum* having the general form and structure of that of *L. helluo* (Pl. XVII, fig. 1); septum widest anteriorly, its sides nearly straight; transverse arms rather thick.

Total length, 13.5 mm. Length of cephalothorax, 6.3 mm.; width, 4.8 mm.

Length of leg I, 19.3 mm.; tib. + pat., 6.2 mm.; met., 3.8 mm.

Length of leg II, 16.2 mm.

Length of leg III, 16.2 mm.

Length of leg IV, 23.5 mm.; tib. + pat., 7 mm.; met., 6.7 mm.

Male.—Coloration as for the female; but the markings more distinct.

Palpal organ of the general type of that of *L. helluo* (Pl. XVII, fig. 2). The auricula conspicuous, more strongly chitinized than usual, dark in color, turned outward apically. Principal tenaculum relatively shorter, and more outwardly directed than in *helluo.*

Total length, 13 mm. Length of cephalothorax, 6.8 mm.; width, 5 mm.

Length of leg I, 20.7 mm.; tib. + pat., 7 mm.; met., 4.8 mm.

Length of leg II, 19.1 mm.

Length of leg III, 19.1 mm.

Length of leg IV, 25.4 mm.; tib. + pat., 7.8 mm.; met., 7.6 mm.

Syn.—1904. *Lycosa antelucana* Montgomery, Proc. Acad. Nat. Sci. Phila. p. 282, Pl. XVIII, figs. 5 and 6.

Type localities.—Arizona and Texas.

Known localities.—Arizona!, Texas!, New Mexico.

The descriptions above are from type specimens.

Lycosa permunda Chamberlin, 1904.

(Can. Entomologist, p. 286.)

Female.—*Cephalothorax* dark brown; a pale narrow median line extending backward from first eye row, widening abruptly in front of dorsal groove, and then gradually narrowing to a point at posterior margin; a broad light-colored marginal stripe on each side not extending forward farther than the third eye row, its upper margin coarsely dentate, the lower border broken by a few dark dots, but not limited below by a continuous dark line or stripe at margin. *Chelicera* black. *Labium* and *endites* dark brown. *Sternum* dark brown, with a yellow median line. *Legs* brown, darker distally; beneath unmarked, but having a number of dark cross-bars above on femora and posterior tibiæ. *Abdomen* above dark, having the usual lanceolate mark at base, followed by a series of light colored, chevron-formed transverse lines, each ending on each side in a light dot; sides yellowish brown, densely spotted with black; venter also yellowish brown, more sparsely covered with smaller black dots, much as in *helluo*.

Length, 22 mm. Length of cephalothorax, 10.7 mm.; width, 8 mm. Length of leg IV, 30.3 mm.

Male.—Colored nearly like the female, but paler throughout. Marginal stripes of cephalothorax not interrupted below by dark spots. Legs clear brown, without any cross-marking on any joints. Palpi yellowish brown excepting tarsus, which is black.

Length, 20 mm. Length of cephalothorax, 10 mm.; width, 7.5 mm. Length of leg IV, 32.4 mm.

Locality.—Kansas !.

In general appearance the female resembles *helluo*, but is easily separated by structure of epigynum and by various other characters. The male is conspicuously different in its palpal organ and in size, proportion and structure from those of related species.

Lycosa riparia Hentz, 1844.

(J. Bost. Soc. N. H., IV, p. 289.)

Female.—*Cephalothorax* with a narrow median light band, widest at dorsal groove, narrowing anteriorly and continuing as a distinct line between eyes to the clypeus; median band formed of grayish-yellow pubescence; tegument of cephalothorax elsewhere deep brown or reddish brown, black over eye area, clothed with black pubescence, intermixed with fewer yellowish or brownish-gray hairs which are more abundant below but form no distinct band; rufous hairs about the eyes and on the face. *Cheliceræ* black with rufous pubescence over upper half and black pubescence below. *Labium* and *endites* black, brown at tips. *Sternum* and *coxæ* of legs beneath black with longer and stiff black hairs and some short gray pubescence. Ground color of tegument of *legs* dark reddish brown; the tarsi and metatarsi darker, all joints except these two with distinct light and dark rings, the latter being broader, clothed respectively with grayish-brown and black pubescence, tarsi and metatarsi appearing entirely black because of black scopulæ and black pubescence, the shorter brown hairs being few. *Abdomen* above grayish brown, with scattered minute spots of black pubescence; a number of black chevron-marks behind and in front an indistinct outline of a lanceolate mark behind a chevron which is commonly divided mesally into two triangular marks; near the middle of lanceolate outline on each side, the dark line more strongly impressed as a black triangular mark with apex forward; a light spot laterally from upper part of basal mark; behind on each side a series of light spots which may be indistinct; front face of abdomen and antero-lateral angles black; sides dark above, having black pubescence intermixed with brown in fine spots and streaks; in middle the sides are lighter, the brown pubescence being in larger spots. The venter and commonly the lower part of sides black, but, especially at sides, with spots of brown; often brown pubescence in four narrow lines on venter, converging from lung slits to spinnerets, divide the black of venter into three contiguous bands, much as in *aspersa*. *Spinnerets* brown. *Epigynum* black or reddish black.

Face moderate in height, hardly one-half the length of the massive cheliceræ. *Cephalothorax* above nearly straight and horizontal or but little convex between third row of eyes and posterior declivity; the posterior declivity short, only posterior end of dorsal groove being upon it; sides rather strongly bulging behind; sides of face convex and strongly slanting.

First row of *eyes* straight or very nearly so, shorter than second row; anterior median eyes distinctly larger than the lateral, less than their radius apart, closer to the lateral eyes; anterior lateral eyes removed from front margin of clypeus and from eyes of second row by about once and a half their diameter; anterior median eyes less than their diameter from eyes of second row; eyes of second row less than their diameter apart (about three-fourths); quadrangle of posterior eyes about one-fifth as long as the cephalothorax.

Legs long; tibia + patella of fourth legs a little longer than cephalothorax and also longer than metatarsus of same legs; tibia + patella of first pair of same length as cephalothorax; patella of first legs unarmed, patella of second armed anteriorly with a single spine; tibia and metatarsus armed as usual; scopulæ on anterior tarsi and metatarsi as usual; scopulæ of posterior tarsi divided by setose bands as usual.

For form *epigynum* see Pl. XVII, fig. 5.

Total length, 18.5 mm. Length of cephalothorax, 9 mm.; width, 6.9 mm.

Length of leg I, 24.5 mm.; tib. + pat., 9 mm.; met., 8.5 mm.

Length of leg II, 22.8 mm.

Length of leg III, 21.4 mm.

Length of leg IV, 29.6 mm.; tib. + pat., 9.3 mm.; met., 8.5 mm.

Male.—For structure of *palpal organ* see Pl. XVII, fig. 6.

Syn.—1875. *Lycosa riparia* Hentz, Sp. U. S., p. 31, Pl. 3, figs. 13, 15.
—. *Lycosa riparia*, Cragin, Contrib. to Knowl. Arachn., Kansas Bull., Washburn, Coll. 1, No. 4, p. 146.
1890. *Lycosa riparia*, Marx, Proc. U. S. N. M., 12, p. 563.
1900. *Lycosa riparia*, Banks, Proc. Acad. Nat. Sci. Phila., p. 539.

Type localities.—North Carolina, Alabama.

Habitat.—North Carolina!, South Carolina, Alabama!, Georgia!, Louisiana!, Mississippi, Virginia, West Virginia, District of Columbia!, Kansas, Texas.

"This common spider is aquatic in its habits, always found near or on water, and diving with ease under the surface when threatened or pursued" (Hentz).

Lycosa aspersa Hentz, 1844.

(Bost. Journ. Nat. Hist., IV, p. 389, Pl. XVII, figs. 11, 12.)

Female.—*Cephalothorax* dark reddish brown, blackish about the eyes; a lighter uneven-edged marginal band on each side, and a similarly colored narrow median stripe more or less distinct; sides of cephalothorax densely clothed with black pubescence with more scattered hairs of yellowish intermixed; the narrow median stripe clothed with yellowish or golden-brown hair, which forms a bright stripe which continues forward as a line between the eyes and reaches the anterior row, the stripe expanding posteriorly about the dorsal groove and then again narrowing down the posterior declivity to the posterior margin; the middle stripe of pubescence sometimes obscure in middle region, but always bright at anterior and posterior portions; along each side similar yellowish hair forms a narrow marginal stripe which is narrower than the broader supramarginal stripe of tegument; front margin of clypeus at middle with a fringe of yellowish hair. *Chelicerœ*, including claws, black, clothed with moderately long black pubescence without any short paler hairs. *Endites* and *labium* brown-black, lighter at tips. *Sternum* black, a narrow light colored median line anteriorly; clothed with black hair. *Coxæ* of legs beneath black, lighter, yellowish brown, laterally, at base beneath a similarly colored light spot which is mostly acutely pointed distally. *Legs* brown, of light shade in young specimens, becoming dark reddish brown with age, deeper colored distally; all joints excepting the tarsi and the metatarsi with light cross-bands which are distinct above, especially on femora, but which may be obscure beneath; light rings much more distinct in young specimens than in old, and in the latter on the posterior pairs of legs than on the anterior; legs densely clothed with long black hairs intermixed with shorter yellowish pubescence, the latter mostly confined to the lighter bands in tegument.

Abdomen above very dark; a basal black mark with end behind forked and followed by a series of chevron-marks, all the marks usually indistinct in older specimens, in which the entire dorsum is black or nearly so; dorsum clothed in life with black and grayish-brown pubescence, the lighter pubescence more concentrated anteriorly and antero-laterally, and also forming some mostly obscure transverse chevron-marks behind; in dark specimens the sides are dark or black-streaked and spotted below with yellow pubescence, with the yellow sometimes predominating over the black; venter with numerous spots and streaks of yellow pubescence usually arranged mostly in four lines or stripes converging to the spinnerets, and thus dividing the dark into three bands similarly converging caudally. *Spinnerets* brown. *Epigynum* reddish brown.

Face rather low, not fully half as high as the cheliceræ are long, the latter long and massive, considerably longer than the face is wide in front. *Cephalothorax* not high, dorsal line highest at third eye row, from there being nearly straight to the posterior declivity.

Anterior row of *eyes* as wide as or slightly wider than the second, nearly straight; anterior median eyes less than their radius apart, about as far from lateral eyes; anterior lateral eyes a little more than two-thirds as large in diameter as the median, once and one-half their diameter from front margin of clypeus, closer to eyes of second row; eyes of second row a little less than their diameter apart; eyes of third row three-fourths as large as the second, twice as far from each other as from the second; cephalothorax 6.5 times the length of the quadrangle of posterior eyes.

Chelicerœ armed as usual. *Labium* longer than wide (8.5 : 8): basal excavation as usual; sides strongly convexly bulging, the curvature less above than below; front margin wide, concave for nearly entire width (Pl. IX, fig. 9). *Legs* stout; tibia + patella IV shorter than the cephalothorax; metatarsus IV of nearly same length as the width of the cephalothorax; tarsi I and II slightly curved, III and IV straight; tarsi scopulate as usual, the scopulæ on legs I and II extending also over metatarsi and over all but basal portion of tibiæ: spines of tibiæ as usual.

For structure of *epigynum* see Pl. XVII, fig. 7.

Total length, 23 mm. Length of cephalothorax, 10.6 mm.; width, 8.2 mm.

Length of leg I, 25.6 mm.; tib. + pat., 9.3 mm.; met., 5.1 mm.

Length of leg II, 23.2 mm.

Length of leg III, 21.5 mm.

Length of leg IV, 30.1 mm.; tib. + pat., 9.8 mm.; met., 8.3 mm.

Male.—Much lighter in *color* than the female, but the color patterns are nearly the same. The lighter pubescence is much more abundant on *cephalothorax* than in the female, much predominating over that of blackish color. *Legs* much lighter with the yellow pubescence dense, while the longer black hairs are comparatively sparse; femora with transverse dark bands above, but these indistinct or absent at sides and ventrally; distinct dark rings on tibiæ. *Labium* and *endites* sometimes colored as in female but often much lighter, almost yellow. *Coxæ* of legs beneath with black on ventral surface, often reduced to a few spots at distal end, the coxæ being elsewhere yellow. On the *abdomen* also the yellow and brown pubescence predominates over the black, the latter appearing over the black basal band (which is distinct, widest toward posterior end and pointed anteriorly), over the antero-lateral angles and in variously formed spots and streaks laterally, most of the dorsum being thus in life of a golden brown color; venter usually yellow with some spots of black, less often as in the female.

The *chelicera* clothed on basal half with long golden yellow hairs, distally with black hairs.

Tibia + patella IV longer than the cephalothorax, of same length as the metatarsus; patellæ I and II armed in front and behind.

For structure of palpal organ see Pl. XVII, fig. 8.

Total length, 18 mm. Length of cephalothorax, 9.1 mm.; greatest width, 7.2 mm.

Length of leg I, 30.1 mm.; tib. + pat., 10 mm.; met., 7.4 mm.

Length of leg II, 27.8 mm.

Length of leg III, 26.2 mm.

Length of leg IV, 35 mm.; tib. + pat., 10.5 mm.; met., 10.5 mm.

Syn.—1876. *Tarentula inhonesta* Keyserling, Verh. z. b. Ges. Wien, 26, p. 634, Pl. 7, fig. 17.
1878. *Tarentula tigrina* McCook.
1885. *Lycosa vulpina* Emerton, Tr. Conn. Acad. Sci., 6, p. 487, Pl. 47, fig. 2.
1890. *Tarentula inhonesta*, Marx, Proc. U. S. N. M., 12.
——. *Lycosa vulpina*, Marx, *ibid.*
1890. *Lycosa tigrina*, Stone, Proc. Acad. Nat. Sci. Phila., 42, p. 423.
1892. *Lycosa vulpina*, Banks, *op. cit.*, 44, p. 67, Pl. I, fig. 39.
——. *Lycosa tigrina*, Marx, Proc. Ent. Soc. W., 2, p. 160.
——. *Lycosa tigrina*, Fox, *ibid.*, p. 538.
1898. *Lycosa tigrina*, Simon, Hist. Nat. Araign., 2.
1900. *Lycosa fatifera*, Banks, Proc. Acad. Nat. Sci., Phila., p. 538.
1902. *Lycosa inhonesta*, Montgomery, *op. cit.*, p. 557, Pl. 29, figs. 21, 22.
1904. *Lycosa inhonesta*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 290, Pl. XX, figs. 38, 39.

Type locality.—"North America."

Known localities.—Massachusetts, Rhode Island, New York!, New

Jersey, Pennsylvania, District of Columbia, Alabama, Georgia!, Indiana, Kansas!.

A well-known species of burrowing habits.

Lycosa arenicola Scudder, 1877.

(Psyche, 2, p. 2.)

Female.—Tegument of *cephalothorax* dark reddish brown to blackish, scarcely lighter above; a median lighter band a little wider than third eye row in front, strongly narrowed anteriorly to dorsal groove and usually expanding again back of groove; the band chiefly produced by a finer gray or white pubescence intermixed with coarser brown, the tegument beneath being usually but little lighter than on sides; sides of cephalothorax covered with brown pubescence, gray hairs scattered but showing more abundantly below, especially posteriorly. *Chelicerœ* dark reddish brown to nearly black, clothed with a dense coat of rusty brown colored pubescence, fringe along furrow of cheliceræ brighter, reddish or coffee colored. *Labium* and *endites* dark reddish brown, paler distally. *Sternum* dark reddish brown to nearly black. Anterior *coxæ* of legs dark brown to nearly black, posterior coxæ lighter. *Legs* reddish brown, the anterior pairs darker than the posterior; the femora, patellæ and tibiæ of the first and second legs nearly black beneath; distal ends of posterior tarsi and metatarsi usually darker; legs clothed with dense coat of mixed gray and brown pubescence and longer dark brown bristles, scopulæ brown. *Abdomen* densely pubescent; a dark brown median band on dorsum reaching to the spinnerets behind, which just in front of middle has on each side a broad indentation, and which has behind the middle a series of narrow paired indentations; the band covered or largely formed by dark brown pubescence. Sides of dorsum grayish brown, the pubescence being brown and gray intermixed, the brown more abundant above; a dark brown band of same color as median one crossing each antero-lateral angle and running obliquely backward and downward, meeting the venter back of middle. *Venter* brown to dark brown, usually a darker band from genital furrow to spinnerets. *Epigynum* dark reddish brown. *Spinnerets* brown.

Cephalothorax wide in front; in profile second eyes seem to be lower down on face than usual, highest at third eye row; pars cephalica convex; posterior declivity beginning on *pars cephalica* a considerable distance in front of thoracic furrow, making the declivity very long and the posterior portion of cephalothorax very low and exaggerating apparent height of front part. *Face* moderate in height, not fully half the length of the cheliceræ, protruding above over base; sides convex, slanting below.

Anterior row of *eyes* almost as wide as second, a little procurved; anterior median eyes larger than the lateral, not fully their radius apart, about as close as to lateral eyes; anterior lateral eyes their diameter from eyes of second row, twice their diameter from front margin of clypeus; eyes of second row their diameter or slightly more than their diameter apart, not fully half as far again from eyes of third row. Quadrangle of posterior eyes hardly one-fifth the length of the cephalothorax.

Lower margin of furrow of *cheliceræ* with three equal teeth, the upper margin with three as usual; the smaller teeth above more than usually stout.

Legs distinctly increasing in thickness from the fourth to the first, the first conspicuously stoutest; tarsi and metatarsi I and II densely scopulate; tarsus III with scopula divided by a median setose band; tarsus IV with scopulæ much reduced, the scopular hairs being sparse along each side, the setose band occupying most of ventral surface; tibiæ I and II and metatarsi I and II armed as usual, the spines of tibiæ usually slender and easily rubbed off or overlooked; patellæ I and II each armed in front with a spine; tibiæ III and IV without true spines above; femora I and II bent forward, IV backward, less so; III nearly straight. Tibia + patella IV shorter than cephalothorax; metatarsus IV much shorter than tibia + patella, but longer than tibia, less than width of cephalothorax.

For structure of epigynum see Pl. XX, fig. 9.

Total length, 20.2 mm. Length of cephalothorax, 10.1 mm.; width, 7.3 mm.

Length of leg I, 23 mm.; tib. + pat., 8.1 mm.; met., 4.9 mm.

Length of leg II, 20.5 mm.

Length of leg III, 19.9 mm.

Length of leg IV, 26.3 mm.; tib. + pat., 9 mm.; met., 6.9 mm.

Syn.—1881. *Tarentula nidifex* Marx, Am. Nat., p. 396.

1885. *Lycosa nidifex* (Marx) Emerton, Trans. Conn. Acad., VI, p. 487, Pl. 47, figs. 4, 4*a*.

1888. *Lycosa arenicola* Scudder, McCook, Proc. Acad. Nat. Sci. Phila., 1888, p. 333.

1889. *Lycosa arenicola* Scudder, Marx, Araneæ N. A., pp. 561 and 594, note 3*d*.

1890. *Lycosa arenicola* Scudder, Stone, Proc. Acad. Nat. Sci. Phila.

1892. *Lycosa arenicola* Scudder, Marx, Proc. E. S. W., II, p. 160.

1895. *Lycosa arenicola* Scudder, Banks, J. N. Y. E. S., III, p. 91.

1898. *Lycosa arenicola* Scudder, Simon, Hist. Nat., II, p. 341.

1902. *Lycosa arenicola* Scudder, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 550, Pl. XXIX, fig. 13.
1904. *Geolycosa arenicola*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 299.

Known localities.—Massachusetts, Rhode Island!, Connecticut!, New York (Long Island!), New Jersey, District of Columbia, Pennsylvania, Maryland, Virginia, Indiana.

This species is our best known turret builder. Its burrows are commonly from 10 to 12 inches deep, often one-half inch wide, and are surmounted by turrets usually one and one-half inches in height.

Lycosa fatifera Hentz, 1842.

(Bost. J. N. Hist., IV, p. 229, Pl. 2, fig. 8.)

Female.—*Cephalothorax* with dark red-brown tegument, often blackish about eyes; clothed with tawny colored or rufous pubescence and showing no markings. *Chelicerœ* dark reddish brown, with brown or grayish-brown pubescence, rufous distally along furrow. *Labium* and *endites* reddish brown, lighter at tips. *Sternum* and *coxœ* of leg beneath light or yellowish brown, clothed with gray pubescence. *Legs* reddish brown; the femora beneath much lighter, yellowish; the tibiæ, tarsi and metatarsi commonly much darker, especially in anterior pairs clothed with grayish pubescence; scopulæ brown. *Abdomen* above dark brown, clothed with dense brown or tawny pubescence; venter with light, sometimes grayish-brown pubescence. *Spinnerets* brown. *Epigynum* dark reddish brown.

Cephalothorax very wide in front, nearly five-sixths as wide as behind, the sides but little bulging. In profile the cephalothorax is seen to have pars cephalica large and convex; highest between eyes of third row and dorsal groove; posterior declivity long, the median furrow being upon its upper portion. *Face* appearing rather high, but only slightly, if at all, more than half the length of the massive chelicerœ; sides convex and slanting as usual. First row of *eyes* as long as second, a little procurved; anterior median eyes more than their radius apart, as far from the anterior lateral eyes which are smaller; anterior lateral eyes more than their diameter from eyes of the second row, more than once and a half their diameter from front margin of clypeus; anterior median eyes their diameter from eyes of second row, or nearly so; eyes of second row their diameter apart; quadrangle of posterior eyes about one-sixth the length of the cephalothorax. *Legs* rather short and stout; the fourth pair two and one-half times the length of the cephalothorax; the second pair twice as long as the cephalothorax; tibia + patella IV shorter than the cephalothorax, same length as tibia +

patella I; metatarsus IV shorter than tibia + patella IV by one-third of its own length; first and second tarsi and metatarsi and distal end of tibiæ scopulate; tarsi III and IV with scopulæ divided by a median setose band; patella I and III armed in front (within) with a single spine.

The *epigynum* of *Lycosa fatifera* is very much like that of *Lycosa lenta*, but is smaller, being not more than half as long, also the septal piece of the guide in *lenta* is more than two and one-fourth times as long as the cross-piece, whereas it is less than twice as long in *fatifera*; the cross-piece is also somewhat differently shaped in the two (Pl. XX, fig. 8.)

Total length, 17.5 mm. Length of cephalothorax, 9.3 mm.; width, 6.5 mm.

Length of leg I, 20.5 mm.; tib. + pat., 8 mm.; met., 4.4 mm.

Length of leg II, 18.7 mm.

Length of leg III, 16.4 mm.

Length of leg IV, 23.5 mm.; tib. + pat., 8 mm.; met., 6.1 mm.

Type locality.—Alabama.

Known localities.—Alabama!, Georgia!, Texas, Missouri!, Kansas!, Illinois, Utah!.

Syn.—1832. *Lycosa fatifera* Sill, J. Sc. and Arts (ad. part.), pp. 106–107.
1875. *Lycosa fatifera* Hentz, Spiders of U. S. (Burgess), p. 26, Pl. 2, fig. 8.
1895. *Lycosa missouriensis* Banks, Ent. News., Vol. IV, p. 206.
1899. *Lycosa domifex* Hancock, Ent. News, Vol. X, p. 26.
1904. *Geolycosa latifrons* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 295, Pl. XIX, figs. 15–18.

It seems very probable that Hentz, in his notes on habits, has confounded two species under the name *fatifera*; but the description and the figure which he gives can hardly be applicable to any other species than the one under consideration. The description and figure indicate a form without distinct markings, and his statement that a "piceous variety is found in Alabama, with the two first joints of the legs pectus and abdomen yellowish underneath, or lighter in color," applies perfectly to some specimens of the form above described which I have from this same locality, and which is very common there and must have been well known to Hentz. This form fits only his description of *fatifera* among all treated by him. The species which Hentz observed living in holes in Massachusetts, and which he says is common there, may have been *L. aspersa* (*inhonesta*), as has been suggested by Banks, but far more likely it was *arenicola*, the common turret builder of that region. Hentz says: "Cheliceres covered with rufous hairs," which is not so in most specimens of *aspersa*. The strong markings of *aspersa* would not have been passed over. However, Hentz would seem to have written his description after he had been in the South and away from Massachusetts for many years, and doubtless had before him only the Southern form, which he erroneously supposed to be the same as the turret builder he recalled as common in Massachusetts. Old and rubbed specimens of *arenicola* might appear similar, as the markings in this form are due to color of the hair. Whatever Northern form it was the habits of which Hentz had in mind, it was long ago separated under another name, and this common and widespread Southern form which Hentz undoubtedly described as and called *fatifera* must logically continue to bear this name.

The species has been found abundant in the "sandy waters bordering the lower end of Lake Michigan" by Mr. J. C. Hancock ('99) who says: "Patches of high grass, sedges and ragweeds made the open lay of ground a paradise of running spiders. Here it was the castle-building species [termed by him *domifex*] seemed perfectly at home, showing its varied accomplishments to best advantage. The artfully-hidden castle is not apparent to the uninitiated while walking over the ground, as it is commonly secreted in a recess of overhanging dried grass. . . . . When one remembers the average size of the adult castle, only five-eighths of an inch high and a little over one-half inch in diameter, it is obvious that close inspection is quite essential. Usually the spider's tube is constructed vertically in the ground, unless obstructions cause some deviations. . . . . Old spiders live in their burrows for more than a season and often remodel them after being injured by storms. Younger specimens re-dig outgrown burrows, enlarging them as occasion requires. . . . . . Materials used in the construction of the turrets were green and dried grass leaves, dried fine sedges, leaves of foxtail grass, fibrous roots, etc. Young specimens not infrequently build a perfect little tower, almost entirely of stones, and one I have in mind had nine such particles made into a compact edifice five millimeters high. The masonry was exquisitely put up, every stone bearing out true proportions about the central opening of four millimeters diameter. Silk used as cement held the whole together securely."

The author has found the burrows of this species abundant over grassy stretches on the foothills near Salt Lake City. In the case of some burrows no turrets are present; but in most cases turrets of dried sticks, grass or earth are found.

Lycosa lenta Hentz, 1844.

(J. Bost. Nat. Hist., IV, p. 386.)

Female.—Tegument of *cephalothorax* reddish brown as usual, lighter brown in a median band which may be very indistinct anteriorly, also lighter along margins, with radiating light lines connecting middle and side bands; clothed principally with light gray pubescence, which is densest in a rather wide marginal band each side and in a middle band, widening from eyes until as wide as eye area at point between eyes and dorsal groove and then suddenly narrowed to only about half as wide, and from there very gradually narrowing caudad; the median band and lateral band of gray on each side connected by radiating lines of same color; on the sides a dark brown pubescence intermixed with the line of gray and more abundant above, below the median gray band. *Cheliceræ* black, the lateral condyles red, clothed with a dense light gray or yellowish gray pubescence. *Labium* and *endites* black or dark brown-black, lighter distally. *Sternum* and *coxæ* of legs beneath black or dark brown-black, clothed with gray and longer, stiffer dark brown or blackish pubescence. *Legs* brown to yellowish, clothed with light gray to brown-gray pubescence; scopulæ brown; legs without rings or markings above. *Abdomen* gray-brown from gray and brown pubescence intermixed, usually in fine streaks and dots; a lanceolate outline or more rarely solid mark at base which is truncated or bifurcated behind; on posterior half a few more indistinct chevron-marks, each bordered behind by a light line, ending in a light spot each side; a row of triangular dark spots on each side behind but connected by the light cross-lines. Sides of abdomen light gray, immaculate or with a few spots of brown. Venter in front of lung-slits brown or gray, often black along the middle; behind lung-slits solid black or sometimes with a light central spot surrounded with black. *Spinnerets* brown. *Epigynum* dark reddish brown.

Cephalothorax high, highest a little behind third eye row, line of dorsum a little convex; dorsal groove partly above and partly on posterior declivity. *Face* hardly above half the length of the long and massive cheliceræ, the sides convex and slanting about as usual.

Anterior row of *eyes* a little shorter than the second, nearly straight; anterior median eyes distinctly larger than the lateral (3 : 2), less than their radius apart and about the same distance from the lateral; anterior lateral eyes a little more than their diameter from front margin of clypeus, scarcely closer to eyes of second row; anterior median eyes less than their diameter from eyes of second row; eyes of second row less than three-fourths their diameter apart; quadrangle of posterior eyes not fully one-fifth the length of the cephalothorax.

Legs moderately long and stout; the posterior tarsi rather slender; tibia + patella IV shorter than cephalothorax; patella I and II armed in front with a spine; tibiæ and metatarsi I and II armed below as usual, the spines small and weak; tarsi and metatarsi I and II scopulate as usual; the scopulæ of tarsi III and IV divided by rather narrow median setose bands.

For structure of *epigynum* see Pl. XVIII, fig. 8.

Total length, 22 mm. Length of cephalothorax, 11 mm.; width, 7.8 mm.

Length of leg I, 28.1 mm.; tib. + pat., 10 mm.; met., 6 mm.

Length of leg II, 25.4 mm.

Length of leg III, 25 mm.

Length of leg IV, 32.1 mm.; tib. + pat., 10 mm.; met., 9.2 mm.

Male.—Coloration nearly as in female.

Chelicerœ above with light yellow-gray pubescence; pubescence on distal portion dark, but fringe along furrow light gray.

Patella I and II armed both in front and behind; spines on tibiæ and metatarsi I and II comparatively long, not reduced as in female. Patella and tibia about equal in length and stoutness, together as long as the tarsus which is distinctly thicker.

For structure of *palpal organ* see Pl. XVIII, fig. 8.

Total length, 20.5 mm. Length of cephalothorax, 10.5 mm.; width, 8 mm.

Length of leg I, 35.7 mm.; tib. + pat., 12.2 mm.; met., 8.8 mm.

Length of leg II, 33 mm.

Length of leg III, 30.4 mm.

Length of leg IV, 40 mm.; tib. + pat., 12.5 mm.; met., 11.6 mm.

Syn.—1844. *Lycosa ruricola* Hentz, J. Bost. Nat. Hist., p. 387.
1875. *Lycosa lenta* Hentz, Sp. of U. S., p. 27, Pl. 3, figs. 1, 2, 3, 4.
——. *Lycosa ruricola* Hentz, *ibid.*, p. 28, Pl. 3, figs. 5, 6.
1890. *Lycosa lenta*, Marx, Proc. U. S. N. M., 12.
1892. *Lycosa ruricola* Hentz, Marx, Proc. Ent. Soc. W., II, p. 160.
1898. *Lycosa lenta* Hentz, Simon, Hist. Nat. des. Araign., II, p. 333.
1900. *Lycosa lenta* Hentz, Banks, Proc. Acad. Nat. Sci. Phila., p. 538.

Locality.—Pennsylvania, North and South Carolina.

Known localities.—Pennsylvania, North Carolina!, South Carolina, Alabama!, Georgia, Florida.

It would seem probable that Hentz did not in all cases distinguish this form from his *erratica*, and that his account applies partly to the latter species. What he regarded as the typical form, however, was a burrow-making species, although, like *carolinensis*, etc., found wandering about and hiding under stones, for in his discussions of *erratica* he says: "This species I formerly supposed to be a variety of *L. lenta*, but it was always found wandering and *never in holes*. I therefore consider it as perfectly distinct, having been often seen running in the grass." Concerning *lenta* he remarks: "This common and powerful species is found wandering in fields, attacking and subduing very large insects. The female carries her young on her back, which gives her a horrible appearance. If caught or wounded the little ones escape rapidly in all directions; but the mother is faithful to her duties and defends her progeny while life endures. It hides under stones, logs, etc."

Var. **baltimoriana** (Keyserling), 1876.

(Sub *Tarentula*, Verh. z. b. Ges. Wien, 26, p. 632.)

Patellæ and distal ends of tibiæ black beneath; femora of the first and second legs with a dark line along posterior side and one or two similar ones above, these replaced with corresponding rows of dots on posterior femora. Otherwise agreeing with type form.

Syn.—1890. *Tarentula baltimoriana*, Marx, Proc. U. S. N. M., 12, p. 563.
1902. *Lycosa baltimoriana*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 561, Pl. 29, fig. 25.
1904. *Lycosa baltimoriana*, Banks, J. N. Y. Ent. Soc., XII, p. 114.
——. *Geolycosa baltimoriana*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 297.

Type locality.—Baltimore, Md.

Known localities.—Rhode Island, Pennsylvania, Maryland, District of Columbia, Virginia, Texas.

I have seen too few specimens of this form to be able to determine satisfactorily the validity of its rank as a variety. It is maintained here as such tentatively. Females showing the variant colors are not known to me personally, nor have such been reported.

Lycosa carolinensis Walckenaer, 1837.

(Insect. Apt., p. 285).

Female.—Tegument of *cephalothorax* uniformly dark reddish brown covered with a dense coat of brown and gray hair making it more or less mouse-colored, showing in fully grown individuals commonly no distinct markings; in some a gray supramarginal band on each side and a similar median one along the dorsum, widening from behind anteriorly. *Chelicerœ* black, covered with a coat of orange-yellow hairs with more sparse long brown bristles; the dense fringe along furrow reddish brown or rust colored. *Labium* and *endites* black, brown at tips. *Sternum* and *coxæ* of legs beneath black, covered with brown hairs. Tegument of *legs* reddish brown, darker distally, paler on ventral surface of femora; on ventral surface at distal end of femur and at both ends of tibia black, these dark bands covered with dark brown hair; the scopulæ of same brown color, but legs elsewhere clothed with much lighter hair which is light brownish gray to whitish. *Abdomen* with the tegument light brown; at base a dark or blackish median stripe which bifurcates at its caudal end and sends out from its sides several pairs of pointed lines directed caudo-laterally; behind the basal stripe a series of chevron-shaped laterally and anteriorly acutely pointed dark cross-marks, often a series of light dots along each side; dorsum densely covered above with long brown to grayish-brown pubescence, except over the dark marks which are clothed and made more distinct by black hair; sides of abdomen above dark with brown and black pubescence intermixed in spots and streaks, the sides below becoming paler, yellow to gray or almost white with larger but more sparse black spots; venter nearly always deep brown or black, due largely to the pubescence being very dense and of the latter color; sometimes a light mark or spot within the light area on each side of middle line, leaving three black stripes converging and uniting in front of the spinnerets and united by a cross-bar behind the genital furrow, while in other rarer cases the reduction of the black may be carried even farther. *Spinnerets* brown. *Epigynum* reddish black.

Face in height moderate, more than half the length of the cheliceræ; sides strongly convex and moderately slanting outward below, not so steep as in *scutulata*.

Anterior row of *eyes* nearly as long as the second, but little procurved; anterior median eyes not fully their radius apart, a little farther from the lateral eyes which are a little smaller; clypeus wide, the anterior lateral eyes more than one and one-half times their diameter, or rather nearer twice from its front margin, closer to eyes of second row; eyes of second row not proportionately large, not much less than their diameter apart; eyes of third row twice as far apart as from those of second row; quadrangle of posterior eyes relatively short, being not fully one-sixth the length of the cephalothorax.

Chelicerae long and very robust, the margins of its furrows armed in typical manner. *Labium* a little longer than wide (12.5 : 11.75); basal excavation one-third or a little more the total length; labium above excavations broadly rectangular, as wide above as below, the sides nearly parallel and scarcely curved, antero-lateral angles rounded; front margin widely truncate. *Legs* long and robust; tibia + patella IV shorter than the cephalothorax, of same length or nearly so as tibia + patella I; spines of anterior tibiæ beneath as usual; patella I and II each armed on the anterior side with a single spine; anterior tarsi and metatarsi beneath with dense scopular pads which extend also over tibiæ except at basal third or half; scopulæ of posterior legs not extending upon tibiæ, divided as usual.

Epigynum oblong, rounded anteriorly; guide inversely T-shaped with the transverse arm shorter and stouter; lateral furrows narrow and of same width throughout. (Pl. XXI, fig. 1.)

Total length, 34.5 mm. Length of cephalothorax, 14 mm.; width, 11.mm.

Length of leg I, 38.7 mm.; tib. + pat., 13.2 mm.; met., 8 mm.

Length of leg II, 35 mm.

Length of leg III, 31.7 mm.

Length of leg IV, 42 mm.; tib. + pat., 13.2 mm.; met., 10.8 mm.

Male.—Rather lighter in color than the female. *Chelicerœ* very densely covered with grayish-yellow hair, the heavy fringe of the furrow rufous.

Patellæ of legs I and II armed both in front and behind.

Patella and tibia of *palpus* of nearly same length and thickness, the tibia enlarging distally; tarsus a little shorter than the two preceding joints together. For structure of tarsal organ see Pl. XXI, fig. 2.

Total length, 21 mm. Length of cephalothorax, 11.1 mm.; width 8.6 mm.

Length of leg I, 35.7 mm.; tib. + pat., 12.2 mm.; met., 8.3 mm.

Length of leg II, 32.3 mm.

Length of leg III, 28.7 mm.

Length of leg IV, 40.2 mm.; tib. + pat., 12.3 mm.; met., 11.5 mm.

Syn.—1842. *Lycosa carolinensis?*, Bosc MSS., Hentz, J. B. Soc. N. H., 4, p. 230.

1852. *Lycosa pilosa* Girard, Marcy's Expl. Red R. of La., p. 252, Pl. 16, figs. 4 and 5.

1875. *Lycosa carolinensis?*, Bosc MSS., Hentz, Sp. of U. S., p. 27, Pl. 2, fig. 9.

1885. *Lycosa carolinensis* Hentz, Emerton, Tr. Conn. Acad. Sci., 6, p. 486, Pl. 47, figs. 1 to 1*b*.

1890. *Lycosa carolinensis*, Marx, Proc. U. S. N. M., 12, p. 561.

——. *Lycosa carolinensis*, Stone, Proc. Acad. Nat. Sci. Phila., 42, p. 423.

1892. *Lycosa carolinensis*, Marx, Proc. Ent. Soc. W., 2, p. 160.

——. *Lycosa carolinensis*, Fox, Proc. Ent. Soc. W., 2, p. 269.

1894. *Lycosa carolinensis*, Banks, J. N. Y. Ent. Soc., 2, p. 50.

1895. *Lycosa carolinensis*, Banks, Ann. N. Y. Acad. Sci., 8, p. 429.

——. *Lycosa carolinensis*, Banks, Ent. News, 6, p. 205.

1896. *Lycosa carolinensis*, Banks, J. N. Y. E. Soc., 4, p. 192.

1898. *Lycosa carolinensis*, Simon, Hist. Nat. Araign., 2, pp. 332 and 347.

1900. *Lycosa carolinensis*, Banks, Proc. Acad. Nat. Sci. Phila., p. 538.

1902. *Lycosa carolinensis*, Banks, Proc. Acad. Nat. Sci., Phila. p. 586.

1902. *Lycosa carolinensis*, Emerton, Common Sp. U. S., p. 73, fig. 176.

——. *Lycosa carolinensis*, Montgomery, Proc. Acad. Nat. Sci. Phila., 556.

1904. *Geolycosa texana* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 293, Pl. XVIII, figs. 13, 14 (color var.).

——. *Geolycosa carolinensis*, Montgomery, *ibid.*, p. 299.

Type locality.—"Carolina."

Known localities.—New Hampshire!, Massachusetts, Rhode Island!, Connecticut, New York!, New Jersey, Pennsylvania, District of Columbia!, North Carolina!, Georgia, Alabama, Florida, Louisiana, Mississippi!, Texas!, Kansas!, Indiana, Colorado, Utah!.

Our largest *Lycosa*, much resembling in its large size and in coloration the famous *Tarentula* of southern Europe and its close allies. Specimens from the Southwest often differ from the typical form in having the venter in part pale as above described.

"This spider has the same habits as *L. fatifera*, making deep excavations in the ground. It is frequently found under stones, and possibly it is in such places, nearer the surface, that the eggs are hatched. The female carries her young on her back, presenting a hideous aspect, being then apparently covered with animated warts. The little monsters have the instinct, if the mother is much disturbed, to escape and scatter in all directions. The male, not unfrequently of an enormous size, is often found wandering in October and November in Alabama, and sometimes enters houses" (Hentz). Concerning its habits in New England, Emerton says: "This species digs a hole six or eight inches deep, but is often found under stones or running in fields and occasionally in houses all over New England."

This species is common in Utah, where the males are frequently seen wandering in the open or hiding under stones. The females dig deep burrows which are sometimes surmounted with turrets, but not so commonly so as in the case of *fatifera*.

Lycosa coloradensis Banks, 1894.

(J. N. Y. Ent. Soc., p. 50.)

Female.—Tegument of *cephalothorax* reddish brown, densely clothed with pubescence which nearly completely masks the ground color. A median light band as wide anteriorly as the eye area, but abruptly narrowed at dorsal groove to only half that width or less; this median band formed of brown-gray pubescence, often mixed anteriorly with darker pubescence which obscures the distinctness of the band. Sides of cephalothorax clothed with dark, brownish to grayish black pubescence, mixed with gray like that of median band, the gray predominating, principally arranged in wide radiating bands and becoming more abundant below, where it forms on each side a marginal band which is widest anteriorly where it nearly touches eye area. *Chelicera* with tegument blackish or reddish black, completely masked on upper half with dense pubescence of rusty brown color, that of lower half dark and very sparse, paler along furrow of *cheliceræ*. *Labium* and *endites* black or nearly so, lighter at tips. *Sternum* and *coxæ* of legs beneath black or nearly so. *Femora* of legs beneath light gray, the tibiæ and more especially the tarsi and metatarsi darker brown because of scopulæ, the ends of femora and of last four tibiæ black; above the femora a little darker than below, brown, but distal joints no darker, no bands at end of any joints showing above. *Legs* densely clothed with pubescence which give the colors as above, the tegument itself being reddish brown above and much paler, yellowish, beneath except at ends of femora and last two pairs of tibiæ which are black. *Abdomen* with middle of dorsum light brown or grayish brown, a dark brown basal lanceolate mark with its margins deeper, its points behind terminating in the apex of a dark chevron-mark, which is followed behind by several other chevrons. The lanceolate mark giving off laterally most commonly two pairs of lines running latero-caudally on each side; side of dorsum dark brown or blackish with numerous small light dots and enclosing on each side a series of large light spots along sides of chevrons, and at outer ends of the lines from basal mark an ocellate light spot contiguous with each side of basal spear-mark near its middle. Upper portion of sides dark brown to black with numerous light spots and darker, below the sides are gray with dark brown or black spots. Venter in front of lung-slits and in a smaller spot at base of spinnerets black, elsewhere gray, with or without small dots of black. *Spinnerets* dark brown. *Epigynum* black or reddish black.

Cephalothorax behind rather low; in profile highest at third eye row or a little behind it, a little depressed or notched at dorsal groove. *Face* low, one-half in height the length of the cheliceræ.

Front row of *eyes* shorter than second; eyes of first row very nearly equal in size; eyes of second row three-fourths their diameter apart; anterior lateral eyes their diameter from eyes of second row, closer still to front margin of clypeus; quadrangle of posterior eyes one-fifth the length of the cephalothorax.

Leg IV less than three times the length of the cephalothorax; tibia + patella IV shorter than cephalothorax, longer than metatarsus; metatarsus IV nearly of same length tib. + pat. I; metatarsi and tarsi I and II scopulate; tarsi III and IV with wide setose bands dividing scopulæ. Tibiæ I and II armed as usual. Patella II armed in front with a single spine.

For structure of *epigynum* see Pl. XVIII, fig. 6.

Total length, 18 mm. Length of cephalothorax, 8 mm.; width, 6 mm.

Length of leg I, 18.4 mm.; tib. + pat., 5.9 mm.; met., 4 mm.
Length of leg II, 17.8 mm.
Length of leg III, 17.3 mm.
Length of leg IV, 22.5 mm.; tib. + pat., 7.2 mm.; met., 6 mm.

Male.—Coloration similar to female; pattern on abdomen rather more distinct and spots on sides fewer.

Patella I and II armed both in front and behind. Tibia and patella of palpus subequal in length and thickness, together as long as tarsus; tarsus much thicker than preceding joints.

For structure of palpal organ see Pl. XVIII, fig. 7.

Total length, 13.3 mm. Length of cephalothorax, 6.7 mm.; width, 5 mm.

Length of leg I, 23.6 mm.; tib. + pat., 8.1 mm.; met., 5.9 mm.
Length of leg II, 21.8 mm.
Length of leg III, 19.3 mm.
Length of leg IV, 26.3 mm.; tib. + pat., 8.1 mm.; met., 7.6 mm.

Type locality.—Colorado.

Known localities.—Colorado!, Arizona!, New Mexico, Kansas!.

Lycosa erratica Hentz, 1842.

(Journ. Bost. Soc. Nat. Hist., 4, p. 388.)

Female.—Sides of *cephalothorax* blackish brown, less commonly paler; a reddish yellow or reddish brown median band, narrowest behind, which widens distinctly at posterior end of pars cephalica and becomes as wide as third eye row, from which point it contracts to a narrow stripe or line which continues forward to the first eye row; along each lateral margin a light band similarly colored to the median one, the lateral bands bisected by a dark line at least anteriorly; the median pale band clothed with light gray or brownish-white pubescence which between the eyes becomes yellowish, the lateral bands similarly clothed; sides of cephalothorax clothed with similar hair intermixed with much black which is most abundant along each side of the median band, but becomes more and more sparse below toward the margins. *Chelicerœ* dark reddish brown, clothed with short yellowish pubescence and with intermixed longer black bristles, a fringe of long dark gray hair along the margin of furrow. *Labium* and *endites* reddish brown. *Sternum* blackish, with usually a paler median stripe; clothed with grayish brown and more scattered blackish hairs. *Legs* and *palpi* brown covered with a short brownish gray pubescence with the usual longer blackish hairs intermixed; all femora with dark cross-bands or annulations which are present also at the ends and in the middle of the tarsi and metatarsi and at the middle of the patellæ of the posterior pairs, but which are not present on these joints of the anterior pairs; the dark annuli on the femora mostly incomplete below; the anterior and posterior face of each femur commonly with a longitudinal black line or stripe. *Abdomen* with a wide pale band over the dorsum, narrowing usually to a point at the spinnerets; within the pale band at base a dark, black-edged, lanceolate mark which extends to or often much beyond the middle, ending usually in a forked apex and followed behind usually by a triangular mark and several dark cross-lines; at other times the basal stripe ends acutely; less commonly it is entirely absent; sides of dorsum laterad of light band dark brown enclosing a series of large angular black spots; sides above brown becoming lighter below, usually marked with numerous small black spots; venter whitish or light yellow, without spots, but in the great majority of cases marked by a black U-shaped stripe, each arm of which has its end behind a lung-slit, the bent middle part being at the spinnerets, the arm of the U-shaped band often connected by a cross-band behind the genital furrow; sometimes the venter is entirely pale without any markings. *Epigynum* reddish brown. *Spinnerets* smoky brown to black.

Face moderate in height, the chelicerae about one and three-fourths times as long; sides convex and moderately divergent below. Anterior row of *eyes* moderately procurved, shorter than the second by twice the diameter of a lateral eye; anterior median eyes their radius apart, closer to the smaller lateral eyes; anterior lateral eyes their diameter from eyes of second row, a little farther from margin of clypeus; eyes of second row their diameter apart, not much farther from the three-fourths as large eyes of the third row; eyes of third row twice as far from each other as from eyes of second row; cephalothorax rather less than five times the length of the cephalothorax. *Chelicerœ* armed as usual, the third tooth of lower margin of furrow a little reduced. *Labium* much longer than wide (16 : 12.5); basal excavation of usual length; sides evenly convexly curved from excavations to anterior angles; front margin truncate. *Legs* long, the distal joints slender, especially so the posterior metatarsi; tibia + patella IV longer than cephalothorax which is longer than tibia + patella I; anterior tibiæ with spines as usual; scopulæ of tarsi as usual, those of anterior pairs extending also upon metatarsi except at base; patella II armed within.

Ends of transverse arms of guide of *epigynum* almost always characteristically excavated on anterior side of ends (Pl. XVII, fig. 3).

Total length, 14 mm. Length of cephalothorax, 5.4 mm.; width, 4 mm.

Length of leg I, 14.6 mm.; tib. + pat., 5 mm.; met., 2.9 mm.

Length of leg II, 13.9 mm.

Length of leg III, 13.2 mm.

Length of leg IV, 19.3 mm.; tib. + pat., 5.9 mm.; met., 4.9 mm.

Male.—Coloration as in female but rather brighter.

For structure of palpal organ see Pl. XVII, fig. 4.

Syn.—1844. *Lycosa sagittata* Hentz.
1846. *Lycosa propinqua* Blackwall, 1846 (Ann. and Mag. Nat. Hist., Vol. XVII, pp. 31, 32).
1875. *Lycosa erratica* Hentz, Sp. U. S. (Burgess), p. 29, Pl. 3, fig. 8.
1876. *Tarentula lepida* Keyserling, Verh. z. b. Ges. Wien, 26, p. 631, Pl. 7, fig. 15.
1877. *Tarentula scalaris*, Thorell, Bull. U. S. Geol. Surv. Terr., III, No. 2, p. 520.
1885. *Lycosa communis* Emerton, Trans. Conn. Acad. Sci., 6, p. 489.
1890. *Lycosa erratica*, Marx, Proc. U. S. N. M., 12, p. 561.
——. *Lycosa communis*, Marx, *loc. cit.*
——. *Lycosa communis*, Stone, Proc. Acad. Nat. Sci. Phila., 42, p. 426.
1891. *Lycosa erratica*, Banks, Ent. News, 2, p. 86.
1892. *Lycosa communis*, Marx, Proc. Ent. Soc. W., 2, p. 160.
——. *Lycosa communis*, Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 64.
——. *Lycosa communis*, Fox, Proc. Ent. Soc. W., 2, p. 269.
1895. *Lycosa erratica*, Banks, J. N. Y. Ent. Soc., Vol. 3, p. 91.
——. *Lycosa erratica*, Banks, Ent. News, 6, p. 205.
1898. *Lycosa erratica*, Simon, Hist. Nat. Araign., 2, p. 331.
1900. *Lycosa erratica*, Banks, Proc. Acad. Nat. Sci. Phila., p. 538.
1902. *Lycosa communis*, Emerton, Common Sp. of U. S., p. 75, figs. 181, 182.
——. *Lycosa lepida*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 562, Pl. 29, figs. 26, 27.
1904. *Lycosa lepida*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 287.

Type locality.—Massachusetts and Alabama.

Known localities.—Massachusetts!, Connecticut, Rhode Island!, New Hampshire!, New York!, Pennsylvania, New Jersey, District of Columbia!, Alabama, Louisiana!, Texas, Georgia!, North Carolina!, Ohio, Illinois, Iowa!, Kansas!, Colorado!, Arizona!, Utah!, Montana!.

I do not think there is room for doubt that the species above described is the real *erratica* of Hentz, when one considers the abdominal markings shown in his figure, in connection with his comments on habits and the localities where he found it common.

Hentz says concerning this species that it "was always found wandering and never in holes; . . . . it was often seen, generally running in the grass." This is a very common and widely distributed species, found under stones and logs in the woods and especially in grassy meadows. It is subject to much variation in size, though its characteristic markings are rarely missed.

Lycosa scutulata Hentz, 1842.

(Journ. Bost. Soc. Nat. Hist., IV, p. 390.)

Female.—*Cephalothorax* with a dark chocolate-colored band each side of the middle line which is widest behind and narrowing forward is prolonged over the eyes of the corresponding side to the front margin of the clypeus, and in young specimens continues down the cheliceræ of the same side to near its distal end; these bands are covered with a blackish pubescence with intermixed lighter yellowish hairs; between these dark bands is a narrower yellowish-brown median band which is much constricted between the last two rows of eyes, but expands again upon the face before reaching the margin of clypeus, this band clothed with yellowish-gray pubescence, clear yellow in front; the sides of cephalothorax below dark bands colored and clothed similarly to median band with below a chocolate-colored submarginal line. *Cheliceræ* reddish brown covered with yellowish or grayish-yellow pubescence at the distal end, within along the femora a fringe of longer hair of somewhat rusty tinge. *Labium* reddish brown, clothed with a grayish or tawny pubescence with intermixed longer, stiffer black hair. *Sternum, endites* and *coxæ* of legs beneath light brown. *Legs* and *palpi* light brown, the tarsi and metatarsi mostly darker, as also the tibiæ at distal ends; the femora with some rather faint longitudinal darker lines clothed with tawny pubescence with intermixed hair of blackish color, the longer ones of the latter pale on distal halves. *Abdomen* with a broad blackish median band extending the entire length narrowed from near middle towards each end, this band covered with intermixed dark brown and blackish pubescence, the band indentated with a brownish-yellow notch on each side in front of middle and behind either with a series of similar indentations of yellow or enclosing corresponding pairs of submarginal spots; each side of median band a narrow brownish band appearing yellow because covered by a dense coat of yellowish pubescence; sides with tegument brown, sheathed with lines of blackish-brown and yellowish pubescence above, paler yellow with black spots below. Tegument of venter brown, densely clothed with yellow pubescence and with small spots of black pubescence, mostly arranged over one or two pairs of darker lines converging toward the spinnerets. *Spinnerets* rather dark brown. *Epigynum* blackish.

Smaller specimens are paler, and the venter may be without spots and unmarked except for faint indications of the posteriorly converging lines.

Cephalothorax highest at third row of eyes, dorsal line in profile a little depressed at front of median groove. *Face* high, two-thirds as high as cheliceræ are long, in profile slightly convex and protrudes a little above. Anterior row of *eyes* procurved, shorter than the second by twice their diameter; eyes subequal in size and nearly equidistant, being separated from each other by a space rather less than their radius; anterior lateral eyes more than their diameter from the front margin of clypeus, closer to the eyes of second row; eyes of second row large, less than their diameter apart; eyes of third row two-thirds as large as those of the second, nearly twice as far from each other as from eyes of second row; cephalothorax five times as long as quadrangle of posterior eyes. Margins of furrow of the cheliceræ armed as usual, the third tooth of the lower margin a little reduced. *Labium* much longer than wide (19 : 16); basal excavation one-third the total length or rather longer; sides below straight and subparallel to middle, then straight and converging to angles in front; front margin very gently convex laterally and indented at middle. *Legs* long and slender; the posterior tarsi slender and nearly as long as tibia + patella; all tarsi densely scopulate, the scopulæ clearly divided on posterior pairs by a narrow median setose band, on the anterior pairs the scopulæ extend also upon the metatarsi entirely to the base and even upon the tibiæ distally.

For structure of *epigynum* see Pl. XVII, fig. 9.

Total length, 21.5 mm. Length of cephalothorax, 10 mm.; width, 7.6 mm.

Length of leg I, 32.6 mm.; tib. + pat., 10.8 mm.; met., 7.8 mm.

Length of leg II, 28.4 mm.

Length of leg III, 21.7 mm.

Length of leg IV, 38.8 mm.; tib. + pat., 12.2 mm.; met., 11.8 mm.

Male.—Front pair of *legs* dark reddish brown to black, excepting tarsus and proximal end of femur, above which are lighter; other legs light brown. Anterior half of median dorsal stripe of abdomen black and distinctly darker than posterior half. *Venter* gray, immaculate. *Chelicerœ* brown with yellow pubescence.

Patella I and II armed in front and behind.

For structure of palpus see Pl. XVIII, fig. 1.

Total length, 11 mm. Length of cephalothorax, 6 mm.; width, 4.7 mm.

Length of leg I, 21.6 mm.; tib. + pat., 7.2 mm.; met., 5.6 mm.

Length of leg II, 20.5 mm.

Length of leg III, 17.8 mm.

Length of leg IV, 25.8 mm.; tib. + pat., 7.7 mm.; met., 8.1 mm.

Syn.—1875. *Lycosa scutulata.*
1875. *Lycosa scutulata.*
1890. *Lycosa scutulata* Marx, Proc. U. S. N. M., XII, p. 563.

1890. *Lycosa scutulata* Hentz, Stone, Proc. Acad. Nat. Sci. Phila., p. 427.
1892. *Lycosa scutulata* Hentz, Banks, Proc. Acad. Nat. Sci. Phila., 1892, p. 66.
——. *Lycosa scutulata* Marx, Hentz, Proc. Ent. Soc. Wash., II, p. 160.
1895. *Lycosa scutulata* Hentz, Banks, J. N. Y. Ent. Soc., Vol. III, p. 91.
——. *Lycosa scutulata* Hentz, Banks, Ent. News, IV, p. 205.
1897. *Lycosa scutulata* Hentz, Banks, Proc. Ent. Soc. Wash., Vol. IV, p. 189.
1898. *Lycosa scutulata* Hentz, Banks, Proc. Col. Acad. Sci., 3d ser., Zool., Vol. I, p. 268.
——. *Lycosa scutulata* Hentz, Simon, Hist. Nat. Araign., Vol. II, pp. 329, 330, 346.
1900. *Lycosa scutulata* Hentz, Banks, Proc. Acad. Nat. Sci. Phila., p. 538.
1902. *Lycosa scutulata* Hentz, Emerton, Common Sp. of U. S., p. 76.
——. *Lycosa scutulata* Hentz, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 553.
1904. *Lycosa scutulata* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 289.

Type location.—Alabama.

Known localities.—Alabama, North Carolina!, Georgia!, Florida, Louisiana!, Mississippi, Texas, Connecticut, New York!, Pennsylvania, New Jersey, District of Columbia, Ohio, Indiana!, Illinois, Iowa!, Kansas!.

Hentz remarks as follows concerning *Lycosa scutulata* after his original description: "This common and very distinct species attains a very large stature. It is most commonly found wandering in quest of prey. . . . The cocoon is very large, spherical and whitish, containing from 150 to 200 eggs, which hatch before the cocoon is opened. The yellow spots on the abdomen seem to be wanting in the young" (*Sp. U. S.*, p. 32).

Lycosa punctulata Hentz, 1842.

(J. Bost. Soc. N. Hist., 4, p. 390.)

Cephalothorax light brown, with each side of the middle a blackish-brown stripe which runs forward over eyes of the corresponding side and reaches the front margin of the clypeus as a much narrower line, also on each side a very narrow marginal and a wider submarginal blackish line; the median light band is narrower than the dark bands enclosing it; between the eyes of the third and second row it is narrowed to a line but widens again above eyes of first row; the dark bands of cephalothorax are clothed with dark somewhat smoky-brown pubescence, the light regions covered with a grayish-brown pubescence about the eyes are longer. *Chelicerœ* black, clothed with short light yellowish pubescence and some mostly very long blackish bristles; at the distal end within along the furrow a fringe of long yellow or rusty yellow hairs. *Labium* and *endites* dark reddish brown; light distally. *Sternum* black, clothed with grayish-brown pubescence. *Coxœ* dark reddish brown. *Legs* elsewhere brown; the distal ends of the tibiæ and metatarsi of the last legs usually darker, legs otherwise without markings; covered with a very stout pale pubescence and with longer straight blackish bristles which are denser than in *scutulata*; the longer bristles appear paler distally as in *scutulata*. Tegument in general brown, blackish brown along a wide median band extending the entire length of the *abdomen*, the band widest in middle, covered by intermixed black and deep brown pubescence with longer black bristles; margin of middle black band smooth, not broken by indentations or enclosed lighter spots; the black pubescence more dense at borders of its median band, the brown over its middle; each side of middle band a grayish-brown stripe; exterior to gray stripes the sides are colored with brown and grayish brown intermingled in spots and streaks, the brown often solid at the antero-lateral angles; sides below and the venter gray with very small spots of black, the venter with a variable number of larger black spots, sometimes also with one or more continuous dark patches. *Epigynum* dark reddish brown to black. *Spinnerets* brown.

Cephalothorax narrow, highest behind second row of eyes; sides rather weakly rounded, high, with the sides steep. *Face* high, rather more than two-thirds as high as the cheliceræ are long, the sides steep and but moderately convex. Anterior row of *eyes* moderately strongly procurved, shorter than second row by about twice the diameter of an anterior eye; anterior median eyes their radius apart, farther from the slightly smaller lateral eyes; anterior lateral eyes scarcely their diameter from the front margin of the clypeus, much farther from the eyes of the second row; eyes of the second row less than their diameter apart; eyes of third row about two-thirds as large as those of the second; quadrangle of posterior eyes one-fifth as long as cephalothorax. *Cheliceræ* armed as usual.

Legs long and moderately slender, the last tarsi slender but not proportionately long; all femora conspicuously flattened laterally, each of the two posterior ones on each side concavated behind and bent conspicuously backward, the two anterior ones concavated in front side and bent forward; anterior tibiæ and metatarsi armed beneath as usual, all tarsi densely scopulate beneath, the posterior ones clearly bisected by a narrow median setose band; the anterior metatarsi also scopulate for most of the entire distance to their bases, but the posterior metatarsi not at all scopulate.

For structure of *epigynum* see Pl. XVIII, fig. 2.

Total length, 16.4 mm. Length of cephalothorax, 7 mm.; width, 5 mm.

Length of leg I, 20 mm.; tib. + pat., 7.4 mm.; met., 4 mm.

Length of leg II, 17.9 mm.

Length of leg III, 16.6 mm.

Length of leg IV, 22.6 mm.; tib. + pat., 7.5 mm.; met., 6.6 mm.

Male.—Chelicerœ black, covered, but not densely, with black pubescence; fringe along furrow pale rufous. *Legs* yellowish or pale brown, the joints beyond patella of anterior pairs darker, reddish brown; distal ends of tibia and metatarsus of leg IV darker blackish. The hair of middle stripe of dorsum of *abdomen*, except black margins, is rufous or nearly so, the light stripes bounding it are made by golden-yellow hair. Venter with a wide median black band, which is widest at its anterior end where it spreads out back of lung-slits.

Patella I and II armed both in front and behind.

For structure of palpal organ see Pl. XVIII, fig. 3.

Total length, 15 mm. Length of cephalothorax, 7.3 mm.; width, 5.5 mm.

Length of leg I, 23.2 mm.; tib. + pat., 8.4 mm.; met., 5 mm.

Length of leg II, 21.9 mm.

Length of leg III, 18.6 mm.

Length of leg IV, 29 mm.; tib. + pat., 9 mm.; met., 9 mm.

Syn.—1842. *Lycosa punctulata* Hentz, J. Bost. Soc. Nat. Hist., p. 390.
1875. *Lycosa punctulata* Hentz, Spiders of U. S., p. 31, Pl. 3, figs. 16, 17.
1885. *Lycosa punctulata*, Emerton, Trans. Conn. Ac., IV, p. 490.
1890. *Lycosa punctulata*, Marx, Proc. U. S. N. M., 12, p. 563.
Non.-Syn.———. *Lycosa punctulata* Hentz, Stone, Proc. Acad. Nat. Sci. Phila.
1892. *Lycosa punctulata*, Banks, Proc. Acad. Nat. Sci. Phila.
——. *Lycosa punctulata*, Hentz, Fox, Proc. Ent. Soc. W., 2, p. 269.
——. *Lycosa punctulata*, Marx, Proc. Ent. Soc. Wash., II, p. 160.
1895. *Lycosa punctulata*, Banks, J. N. Y. Ent. Soc., 3, p. 91.
1900. *Lycosa punctulata*, Banks, Proc. Acad. Nat. Sci. Phila., p. 538.
1902. *Lycosa punctulata*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 552.
1904. *Lycosa punctulata*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 288.

Type location.—Pennsylvania.

Known localities.—Pennsylvania, North Carolina!, Georgia!, Alabama, Florida, Louisiana!, Mississippi!, Massachusetts, Connecticut, Rhode Island!, Indiana!, Ohio.

Lycosa frondicola Emerton, 1885.

(Trans. Conn. Acad. Sci., 6, p. 484, Pl. 46, figs. 3 to 3*b*.)

Female.—Sides of *cephalothorax* dark brown above, lighter toward margin; a median light brown band which is widest just behind the eye area, where it is wider than the third row; from there it very gradually narrows caudally and anteriorly passes broadly between the eyes of the third row to those of the second; the median band in life densely clothed with light gray pubescence; sides of cephalothorax clothed with mixed black and gray pubescence, the gray predominating, increasing in abundance from above below and finally forming a narrow marginal light gray stripe in which the hair is unmixed with any black. *Cheliceræ* black, clothed over basal portion with light brown pubescence, distally with black. *Labium* and *endites* dark reddish or blackish brown, lighter at tips. *Sternum* and *coxæ* of legs beneath dark reddish-brown to black, the coxæ somewhat paler basally; clothed with black hair. *Legs* brown or reddish brown with some dark annulations on the femora, which may be indistinct and which are commonly incomplete above and below; the patellæ, tibiæ and metatarsi of the posterior pairs of legs also normally annulate with dark, the patellæ showing one ring, the tibiæ two and the metatarsi three; the anterior legs not marked beyond the femora; legs densely clothed with gray pubescence, longer black hairs sparse. *Abdomen* above grayish brown, the pubescence being mixed gray and brown, the gray sometimes arranged over entire dorsum in minute spots and streaks; black pubescence over two angular spots close together in front of middle, these spots forming the angular lateral portion of an elsewhere faint basal lanceolate outline which bifurcates at its posterior end; a number of less distinct dark transverse chevron-lines behind; a black band or spot crossing over each antero-lateral angle caudally, with pubescence of same color, this band dissolving in the gray and brown pubescence behind; sides of abdomen light brown, densely covered with gray and brown pubescence, these sometimes uniformly mingled but more commonly intermixed in numerous small spots and streaks; venter with a wide median band of black back of spinnerets, the edges of which are uneven, this band frequently occupying the entire venter; at times the dark band is entirely absent. *Epigynum* reddish brown. *Spinnerets* brown.

Face low and wide, in height less than half the length of the cheliceræ, sides rounded and strongly slanting. Dorsal line of cephalothorax highest between third eye row and dorsal groove, being convex between eyes and the posterior declivity.

Anterior row of *eyes* but slightly procurved, nearly or quite as wide as the second; anterior median eyes their radius apart, closer to the somewhat smaller lateral eyes; anterior lateral eyes one and one-half times their diameter from the front margin of clypeus, less than their diameter from eyes of second row; eyes of second row considerably less than their diameter apart; eyes of third row more than twice as far from each other as from eyes of second row; quadrangle of posterior eyes a little more than one-sixth as long as the cephalothorax.

Chelicerœ massive; margins of furrow armed as usual. *Labium* a little longer than wide (16 : 15); basal excavation as usual; attenuated anteriorly, the sides below well rounded convexly, straight above; front margin incurved or concave for its entire length. *Legs* strong, moderately slender distally; tibia + patella IV evidently shorter than the cephalothorax, the metatarsus a little longer than or nearly of the same length as the width of the cephalothorax; tarsi and metatarsi I and II scopulate beneath, tarsi III and IV as usual; spines of anterior tibiæ as usual; patella II armed anteriorly.

Side ridges and furrows of the *epigynum* are of the usual form; the guide is of the inversely T-shaped form, the septal piece is enlarged or widened at its middle, being thus more or less fusiform, being narrow adjacent to the transverse arms; transverse piece as long as or a little longer than the median, its arms passing well out laterally behind the lateral tubercles and being scarcely confined at the ends; guide plates along front of tranverse arms narrow, even more so upon posterior end of septum where they fade out (Pl. XVIII, fig. 4).

Total length, 13 mm. Length of cephalothorax, 6.5 mm.; width, 4.7 mm.

Length of leg I, 14.6 mm.; tib. + pat., 5.3 mm.; met., 3.1 mm.
Length of leg II, 13.9 mm.
Length of leg III, 12.6 mm.
Length of leg IV, 18.5 mm.; tib. + pat., 5.8 mm.; met., 5 mm.

Male.—Cephalothorax in color nearly as in the female. *Legs* lighter. *Abdomen* with the black bands over the antero-lateral angles more distinctly continuing caudally as a dark band along sides of dorsum, this band behind frequently breaking up into oblique lines and spots; abdomen otherwise as in the female.

Patella I and II armed both in front and behind.

Apical portion of tarsus of *palpus* evidently shorter than the bulb, acute; auricle large and broad, the terminal part of embolus lying in it clearly exposed; tenaculum at base horizontal and rather stout, then bent forward rather abruptly and becoming very slender. (Pl. XVIII, fig. 5.)

Total length, 10 mm. Length of cephalothorax, 5.2 mm.; width, 4 mm.

Length of leg I, 14.1 mm.; tib. + pat., 4.9 mm.; met., 3.2 mm.
Length of leg II, 12.6 mm.
Length of leg III, 11.5 mm.
Length of leg IV, 15.7 mm.; tib. + pat., 5 mm.; met., 4.8 mm.

Syn.—1877. *Tarentula modesta* Thorell, Bull. U. S. G. S. Terr., 3, No. 2, p. 520 (name preoccupied by *modesta* Keys.).
1885. *Lycosa nigroventris* Emerton, Tr. Conn. Acad. Sci., 6, p. 488, Pl. 47, figs. 5 to 5*b*.
1890. *Tarentula pudens* Marx, Proc. U. S. N. M., 12, p. 564.
——. *Lycosa frondicola*, Marx, *ibid.*, p. 561.
——. *Lycosa frondicola*, Stone, Proc. Acad. Nat. Sci. Phila., 42, p. 426.
1892. *Lycosa frondicola*, Marx, Proc. Ent. Soc. W., 2, p. 160.
——. *Lycosa frondicola*, Fox, *op. cit.*, p. 269.
——. *Lycosa frondicola*, Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 64.
1894. *Lycosa modesta*, Banks, J. N. Y. E. Soc., 2, p. 50.
1895. *Lycosa modesta*, Banks, Ann. N. Y. Ac. Sci., 8, p. 429.
——. *Lycosa frondicola*, Banks, J. N. Y. Ent. Soc., 3, p. 91.
1902. *Lycosa frondicola*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 561, Pl. 30, figs. 28, 29.
1904. *Trochosa frondicola*, Montgomery, *ibid.*, p. 306.

Type locality.—Massachusetts.

Known localities.—Massachusetts!, New Hampshire!, Connecticut, Rhode Island!, New York, New Jersey, Pennsylvania, District of Columbia!, Ohio, Indiana, Illinois, Iowa!, Kansas!, Montana!, Utah!, Colorado!, Arizona!.

From a study of specimens from various places in the West, I am convinced that the species described by Thorell from Colorado as *Tarentula modesta* is the same as the Eastern *L. frondicola*, and Thorell's name would have to be used except that it is preoccupied by Keyserling's species. In 1890 Marx proposed the name *pudens* to take the place of *modesta*; but as the species had been described by Emerton in 1885 as *frondicola*, the latter name must stand. A study of the male specimen upon which *L. nigroventris* was based convinces me that it is the same as *frondicola*.

L. frondicola is a widely distributed species, common especially in the central, northern and mountainous parts of the United States. It is found most frequently in and at the edges of woods, among fallen leaves and sticks. Specimens from the dryer parts of the West, as with various other species, show a tendency to lose the dark coloration, especially that of the venter. Some specimens have the venter entirely pale.

Lycosa pratensis Emerton, 1885.

(Trans. Conn. Acad., VI, p. 483, Pl. XLVI, figs. 4, 4*a*, 4*b*.)

Female.—A wide median light band, widest between third eye row and dorsal groove, and from there narrowing backward to end of *cephalothorax*, commonly constricted or indented at groove, also narrowing and passing forward between eyes of third row and reaching those of second row. Tegument of middle band light reddish brown clothed with yellowish or brownish-gray pubescence, usually two dark longitudinal lines in wide part in front of dorsal groove; on each side, at a distance above margin greater than its own width, a narrow light band colored like the median one; elsewhere the tegument deep brown, clothed mostly with dark to blackish-brown pubescence, with grayish intermixed. *Chelicerae* dark reddish brown with grayish-brown pubescence. *Labium* and *endites* dark brown, inclined to be lighter at tips. *Sternum* reddish brown, sparsely clothed with a few short hairs of light color and more numerous long bristles of black. *Coxæ* of legs beneath brown, grayish-yellow pubescence much more abundant than on sternum. *Legs* brown, darker distally, at least femora with rather faint darker rings, which on the two anterior pairs are most distinct on the meso-caudal aspect and on the two posterior pairs on the meso-cephalic aspect; clothed with shorter grayish-yellow pubescence and longer blackish or blackish-brown hair. *Abdomen* in general color reddish brown, lighter beneath; above with a complicated pattern of black lines, in part as follows: at base a lanceolate outline, giving off on each side near apical third a line running caudo-laterally to dark area at sides, its tip at middle touching apex of a chevron-mark which is followed caudally by a number of similar marks; each chevron-mark commonly double or paired, *i.e.*, consisting of two parallel chevrons separated by a light line, except sometimes at ends; on each side of chevrons irregular darker spots and blotches. The tegument of the sides with spots of black, but that of venter unmarked. The pubescence of the abdomen is yellowish-gray and brown in life, or in dry specimens, the pubescence largely concealing the complicated markings of the tegument and so arranged as to produce above two rows of light spots more or less connected by transverse light lines. Sides with light and dark pubescence, more or less in streaks and spots, but venter without markings. *Spinnerets* brown. *Epigynum* dark reddish brown.

Face low, less than half the length of the cheliceræ (1 : 2.4), sides convex, widely slanting, about as wide at base as length of cheliceræ, high and narrow; in profile dorsal line rather strongly convex. Anterior part of head rounded, the space between third and second rows of eyes sloping rather strongly; the first row of eyes projecting forward so as to be seen clearly from above.

Front row of *eyes* straight or slightly recurved, slightly longer than the second; anterior median eyes their radius apart, closer to the but little smaller side eyes; anterior lateral eyes about their diameter from the front margin of clypeus, closer to eyes of second row; eyes of second row not more than two-thirds their diameter apart; eyes of third row scarcely smaller than of second, their diameter from latter, more than twice as far from each other; quadrangle of posterior eyes about one-fifth as long as the cephalothorax.

Lower margin of furrow of the *chelicerœ* armed with three equidistant conical teeth, these equal in size, the third no smaller than the first. The upper margin with three teeth, the middle, as usual, much largest, the first and third about equal, both usually contiguous with base of second, or the third slightly removed.

Legs short and moderately slender; tibia + patella of fourth legs shorter than the cephalothorax; metatarsus of fourth legs much shorter than tibia + patella; anterior tarsi slightly curved, others straight; two anterior pair of femora slightly bent forward, last pair slightly bent backward; first and second tarsi scopulate; third and fourth tarsi not truly scopulate, subdensely setulose; tibiæ and metatarsi of first and second legs armed beneath as usual, patella of these legs unarmed.

Epigynum as figured (Pl. XXI, fig. 3).

Total length, 13 mm. Length of cephalothorax, 5.1 mm.; width, 3.8 mm.

Length of leg I, 10.9 mm.; tib. + pat., 4.1 mm.; met., 2.1 mm.

Length of leg II, 10.6 mm.

Length of leg III, 9.2 mm.

Length of leg IV, 14 mm.; tib. + pat., 4.8 mm.; met., 3.3 mm.

Syn.—1890. *Lycosa pratensis*, Marx, Proc. U. S. N. M., 12.
1892. *Lycosa pratensis*, Banks, Proc. Phil. Acad. Nat. Sci., 44, p. 64.
1894. *Lycosa pratensis* Emerton, Trans. Conn. Acad. Sci., IX, p. 422, Pl. III, fig. IV.
1895. *Lycosa pratensis* Emerton, Banks, J. N. Y. Ent. Soc., III, p. 91.
1902. *Lycosa pratensis* Emerton, Common Sp. U. S., p. 69, figs. 168, 169, 170.
1904. *Trochosa pratensis*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 303.

Type locality.—Massachusetts, Connecticut, New Hampshire.

Known localities.—Massachusetts, Connecticut, New Hampshire!, New York!, Long Island!, Canada (mountains near Lagan, Lake of Woods, Gaspé, Anticosti, Byron I., Port Hawkesbury).

According to Emerton, in New England "this is the most common species, under stones and under leaves in winter." Also: "This does not seem to be a very active spider, and is commonly found under stones."

Its habits in New York I have found similar.

Lycosa kochii (Keyserling), 1876.

(Sub *Tarentula*, Verh. z. b. Ges. Wien, 26, p. 636, Pl. 7, fig. 18.)

Female.—*Cephalothorax* with a pale stripe as wide as third eye row, becoming abruptly a little narrower near posterior end of pars cephalica and then gradually narrowing posteriorly. Tegument of median stripe reddish brown, but quadrangle of posterior eyes often black; median stripe clothed with gray-brown pubescence. Sides of cephalothorax darker above and becoming lighter below; clothed with gray-brown pubescence, like that of dorsal stripe, mixed with dark blackish pubescence, the brown hair becoming gradually more abundant from above below but forming no distinct marginal bands. *Cheliceræ* dark red-brown with short light brown pubescence basally and darker longer hairs on distal part. *Endites* reddish brown, light at tips. *Labium* darker, blackish, also lighter distally. *Sternum* dark brown, marked by a faint paler median line, clothed with brownish-gray pubescence and longer black bristles. *Coxæ* of legs beneath a little lighter than sternum. *Legs* clear brown, entirely unmarked or, more rarely, with indistinct annular markings on femora. *Palpi* similarly colored. *Abdomen* with brown-gray, brown and black hair; venter pale, immaculate; sides above finely streaked and spotted with the darker pubescence among the paler. Anterior face of abdomen with a black transverse band extending over each antero-lateral angle. At base a lanceolate outline, sometimes absent, which behind gives off a number of lines on each caudo-laterally, and is followed behind by a series of chevron-formed lines; in most on each side of dorsum a row of dark angular marks in which the ends of the chevron-lines terminate. *Spinnerets* brown, densely pubescent. *Epigynum* dark reddish brown.

Cephalothorax highest at posterior eyes, moderately low behind, a little concavated at dorsal groove. *Face* in height less than half the length of the cheliceræ, its sides convex and widely slanting.

Anterior row of *eyes* as long as second, gently procurved; anterior median eyes more than their radius apart, about half as far from the smaller lateral eyes; anterior lateral eyes about their diameter from front margin of clypeus, farther from eyes of second row. Eyes of second row separated by three-fourths their diameter or a little more. Eyes of the third row once and a half again as far from each other as from the eyes of the second row. Quadrangle of posterior eyes about one-fifth the length of the cephalothorax.

Lower margin of furrow of *cheliceræ* armed with two equal stout teeth, the upper margin with three as usual. *Labium* as wide as long; basal excavation less than one-third the total length (1 : 3.6); rather strongly attenuated in front with sides above straight or slightly concave below angles; anterior margin indented at middle but sides a little convex.

Tibia + patella of fourth *legs* shorter than the cephalothorax; tarsi I and II and metatarsi of same legs except at base scopulate; tarsi of third and fourth legs clothed beneath with bristles. Patellæ of first and second legs unarmed.

Epigynum as figured (Pl. XXI, fig. 5).

Total length, 11.4 mm.; length of cephalothorax, 4.5 mm.; width, 3.4 mm.

Length of leg I, 10.5 mm.; tib. + pat., 3.9 mm.; met., 2.1 mm.

Length of leg II, 10.5 mm.

Length of leg III, 10.2 mm.

Length of leg IV, 14.5 mm.; tib. + pat., 4.8 mm.; met., 4 mm.

Male.—Colored like female but lighter; femora of legs lighter and clearer brown, tibia and more distal joints darker, reddish brown.

Patella of second legs with a spine in front.

Tibia and patella of *palpus* of same length and thickness, together about equalling the length of the tarsus. For structure of palpal organ see Pl. XXI, fig. 4.

Total length, 9.2 mm. Length of cephalothorax, 4.2 mm.; width, 3.2 mm.

Length of leg I, 10.7 mm.; tib. + pat., 3.9 mm.; met., 2.4 mm.

Length of leg II, 9.6 mm.

Length of leg III, 8.8 mm.

Length of leg IV, 11 mm.; tib. + pat., 3.9 mm.; met., 2.6 mm.

Type locality.—"North America."

Known localities.—Colorado!, Utah!, Oregon, Arizona!, California!.

Lycosa gulosa Walckenaer, 1837.

(Ins. Apt., 1, p. 338.)

Female.—*Cephalothorax* dark reddish brown crossed by blackish radiating lines; a wide median light stripe which is constricted between thoracic groove and third eye row and again behind the groove, widest in front of the first constriction, extending to the second eye row in front; the median light brown band clothed with light gray pubescence; on each side a supramarginal irregular edged band of same color and pubescence as the median one; cephalothorax except on light stripes clothed with dark brown pubescence. *Cheliceræ* black, paler distally, clothed for most of length with yellowish pubescence, distally with longer dark brown hairs; the fringe along furrow rust colored. *Labium* and *endites* deep brown, paler at tips. *Sternum* deep reddish brown or, more rarely, black, clothed with short grayish-brown and longer dark brown pubescence. *Coxæ* of legs beneath brown to reddish-brown, lighter than sternum. *Legs* reddish brown, all joints except the tarsi with black annulations which are usually more distinct proximally and deeper above on femora than ventrally; clothed with brown hair which is also the color of the scopulæ. *Abdomen* above grayish-brown, the pubescence consisting of gray and brown intermixed; at base a dark, deeper margined, sublanceolate stripe ending obtusely or bifurcating at the middle, but this basal mark frequently inconspicuous and sometimes absent; posterior portion of dorsum rarely with some dark chevron-shaped cross-lines; a black spot over each antero-lateral angle which is usually followed caudad by a row of dark angular spots and marks along the sides; sides and venter yellowish or grayish brown, the pubescence, as on dorsum, being light and dark often intermixed in fine spots and streaks; the tegument of venter often showing two pairs of dark lines or stripes converging toward the spinnerets; entire animal darkening with age, the venter then showing usually a broad dark brown to black band over its length from genital furrow to the spinnerets. *Spinnerets* brown. *Epigynum* dark reddish-brown to black.

Face about half as high as the length of the cheliceræ, sides rounded and slanting; width at base less than the length of the cheliceræ. Dorsal line of cephalothorax highest at third eye row, somewhat concavated at median furrow.

Anterior row of *eyes* considerably shorter than the second (by twice the diameter of a lateral eye or more), moderately procurved; anterior median eyes less than their radius apart; anterior lateral eyes about two-thirds as large as the median, a little less than their diameter from eyes of second row and a little more than their diameter from front margin of clypeus; eyes of second row large, about three-fifths their diameter apart; eyes of third row but little smaller than those of second (ad. 5 : 6), more than twice as far from each other as from eyes of second row; quadrangle of posterior eyes between one-fifth and one-sixth the length of the cephalothorax.

Cheliceræ with furrows armed as usual. *Labium* nearly as wide as long, not much attenuated; front margin concavated. *Legs* with tibia + patella IV of same length as cephalothorax or a very little longer; metatarsus IV longer than the cephalothorax is wide; anterior tibiæ and patella armed as usual; tarsi and metatarsi I and II scopulate; tarsi III and IV as usual.

Epigynum broadly ovate with posterior end widely truncate; side ridges relatively very thick; septal piece of guide in front of enlarged posterior end with sides parallel or nearly so, the femur at its side narrow and not much differing in width from anterior end back to the caudal enlargement of guide (Pl. XXI, fig. 7).

Total length, 14 mm. Length of cephalothorax, 7.7 mm.; width, 6 mm.

Length of leg I, 19.7 mm.; tib. + pat., 7.4 mm.; met., 4.1 mm.

Length of leg II, 19.4 mm.

Length of leg III, 18.6 mm.

Length of leg IV, 24.1 mm.; tib. + pat., 7.8 mm.; met., 6.7 mm.

Male.—Colored nearly as in the female. *Legs* dark brown or blackish distally, showing mostly no rings or marks except on femora. *Palpi* reddish yellow with ends of joints dark and some dark marks on femora.

Patella of palpus as long as the tibia, these two joints together of about the same length as the tarsus; terminal portion of palpus a little shorter than the bulb.

Embolus bending outward and somewhat distally from base, resting upon the lectus only across the auricle, the greater part of its length being supported only by its much elongated basal flap (Pl. XXI, fig. 6).

Total length, 11.2 mm. Length of cephalothorax, 5.5 mm.; width, 4.8 mm.

Length of leg I, 19.7 mm.; tib. + pat., 7.1 mm.; met., 4.6 mm.

Length of leg II, 18.5 mm.

Length of leg III, 17.3 mm.

Length of leg IV, 22.8 mm.; tib. + pat., 7 mm.; met., 6.7 mm.

Syn.—1876. *Tarentula pulchra* Keyserling, Verh. z. b. Ges. Wien, 26, p. 628, Pl. 7, figs. 13, 14.
1885. *Lycosa kochii* Emerton (nec Keyserling), Trans. Conn. Acad. Sci., 6, p. 485, Pl. 46, figs. 6 to 6c.
1890. *Lycosa kochii* Stone, Proc. Acad. Nat. Sci. Phila., 42, p. 426.
1892. *Lycosa kochii* Marx, Proc. Ent. Soc. W., 2, p. 160.
——. *Lycosa kochii* Banks, Proc. Acad. Nat. Sci. Phila., p. 64.
1902. *Lycosa kochii* Emerton, Common Sp. U. S., p. 74, figs. 179, 180.
——. *Lycosa purcelli* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 566, Pl. 30, figs. 30, 31.
1904. *Lycosa pulchra* (Keys.), Chamberlin, Canad. Ent., p. 147.
——. *Lycosa cuepigynata*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 279, Pl. XVIII, figs. 1, 2.
——. *Lycosa insopita*, Montgomery, *ibid.*, p. 280, Pl. XVIII, figs. 3, 4.
——. *Trochosa purcelli*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 305.

Type locality.—"North America."

Known localities.—Connecticut, Massachusetts, Rhode Island!, New Hampshire!, New York!, Pennsylvania, New Jersey, District of Columbia!, Virginia North Carolina!, Alabama!, Mississippi!. Texas!, Kansas!, Indiana, Utah!

Types in collection of Dr. Koch.

A strongly marked and widely distributed species which, as might be expected, is subject to some variations in size and coloration. The epigynum and the peculiar palpus of the male are constant in essential features and at once reveal the species beneath more superficial differences. The pattern of the markings on the legs, the cephalothorax and of the dorsum of abdomen remain pretty nearly the same always except as to depth and distinctness of the colors. The venter of the abdomen becomes dark or even black with age, the entire animal also then taking on a darker color.

Lycosa modesta (Keyserling), 1876.

(Sub *Tarentula*, Verh. z. b. Ges. Wien, p. 626, Pl. VII, figs. 11, 12.)

Female.—*Cephalothorax* with a light median band as wide as space between eyes of third row; sides of median band nearly straight or slightly curved convexly, converging gradually caudally, in front reaching eyes of second row but there commonly darker; median band with tegument light reddish brown, darker between eyes, clothed with brown-gray pubescence; on each side a narrow marginal and a narrow supramarginal line of gray pubescence like that upon middle band, the two marginal lines often indistinctly separated. Sides of cephalothorax deep brown or nearly black, clothed with mixed dark brown and brownish-gray pubescence, the gray arranged in radiating streaks, more abundant below. *Chelicerœ* dark red-brown, lighter distally, clothed with dark brown hairs except below and along furrow, where they are lighter and clearer. *Labium* and *endites* dark brown, light at tips. *Sternum* shining reddish black or deep brown, sparsely provided with dark hairs about borders. *Coxœ* beneath dark brown, paler at bases. *Legs* brown, darker distally, especially the tibia and metatarsus, the tarsus being lighter on anterior pairs; annuli above, which are more obscure beneath, clothed with shorter gray and more sparse longer and stiffer hairs. Scopulæ grizzly brown. *Abdomen* having the tegument brown mottled with light and dark; a black lanceolate outline at base which on each side posteriorly gives off a number of lines caudolaterally, the basal mark sometimes absent; lanceolate mark followed behind by a series of black transverse chevron-lines; in most on each side of the dorsum behind a row of white spots in which the ends of the dark chevron-lines terminate, these spots formed of bunches of white hair; a black mark over each antero-lateral angle; sides brown with darker mottlings and streaks and spots of gray or whitish hair. *Venter* black with some light spots at sides. Pubescence of *abdomen* is light gray or white and a darker color, dark smoky gray to black, the latter found unmixed on venter, the former predominating above. *Spinnerets* brown. *Epigynum* reddish brown and figured.

Cephalothorax moderately high and steep sided, relatively wide in front. In profile line of dorsum highest behind third eye row, concavated at front of dorsal furrow. Face low, in height hardly half the length of the cheliceræ. *Face* at base about wide as length of cheliceræ, sides more than usually widely slanting, more convex below.

Anterior row of *eyes* a little shorter than the second, procurved; anterior median about their radius apart, twice as large in diameter as the lateral eyes; anterior lateral eyes nearly their diameter from the front margin of the clypeus, more than their diameter from eyes of second row; anterior median eyes less than half their diameter from eyes of second row and nearly as close to front margin of clypeus; eyes of second row scarcely more than half their diameter apart, two-thirds their diameter from eyes of third row which are two-thirds or a little more as large; eyes of third row twice as far from each other as from eyes of second row. Cephalothorax 5.5 times as long as the quadrangle of posterior eyes.

Legs short, the fourth pair less than three times the length of the cephalothorax; tibia + patella IV shorter than the cephalothorax; metatarsus IV shorter than tibia + patella; tarsi and metatarsi I and II scopulate, the scopulæ not dense; tarsi III and IV with very thin scopulæ at sides, the ventral surface mostly occupied by a broad band of long setæ; tibia + metatarsus I and II armed as usual beneath; patella I and II unarmed.

Total length, 11.2 mm. Length of cephalothorax, 4.9 mm.; width, 3.7.mm.

Length of leg, I, 9.8 mm.; tib. + pat., 3.7 mm.; met., 1.8 mm.

Length of leg II, 9.3 mm.

Length of leg III, 9.1 mm.

Length of leg IV, 12.6 mm.; tib. + pat., 4 mm.; met., 3.5 mm.

Male.—Cephalothorax relatively narrower in front than in female and more depressed. Patella I and II unarmed. Tibia + patella IV shorter than cephalothorax.

Patella as long as tibia, the latter thick distally. Femur laterally compressed above with 1, 1, 3 spines.

Total length, 8.4 mm. Length of cephalothorax, 4.6 mm.; width, 3.4 mm.

Length of leg I, 11.9 mm.; tib. + pat., 4.3 mm.; met., 2.7 mm.

Length of leg II, 10.2 mm.

Length of leg III, 10 mm.

Length of leg IV, 13.4 mm.; tib. + pat., 4.4 mm.; met., 2.7 mm.

Syn.—1890. *Tarentula modesta,* Marx, P. U. S. N. M., p. 564.
1902. *Lycosa sepulchralis* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 543, Pl. XXIX, fig. 7.
1903. *Lycosa sepulchralis* Montgomery, *ibid.*, p. 645, Pl. 29, fig. 7.
1904. *Trochosa sepulchralis,* Montgomery, *ibid.*, p. 307.

Type locality.—Maryland (Baltimore).

Habitat.—Maryland, District of Columbia, Pennsylvania!, Texas!.

Lycosa pictilis Emerton, 1885.

(Tr. Conn. Acad. Sci., 6, p. 485, Pl. 46, figs. 5 to 5*b*.)

Female.—*Cephalothorax* with a median grayish band (of pubescence) which, beginning at the second eye row, passes between the eyes of third row and then abruptly bulges on each side, being much wider than eye area midway between eyes and dorsal groove, then narrowing to dorsal groove where it is about same width as eye area; parallel sided to posterior declivity and then narrowing down the declivity; the median band, while chiefly of gray hair, has intermixed brown hair which is more abundant anteriorly between eyes; in wide area back of eyes an intramarginal line on each side is formed of brown hair, these lines being parallel to the sides and merging together in the brown between the eyes. Sides of cephalothorax chocolate brown, clothed with brown pubescence; a narrow marginal and a similar supramarginal line of grayish hair on each side. *Chelicerœ* reddish black. *Labium* with gray pubescence. *Sternum* blackish brown. *Coxœ* of legs beneath paler brown like other joints of legs. *Legs* dark brown; femora lighter beneath on basal half, apically on most femora two interrupted light rings and a few light, transverse marks above elsewhere. Tibia with several light rings, which on the anterior pair may be confluent beneath; other joints unmarked. *Abdomen* beneath at sides dusky brown, having a blackish-brown tegument covered with brown hair, rather darker on sides above; a black spot on each antero-lateral angle which encloses a light spot, the latter nearly breaking through lower margin of spot; mesally from the black spot is a large light spot on each side; along the inner posterior margin of each of these orange spots being a short oblique black line, the two lines not meeting in the middle; posteriorly is a series of median black chevron-marks, the first divided or nearly so at middle; at the outer end of each of the chevrons is a light spot enclosed by black, the light spots thus forming a lateral series on each side; in front of each half of each chevron is a light colored spot; these spots in front of the posterior chevrons confluent. The series of light spots on each side in life covered with grayish or gray pubescence; the large light spots in front covered with orange-colored or with rusty-brown hair and connected at middle with gray hair; light transverse marks in front of posterior chevrons covered with gray hair; middle of dorsum in front covered with mostly gray and with fewer brown hairs. *Epigynum* and *spinnerets* black-brown. *Legs* over the light spots with partly gray pubescence; pubescence elsewhere brown.

Median dorsal line of *cephalothorax* straight, not depressed at dorsal furrow. Sides of *face* convex and widely slanting.

Anterior row of *eyes* procurved, but little shorter than the second row; anterior lateral eyes their diameter or a little farther from front margin of the clypeus, a little farther from eyes of second row; anterior median eyes less than their diameter apart (four-sevenths), closer to the smaller lateral eyes (1 : 1.7); eyes of second row fully their diameter apart; anterior median eyes about their diameter from eyes of second row; quadrangle of posterior eyes as wide in front as long, about one-fifth as long as the cephalothorax.

For structure of *epigynum* see Pl. XIX, fig. 8.

Total length, 11.5 mm. Length of cephalothorax, 5 mm.; width, 3.6 mm.

Length of leg I, 13.1 mm.; tib. + pat., 4 mm.; met., 2.3 mm.

Length of leg II, 11 mm.

Length of leg III, 10.5 mm.

Length of leg IV, 14.9 mm.; tib. + pat., 4.6 mm.; met., 4.1 mm.

Male.—Coloration of *cephalothorax* and *legs* nearly as in female. *Abdomen* with nearly same markings but black spot over front angles circular, not enclosing a light spot; venter with gray pubescence; gray pubescence of dorsum much more abundant than in female, the rusty colored pubescence largely replaced by it.

Tarsus of *palpus* some (11 : 13) shorter than the tibia + patella; patella and tibia of about same thickness, the former slightly longer; tibia but slightly thickened distally; tarsus clearly wider than tibia (5 : 4).

For structure of palpal organ see Pl. XIX, fig. 6.

Total length, 9.3 mm. Length of cephalothorax, 5.3 mm.; width, 3.9 mm.

Length of leg I, 13.4 mm.; tib. + pat., 4.5 mm.; met., 3.3 mm.

Length of leg II, 12.4 mm.

Length of leg III, 12.3 mm.

Length of leg IV, 16.8 mm.; tib. + pat., 5 mm.; met., 4.7 mm.

Syn.—*Lycosa pictilis*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 287, Pl. XVIII, figs. 7, 8.

Locality.—New Hampshire!.

"This very distinct species is abundant among the moss and low shrubs on the upper part of Mt. Washington, New Hampshire, and the neighboring mountains."

The descriptions above are based upon the type specimens.

Lycosa fumosa Emerton, 1894.

(Tr. Conn. Acad. Sci., 9, p. 421, Pl. 3, figs. 1, 1*a*.)

Female.—*Cephalothorax* nearly black, of a reddish tinge. *Chelicerœ* the same color as cephalothorax. *Labium* and *endites* lighter in color than cephalothorax, pale distally. *Sternum* similar to cephalothorax but lighter. *Coxœ* of legs beneath brown, clearly paler than sternum. *Legs* a little lighter and more reddish than cephalothorax, the femora slightly darker than other joints, all joints unmarked or the femora with a few faint light spots. *Palpi* like legs. *Cephalothorax, sternum* and *legs* clothed with gray-brown pubescence, being probably bleached in the alcohol. *Abdomen* entirely black, slightly paler beneath especially in front of lung-slits, clothed with brown pubescence; pubescence of entire body and legs rather dense.

Cephalothorax comparatively low, angularly depressed in profile at dorsal groove. *Face* one-half as high as the length of the chelicerœ. Anterior row of *eyes* of the same length as the second or very nearly so, nearly straight, the center of lateral eyes being but slightly lower; anterior median eyes slightly smaller than the lateral; the tubercles of the lateral eyes increase their apparent size; anterior median eyes their full diameter apart, same distance from the lateral eyes, more than their diameter from eyes of second row; anterior lateral eyes more than their diameter from eyes of second row (nearly one and one-third), closer, but little more than diameter, from front margin of clypeus; eyes of second row not fully their diameter apart; eyes of third row three-fourths as large as those of second; quadrangle of posterior eyes a little wider in front than long (11.5 : 10) unusually wide behind, being there nearly twice as wide as long (19 : 10), the pars cephalica being wider than usual and the third eyes set well out laterally; the quadrangle of posterior eyes between one-fifth and one-sixth as long as the cephalothorax (about 1 : 5.6).

Lower margin of the furrow of the *chelicerœ* with three stout teeth, the third being a little stouter than the others; the first two with posterior face more curved than the anterior and so appearing bent forward; upper margin with three teeth, the first minute, the middle stout and acute as usual, the third as long as median but more slender.

Legs with the anterior tibiæ armed beneath with three pair of spines, these short as usual, the apical pair reduced; anterior patella armed behind; tibiæ II armed in front and behind; tibia + patella IV a little longer than cephalothorax, shorter than tibia + patella I.

Total length, 16 mm. Length of cephalothorax, 7 mm.; width, 5.8 mm.

For structure of *epigynum* see Pl. XIX, fig. 2.

Length of leg I, 21.6 mm.; tib. + pat., 8.2 mm.; met., 5 mm.

Length of leg II, 21.6 mm.

Length of leg III, 18.9 mm.

Length of leg IV, 23.7 mm.; tib. + pat., 8 mm.; met., 7 mm.

Male.—Cephalothorax, chelicerœ and *sternum* blackish. *Labium, endites* and *coxæ* of legs beneath dark brown, as in female. Pubescence throughout brown, dense.

For structure of palpal organ see Pl. XIX, fig. 3.

Total length, 11 mm. Length of cephalothorax, 6 mm.; width, 5 mm.

Length of leg I, 23.6 mm.; tib. + pat., 8 mm.; met., 6.8 mm.

Length of leg II, 2.3 mm.

Length of leg III, 21.6 mm.

Length of leg IV, 24.4 mm.; tib. + pat., 7.7 mm.; met., 7.7 mm.

Locality.—Canada!.

The description above was taken from the types.

Lycosa beanii Emerton, 1894.

(Tr. Conn. Acad. Sci., 19, p. 421, Pl. 3, figs. 2 to 2*b*.)

Female.—Sides of *cephalothorax* and eye region blackish brown; back of eyes a lighter reddish brown median stripe as wide as the eye area; the median stripe narrowing distinctly to posterior declivity, constricted in front of dorsal groove, widening out again at posterior margin. No light colored lateral stripes. *Chelicerœ* blackish or blackish brown. *Labium* and *endites* reddish brown. *Sternum* deep brown, faintly paler along middle. *Coxæ* of legs beneath distinctly lighter than sternum, brown. *Legs* brown, paler than sides of cephalothorax, entirely unmarked below but femora above and on sides, especially on posterior pairs, with rather indistinct closely arranged dark and light transverse markings. *Abdomen* brown down middle, blackish brown across front declivity and in a band passing over each antero-lateral angle and down the side of dorsum. A dark basal lanceolate mark evident reaching the middle of dorsum behind. Posteriorly a series of dark angular bars crossing from side to side, leaving light colored chevrons between, farther forward, at and just behind the middle, the sides of the dark lateral bands simply dentate, the teeth not connected across middle. Sides becoming lighter from above below, the lower portion and the venter rather light brown, the venter appearing to have been somewhat darker down its middle behind lung-slits in life. *Spinnerets* brown. *Epigynum* dark reddish brown.

Cephalothorax highest as usual at third eye only slightly descending posteriorly; the dorsal line nearly horizontal, a little depressed at dorsal groove. *Face* with sides sloping moderately, in height about half the length of the cheliceræ. Anterior row of eyes clearly shorter than the second, procurved; diameter of anterior median eyes is to diameter of eye of second row as 1 : 2.2; anterior lateral eyes once and a half their diameter from margin of clypeus, a little closer to eyes of second row; anterior median eyes their diameter from eyes of second row, and one-half their diameter apart, scarcely closer to lateral eyes (which are scarcely smaller); eyes of second row a little more than three-fourths their diameter apart; posterior quadrangle of same length and breadth, wider behind than in front in ratio of nearly 9.25 : 7, and about one-fifth as long as cephalothorax.

Lower margin of the furrow of the *cheliceræ* with two stout and equal teeth; upper margin of the furrow with three teeth, the first of these is low but wide and bluntly rounded, the second as usual much largest, conical and acute, the third of intermediate size, shaped like the second.

Tarsi of *legs* not curved, all straight; first two pairs of femora bent forward; third femora nearly straight, scarcely bent backward; fourth femora a little bent backward. *Scopulæ* distributed about as usual but rather sparse, divided by setose band on all tarsi!.

Epigynum 1 mm. wide and about same length (*i.e.*, shorter than any of coxæ, the third of which is 1.6 mm. long) (Pl. XIX, fig. 5).

Total length, 12 mm. Length of cephalothorax, 5.3 mm.; width, 3.8 mm.

Length of leg I, 11.6 mm.; tib. + pat., 6.4 mm.; met., 2.4 mm.

Length of leg II, 10.9 mm.

Length of leg III, 10.4 mm.

Length of leg IV, 14.2 mm.; tib. + pat., 4.2 mm.; met., 4.2 mm.

Male.—*Coloration* very nearly the same as in female. *Legs* not at all marked, the first and second femora darker than posterior ones, first tibia also darker. *Palpi* darker than in the female, the tarsi a little darker than other joints. Inner margins of dark lateral bands of dorsum dentate and serrate, but not with any connecting angular or chevron-shaped marks across middle.

For structure of palpal organ see Pl. XIX, fig. 4.

Total length, 8.8 mm. Length of cephalothorax, 4.5 mm.; width, 3.3 mm.

Length of leg I, 10.4 mm.; tib. + pat., 3.7 mm.; met., 2 mm.

Length of leg II, 9.8 mm.

Length of leg III, 9.6 mm.

Length of leg IV, 12.8 mm.; tib. + pat., 4 mm.; met., 3.6 mm.

Locality.—Canada!.

The descriptions above are from the types.

Lycosa albohastata Emerton, 1894.

(Tr. Conn. Acad. Sci., 9, p. 423, Pl. 3, figs. 3 to 3*b*.)

Male.—*Cephalothorax* with a wide median band of reddish-brown color extending to clypeus anteriorly; in front this band is as wide as the clypeus and wider than the eye area, narrowing gradually and constantly backward to a point at posterior margin, the sides nearly straight; this band appears to have been clothed in life with light gray pubescence. Sides of cephalothorax dark brown, presenting a reddish-brown background covered with radiating blackish lines which are more or less confluent above and below. *Chelicerœ* reddish brown. *Labium* and *endites* brown, paler distally. *Sternum* black or very nearly so. *Coxœ* beneath brown. *Legs* brown of orange hue; all joints except tarsi with black annuli, these annuli incomplete beneath except on femora where they are most distinct. *Abdomen* with a light basal mark, the sides of which are nearly parallel to its middle, then narrowed to a truncate point at middle of abdomen; this basal mark is densely clothed with white hairs and is margined at sides and behind by black, mostly broken into irregularly elongated spots, from the sides of this black extend somewhat broken lines of black more or less obliquely outward and backward, the last two lines extending from the angles of the truncate apex of basal mark; behind in the middle is a series of transverse black lines, and along each side a number of black dots; on each side of dorsum behind a row of light spots clothed with whitish hairs; the background of abdomen above orange-brown; sides of abdomen orange-brown mottled with numerous irregular black dots and marks; venter with clear orange-brown, darkened in front of lung-slits and along a narrow border laterally and posteriorly. *Palpi* with the femora black, not distinctly ringed, the patella and tibia orange, the tarsus darker, blackish. Pubescence on entire body except where stated otherwise orange-brown.

Face as compared with chelicerœ low and relatively wide, the length of the cheliceræ being about two and one-half times as great as the height of the face; sides sloping and rounded as usual. Anterior row of *eyes* slightly procurved, nearly as long as the second; anterior median eyes three-fourths their diameter apart; anterior lateral eyes three-fourths as large as the median, closer to the median than the latter are to each other (2 : 3); anterior lateral eyes their diameter from front margin of clypeus and the same distance from eyes of second row; anterior median eyes scarcely more than one-half their diameter from eyes of second row; eyes of second row slightly more than twice as large in diameter as the anterior median eyes (9 : 4); quadrangle of posterior eyes as wide in front as long; wider behind than in front in ratio of 6.3 : 4.6; between one-fourth and one-fifth as long as cephalothorax.

Lower margin of the furrow of the *chelicerœ* with three *teeth* which are stout and conical, the third a little reduced; upper margin with three teeth as usual, the first minute. *Labium* of usual shape, slightly curved for entire width. *Legs* with tibia + patella IV of same length as the cephalothorax; metatarsus distinctly longer than the width of the cephalothorax; both the posterior and the *anterior* tarsi with the scopulæ divided by a median setose band, the anterior metatarsi with only sparse scopular hairs.

Tibia of *palpus* of same length as patella and of same thickness proximally, the tibia widening moderately distally; tibia and patella together a little longer than the tarsus.

For structure of palpal organ see Pl. XIX, fig. 1.

Total length, 6 mm. Length of cephalothorax, 3 mm.; width, 2.2 mm.

Length of leg I, 8.2 mm.; tib. + pat., 2.8 mm.; met., 2 mm.

Length of leg II, 7.7 mm.

Length of leg III, 7.3 mm.

Length of leg IV, 9.6 mm.; tib. + pat., 3 mm.; met., 2.7 mm.

Female.—Coloration of the female is nearly same throughout as male. *Eye* arrangement and general structure as for the male. *Legs* with tibia + patella shorter than the length of the cephalothorax; metatarsus IV very little longer than cephalothorax is wide.

The *epigynum* of specimen studied (type) is not entirely adult.

Total length, 7.2 mm. Length of cephalothorax, 3.7 mm.; width, 2.8 mm.

Length of leg I, 8 mm.; tib. + pat., 2.9 mm.; met., 1.8 mm.

Length of leg II, 7.9 mm.

Length of leg III, 7 mm.

Length of leg IV, 11.1 mm.; tib. + pat., 3.2 mm.; met., 2.9 mm.

Locality.—Laggan, Canada!.

The description above was taken from the types. Two males from the valley near Laggan and young females from the neighboring mountains 6,000 to 7,000 feet high.

Lycosa quinaria Emerton, 1894.

(Tr. Conn. Acad. Sci., 9, p. 422, Pl. 3, figs. 5, 5*a*.)

Female.—*Cephalothorax* dark reddish brown without markings. *Cheliceræ* reddish black. *Labium* and *endites* colored like cephalothorax, the endites scarcely paler distally, the labium not paler distally. *Sternum* like cephalothorax. *Coxæ* beneath lighter than sternum. *Legs* reddish brown, paler beneath, unmarked except for a few fine and inconspicuous longitudinal black lines, which are most distinct on femora, on each of which there is one on the dorsal surface. *Abdomen* dark brownish or gray, faintly paler along the middle, with a series of inconspicuous black marks each side. *Epigynum* reddish brown. *Spinnerets* concolorous with abdomen.

Cephalothorax shaped about as usual. *Face* with sides rounded and widely sloping, in height about half the length of the cheliceræ.

Anterior row of *eyes* well procurved, a line passing through the center of the median eyes being tangent to the posterior margins of the lateral eyes; anterior median eyes less than their diameter apart (five-sevenths) some closer to the subequal lateral eyes; anterior lateral eyes their diameter from front margin of clypeus, a little farther from eyes of second row; anterior median eyes their diameter from eyes of second row; eyes of second row four-fifths their diameter apart; quadrangle of posterior eyes a little wider in front than long (9.75 : 6.75); between one-fifth and one-sixth the length of the cephalothorax (nearly 5.5 : 1).

Lower margin of furrow of *chelicerœ* with three teeth equal in size or, if any different, the third largest, moderately stout and acute; upper margin with three teeth of usual proportions.

Legs stout; tarsi all straight, not at all curved; third femora straight; fourth femora a little bent backward, not excavated behind; second and first femora bent forward and their anterior sides moderately excavated near middle; tarsi and metatarsi of legs I and II scopulate; tarsi of legs III and IV divided by a median setose band as usual.

Total length, 10 mm. Length of cephalothorax, 5.2 mm.; width, 4 mm.

For structure of epigynum see Pl. XIX, fig. 7.

Length of leg I, 12 mm.; tib. + pat., 4.4 mm.; met., 2.6 mm.

Length of leg II, 11.6 mm.

Length of leg III, 11.4 mm.

Length of leg IV, 15.8 mm.; tib. + pat., 4.9 mm.; met., 4.6 mm.

Locality.—Canada (Alberta)!.

The types are two females collected by J. B. Tyrrell in 1886, and from these the description above was made.

Lycosa rubicunda (Keys.), 1876.

Female.—*Cephalothorax* with a light brown median band which expands anteriorly so as to enclose the eye area, than which it is much wider anteriorly; reaching front margin of clypeus; behind eyes it narrows rapidly, running almost to a point at dorsal groove, here usually sending out a narrow branch on each side and behind continuing as a narrow line to end of cephalothorax. Pubescence of median band light or yellowish brown, rather sparse. Sides of cephalothorax dark reddish brown, pubescence sparse; a marginal light band each side, of same color and pubescence as median band. Sometimes uniform in color, without distinct markings. Cephalothorax appearing polished even when not rubbed because of sparseness of pubescence. *Chelicerœ* dark reddish brown clothed with moderately long brown pubescence. *Labium* and *endites* brown, light distally. *Sternum* and *coxœ* of legs beneath brown. *Legs* brown, paler beneath, usually with dark annuli which are obscure or absent beneath but distinct above. *Abdomen* with yellowish-brown and black pubescence; at base a lanceolate outline reaching to middle, from each side giving off latero-caudally a series of dark lines and followed behind by a series of chevron-marks; sides of dorsum with numerous dark dots and dashes; venter grayish brown with some dark spots and a narrow dark median line extending from spinnerets forward and widening in front to enclose the epigynum and sometimes also widening about spinnerets. *Spinnerets* yellowish. *Epigynum* reddish brown.

Cephalothorax high, with the sides steep; rather narrow, the sides behind not strongly bulging. *Pars cephalica* long; in profile line of dorsum conspicuously arched, rounded in front, the highest point behind eyes of third row. *Face* low, in height considerably less than half the length of the chelicerae; sides of face convex, widely slanting.

First *eye* row clearly longer than second, slightly recurved; anterior median eyes less than their radius apart, half as far from the smaller lateral eyes; anterior lateral eyes their diameter from front margin of clypeus, less than their diameter from eyes of second row; eyes of second row about half their diameter apart, a little farther from the but little smaller eyes of third row, which are fully four times as far from each other; third row twice the diameter of one of its eyes, wider than second row; quadrangle of posterior eyes much wider than long; cephalothorax six and a half times the length of the quadrangle of posterior eyes.

Teeth of margins of furrow of *chelicerœ* as usual.

Legs short and moderately stout, the fourth pair less than three times the length of cephalothorax; tibia + patella of fourth legs shorter than cephalothorax, metatarsus of fourth legs clearly shorter than tibia + patella; tarsi I and II and distal part of metatarsi I and II scopulate, scopulæ not dense. Tarsi III and IV with sparse scopular hairs laterally elsewhere clothed with long bristles.

Tibiæ and metatarsi I and II armed beneath as usual, the spines rather small and slender. Patellæ I and II each armed in front with a single spine.

Epigynum as figured (Pl. XIX, fig. 9).

Total length, 9.6 mm. Length of cephalothorax, 4.5 mm.; width. 3.3 mm.

Length of leg I, 9.7 mm.; tib. + pat., 3.6 mm.; met., 1.9 mm.

Length of leg II, 9.4 mm.

Length of leg III, 8.8 mm.

Length of leg IV, 12.1 mm.; tib. + pat., 4 mm.; met., 3.2 mm.

Syn.—1885. *Lycosa polita* Emerton, Trans. Conn. Acad. Sci., 6, p. 484, Pl. 46, figs. 2, *2a*, *2b*, *2c*.
1890. *Lycosa polita*, Marx, Proc. U. S. N. M., 12, p. 563.
——. *Trochosa rubicunda*, Marx, *ibid.*, p. 564.
1892. *Lycosa polita*, Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 66.
——. *Lycosa polita*, Marx, Proc. Ent. Soc. W., 2, p. 160.
——. *Lycosa polita*, Fox, Proc. Ent. Soc. W., 2, p. 267.
1893. *Lycosa rubicunda* Keyserling, Banks, J. N. Y. Ent. Soc., I, p. 125.
1894. *Lycosa polita* Emerton, Trans. Conn. Acad., 9, p. 422.
1902. *Lycosa polita* Emerton, Common Spiders of U. S., p. 70, fig. 171.
1904. *Trochosa rubicunda*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 307, Pl. XIX, fig. 30.

Type locality.—Eastern Massachusetts; Albany, New York; New Haven, Connecticut.

Known localities.—Massachusetts, Connecticut!, Rhode Island!, New York!, Indiana, District of Columbia.

"Under stones in summer and under leaves in winter. Eggs in June and July."

Lycosa avara (Keyserling), 1876.

(Sub *Trochosa*, Verh. z. b. Ges. Wien, 26, p. 661, Pl. VIII, figs. 38, 39.)

Female.—*Cephalothorax* with a light median band widest between third eyes and dorsal groove where it is as wide as third eye row;

somewhat abruptly contracted at front of groove and then gradually narrowing to posterior end of cephalothorax, reaching second eye row in front; tegument of median band light brown clothed with yellow or brown-gray pubescence; on each side a narrow marginal and a wider supramarginal band of same color and pubescence as the median one; sides of cephalothorax elsewhere with dark reddish brown tegument, the pubescence over which is mixed light brown and blackish. Region about eyes usually blackish. *Cheliceræ* dark red-brown, the lateral condyles red, the claw also reddish. *Labium* and *endites* dark reddish brown, paler at tips. *Sternum* lighter reddish brown, with shorter brown gray pubescence and longer black bristles. *Coxæ* of legs beneath brown. *Legs* brown with indistinct darker annuli, clothed with shorter and more dense gray pubescence and longer dark brown or blackish bristles. Tegument of *abdomen* above reddish brown, lighter beneath; pubescence above intermixed gray and brown and with black forming a mostly obscure lanceolate outline at base and scattered spots; sides and venter also with small darker streaks and spots in the pubescence; pubescence beneath lighter than above. *Spinnerets* brown. *Epigynum* reddish brown.

Sides of *face* convex, slanting outward, a little less than half as high as the cheliceræ are long, at base nearly as wide as length of cheliceræ; in profile line of dorsum highest at third eyes, convex between third eyes and posterior declivity.

Anterior row of *eyes* slightly procurved, scarcely shorter than the second; anterior median eyes less than their radius apart, as far from the smaller lateral eyes; anterior lateral eyes not fully one-half their diameter from front margin of clypeus and about their diameter from eyes of second row; eyes of second row, considerably less than their diameter apart, scarcely farther from eyes of third row, which as usual are more than twice as far from each other; eyes of third row smaller than those of second nearly in ratio of 2.5 : 3. Quadrangle of posterior eyes one-fifth the length of cephalothorax.

Three equal and equidistant conical teeth along lower margin of furrow of *cheliceræ*; upper margin of furrow with three teeth as usual, the first and third nearly equal, the third more removed from second.

Legs slender; tibia + patella IV shorter than cephalothorax; metatarsus IV scarcely shorter than tibia + patella; posterior femora (IV) bent backward, second anterior pair of femora a little curved forward; tarsi I and II a little curved, tarsi III and IV with scopulæ divided by median setose bands; both tarsi and metatarsi I and II scopulate for entire length; tibiæ and metatarsi I and II armed as usual; patella I and II not armed.

For *epigynum* see Pl. XX, fig. 2.

Total length, 13 mm. Length of cephalothorax, 5 mm.; width, 3.7 mm.

Length of leg I, 10.8 mm.; tib. + pat., 3.9 mm.; met., 2.1 mm.

Length of leg II, 10.4 mm.

Length of leg III, 10.1 mm.

Length of leg IV, 13.7 mm.; tib. + pat., 4.1 mm.; met., 4 mm.

Male.—For structure of palpus see Pl. XX, figs. 1, 3.

Total length, 8 mm. Length of cephalothorax, 3.9 mm.; width, 3 mm.

Length of leg I, 10.6 mm.; tib. + pat., 3.9 mm.; met., 2.3 mm.

Length of leg II, 10.2 mm.

Length of leg III, 9.9 mm.

Length of leg IV, 11.3 mm.; tib. + pat., 4.3 mm.; met., 2.3 mm.

Syn.—1892. *Lycosa rufiventris* Banks, Proc. Acad. Nat. Sci. Phila., p. 65, Pl. 3, fig. 35.
1895. *Lycosa rufiventris* Banks, J. N. Y. E. Soc., 3, p. 91.
1903. *Lycosa avara*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 650, Pl. XXIX, fig. 2.
1904. *Trochosa avara*, Montgomery, *ibid.*, p. 304, Pl. XX, fig. 42.

Known localities.—Massachusetts, New York!, Texas!, Kansas!, Iowa!.

Var. **gosiuta**, new.

Females from Utah thus far seen differ a little from the type form in the shape of the epigynum. The blunt process at distal end of guide in *avara* proper is absent in this variety, and the lateral ends of the transverse arms extend forward beyond the middle of the foveæ (Pl. XX, fig. 4).

Locality.—Utah!.

Lycosa cinerea (Fab.), 1793.

(Sub *Araneus*, Ent. Syst., II, p. 423.)

Female.—*Cephalothorax* with the tegument marked with a broad median band which is wider than the eye area and covers clypeus in front; this band constricted back of eye area and again, more strongly, at posterior limit of pars cephalica, back of which its edges are irregular or toothed, and widening triangularly down the posterior declivity, across the lower border of which it is united with the broad lateral bands of the same color; the pale lateral bands extending forward only to the pars cephalica, with upper margin toothed; except for these light bands the cephalothorax is dark chocolate-brown; in life the cephalothorax is densely covered with white and gray hair intermixed in spots and streaks, radiating more or less from the dorsum laterally. *Cheliceræ* black, clothed with gray or grayish-brown hair. *Legs* with clear brown tegument which is itself faintly annulate, the clothing of white hair making the annulation much more distinct. The *abdomen* having on dorsum a median gray band which is margined on each side anteriorly with a black stripe, continued posteriorly by a row of black dots which in life are ocellate with central patches of white hair; the median light band enclosing anteriorly a hastate outline which is open anteriorly and is bifurcate behind; sides of abdomen white spotted with black; venter white in life, but the tegument denuded of hair commonly shows a smoky band from genital furrow to spinnerets. *Spinnerets* brown. *Coxæ* and *sternum* brown, the latter dusky marginally. *Labium* brownish black. *Endites* brown. The general color effect of this species in life is that of a dusky-white body marked with small spots and streaks of gray and black.

Cephalothorax highest at middle of pars cephalica some distance back of third eye row. The third eyes upon a plane strongly sloped antero-ventrally, the face more strongly slanting. First *eye* row of about same length as the second.

For structure of *epigynum* see Pl. XX, fig. 6.

Total length, 11.5 mm. Length of cephalothorax, 6.2 mm.; width, 4.8 mm.

Length of leg I, 13.8 mm.; tib. + pat., 4.8 mm.; met., 3 mm.

Length of leg II, 12.7 mm.

Length of leg III, 12 mm.

Length of leg IV, 17 mm.; tib. + pat., 5.5 mm.; met., 4.2 mm.

Male.—Coloration as in female or nearly so. For structure of palpal organ see Pl. XX, fig. 5. A specimen gave the following measurements:

Total length, 9.8 mm. Length of cephalothorax, 5.1 mm.; width, 4 mm.

Length of leg I, 12.5 mm.; tib. + pat., 4 mm.; met., 3 mm.

Length of leg II, 11.4 mm.

Length of leg III, 11 mm.

Length of leg IV, 14.7 mm.; tib. + pat., 4.8 mm.; met., 4 mm.

Syn.—1831. *Lycosa lynx* Hahn, Die Arachn., II, p. 13, fig. 194.
1841. *Lycosa maritima* Hentz.
1848. *Lycosa halodroma* C. Koch, Die Arachn., V, p. 196, figs. 410, 411.
——. *Arctosa cinerea* C. Koch, *ibid.*, XIV, p. 123, fig. 1358.
——. *Arctosa lynx* C. Koch, *ibid.*, p. 133, fig. 1364.
1875. *Lycosa maritima* Hentz, Spiders U. S., *ed.* Burgess.
1885. *Lycosa cinerea*, Emerton, New England Lycos., Tr. Conn. Acad. Sci., VI, p. 488, Pl. 47, fig. 3.
1889. *Trochosa cinerea* Marx, Proc. U. S. N. M., p. 564.

1902. *Lycosa cinerea* Emerton, Common Sp. U. S.
——. *Lycosa cinerea* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 555, Pl. XXIX, figs. 17, 18.
1904. *Trochosa cinerea*, Montgomery, *ibid.*, p. 305, Pl. XX, fig. 43.

Type locality.—Europe.

Known localities.—Massachusetts, Connecticut, Indiana, New Jersey, New York (Long Island!), South Carolina, Utah!, Arizona, New Mexico, Texas.

A common form along the Atlantic seashore. Its color of dirty white finely marked with streaks and spots of gray and black harmonizes with that of the sand over which it runs.

Lycosa floridiana (Banks).

(Sub *Trochosa*, Tr. Am. Ent. Soc., Vol. XXIII, p. 72.)

Female.—*Cephalothorax* with a broad median yellow stripe wider than the eye area in front, and narrowing gradually caudally; eye region black, the clypeus either entirely black or paler across margin; sides of cephalothorax brown. *Chelicerœ* yellow to dark brown. *Labium* black. *Endites* brown. *Sternum* and *coxœ* of legs beneath light brown or yellow. *Legs* light brown or yellow proximally, with a tendency to become darker, smoky or blackish, distally. *Abdomen* pale mesally above from anterior end to spinnerets, a faint lanceolate outline in basal part; a black spot over each antero-lateral angle, followed or not with a number of other dark spots so as to form a dark border each side of dorsum; venter and lower portion of sides immaculate.

Face low, strongly slanting outward, evenly convexly rounded laterally.

First row of eyes a little shorter than the second, weakly procurved, anterior median eyes larger than the lateral, considerably closer to the lateral than to each other.

Epigynum wider than long; septum wide anteriorly, evenly arched ventrally; foveæ oval, obliquely and well caudally placed, suggesting an approach to the *Allocosa* type.

Total length, 7 mm. Length of cephalothorax, 3.2 mm.; width, 2.2 mm.

Length of leg I, 6.8 mm.; tib. + pat., 2.5 mm.; tarsus, 1 mm.

Length of leg II, 6.4 mm.

Length of leg III, 6.2 mm.

Length of leg IV, 7.8 mm.; tib. + pat., 3 mm.; tarsus, 1.2 mm.

Locality.—Florida.

The genus **ALLOCOSA** Banks, 1900.

(Proc. Acad. Nat. Sci. Phila., p. 537.)

Cephalothorax glabrous or nearly so to sparsely pubescent. Anterior tibiæ armed beneath with three pairs of *spines*, of which the third pair is apical in position and all of which are moderate to minute in size, either armed or unarmed laterally. Anterior row of *eyes* straight to a little procurved, from longer to shorter than the second row; anterior median eyes larger than the lateral, more or less; clypeus narrow, at most as wide as the diameter of an anterior lateral eye; eyes of second row of moderate size, much less than their diameter apart; quadrangle of posterior eyes trapeziform, wider behind than in front. *Labium* longer than wide, well attenuated anteriorly; basal excavation short, about one-fourth the total length. *Spinnerets* very short, anterior and posterior pairs subequal in length. *Epigynum* simple, presenting no true guide, or but weakly furrowed, the spermatheca opening free posteriorly. Bulb of *male palpus* bearing a scopus which is exterior in position.

1842. *Lycosa* Hentz (ad. part. *funerea*), J. Bost. Soc. Nat. Hist., 4, p. 228–299.
1875. *Lycosa* Hentz (ad. part. *funerea*), Sp. U. S., p. 24.
1876. *Lycosa* Keyserling (ad. part. *rugosa*), Verh. z. b. Ges. Wien. pp. 610–624.
1888. ? *Tricca* Simon, Ann. Ent. Soc. Fr., p. 250.
1890. *Lycosa* Marx (ad. part. *funerea* and *rugosa*), Proc. U. S. N. M., p. 12.
1890. *Pardosa* Stone (ad. part. *nigra*), Proc. Acad. Nat. Sci. Phila., 42, p. 432.
1894. *Trochosa*, Banks (ad. part. *parva*), J. N. Y. E. Soc., p. 52.
1898. *Lycosa* Simon (ad. part.), Hist. Nat. Araign., 2.
——. *Aulonia*(?) Banks, Proc. Cal. Acad. Sci., p. 273.
1904. *Allocosa* Banks, Journ. N. Y. Ent. Soc., p. 113.

Cephalothorax arched convexly behind, strongly attenuated anteriorly; pars cephalica narrow and inclined anteriorly, rather low; face with sides convex and sloping outward from above below; posterior eyes seen from above well removed from sides of pars cephalica. General appearance of cephalothorax much like that of a Drassid. In the known species the cephalothorax is entirely without distinct pale stripes, or with a median paler band weakly contrasting.

Chelicera rather weak; lower margin of furrow armed with three teeth, the superior with two. *Legs* short; posterior tarsi simply setose, and the anterior either entirely setose or with sparse lines of scopular hairs at the sides.

Excepting as to curvature of the anterior row of eyes, this genus is much like most species of Simon's old genus *Tricca*, now withdrawn by its author into *Lycosa*. It has the same form of cephalothorax and shows the same tendency toward excessive reduction of the spines of the anterior legs, these spines in some species of *Tricca* being entirely absent from the tibiæ (cf. *degesta, infra*). In *Tricca* the anterior row of eyes is always more or less recurved, while in *Allocosa* it is at most straight. This difference may prove not to hold good. It may become impossible ultimately to maintain this group separate from *Lycosa*, the American species of which it closely approaches through the *Trochosa* group.

Key to Species of Allocosa.

1. All joints of legs except femora clear yellow, without any darker annulations or markings except at ends of tibiæ IV, *rugosa* (Keys.).
   Legs beyond femora more or less distinctly annulate with dark, 2.
2. Anterior row of eyes longer than the second; anterior median eyes not more than one-fifth their diameter apart; anterior tibiæ armed neither in front nor behind, and the ventral spines minute, *degesta* Chamb.
   Anterior row of eyes shorter than the second; anterior median eyes their radius or nearly so apart; anterior tibiæ armed in front and behind and the ventral spines longer, ... 3.
3. Femora of first legs solid black above, a sub-basal brown band on the others, ... *funerea* (Hentz).
   Femora of first legs not solid black, marked with three black rings, ... 4.
4. First pair of ventral spines of anterior tibiæ reaching the bases of the median pair, the basal spines in length equalling the diameter of the joint; upper margin of furrow of chelicera with three teeth, *parva* (Bks.).
   First pair of ventral spines of anterior tibiæ not reaching bases of median pair; and none of the spines in length equalling the diameter of the joint; upper margin of furrow of chelicera with two teeth, ... *evagata*, sp. n.

Allocosa rugosa (Keyserling), 1876.

(Verh. z. b. Ges. Wien, 26, p. 624, Pl. 7, figs. 9, 10.)

Female.—*Cephalothorax* shining black with obscure brown lines radiating from above; sometimes with a brownish luster; clypeus a little paler, brownish. *Chelicerœ* black. *Labium, endites* and *coxœ* of legs beneath brown. *Sternum* brownish black. *Legs* with all femora black, all other joints yellow or pale brown, except the posterior tibiæ which have a dark ring at each end. *Abdomen* with front declivity and the sides blackish with some minute lighter dots; dorsum obscure brown, black lines outlining a lanceolate mark at base which is continued behind as a fine black median line with a row of black dots on each side of it; outside these more median marks is on each side a straight row of black spots which are in part confluent; sides of dorsum with obscure irregular dark markings; venter brown. *Spinnerets* and *epigynum* brown.

Chelicerœ one and one-third times as long as the *face* is high; sides of face convex and bulging outward below. *Cephalothorax* with its dorsal line in profile convex, not much descending posteriorly and not concavated at middle.

Anterior row of *eyes* shorter than the second, distinctly procurved; anterior median eyes, oval and diverging, their radius apart, hardly half so far from the lateral eyes which are a little smaller, about half their diameter from eyes of second row; anterior lateral eyes less than their diameter (about two-thirds) from front margin of clypeus, a little farther from eyes of second row; eyes of second row comparatively low on face, a little more than half their diameter apart; cephalothorax about 4.5 times as long as the quadrangle of posterior eyes.

Epigynum nearly as in the next species (*funerea*), but the median part or lobe more convex.

Total length, 5.6 mm. Length of cephalothorax, 2.6 mm.; width, 1.9 mm.

Length of leg I, 5.5 mm.; tib. + pat., 1.9 mm.; met., 1.2 mm.

Length of leg II, 4.9 mm.

Length of leg III, 4.9 mm.

Length of leg IV, 7.8 mm.; tib. + pat., 2.4 mm.; met., 2.3 mm

Male.—*Coloration* as in female excepting palpi which are entirely black.

Patella of *palpi* as long as or a little longer than the tibia which thickens distally and, seen from above, is some thicker than the preceding joint; tarsus relatively narrow; not much broader than the tibia, its apical part bent ventrad. For palpal organ see Pl. XXIII, fig. 3.

Total length, 4.5 mm. Length of cephalothorax, 2.4 mm.; width, 1.8 mm.

Length of leg I, 5.2 mm.; tib. + pat., 2 mm.; met., 1 mm.

Length of leg II, 4.7 mm.

Length of leg III, 4.5 mm.

Length of leg IV, 7.5 mm.; tib. + pat., 2.7 mm.; met., 2 mm.

Syn.—1890. *Pardosa nigra* Stone, Proc. Acad. Nat. Sci. Phila., Vol. 42, p. 432, Pl. XV, figs. 4, 4*a*.
Non. syn.—1891. *Lycosa funerea* Banks, Ent. News.
Syn.—1902. *Lycosa nigra*, Montgomery, *op. cit.*, p. 538, Pl. 29, fig. 1.
1904. *Lycosa nigra*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 285, Pl. XX, figs. 40, 41.

Type locality.—Maryland (Baltimore).

Known localities.—Maryland, Pennsylvania, District of Columbia!.

Allocosa funerea (Hentz), 1842.

(Sub *Lycosa*, Proc. Bost. Soc. Nat. Hist., 4, p. 393.)

Female.—*Cephalothorax* shining reddish black becoming a little paler above, the marginal lines deep black; clypeus pale. *Cheliceræ* deep reddish brown. *Labium* and *endites* brown. *Sternum* dark brown, blackish at borders. *Coxæ* of legs yellowish brown. *Legs* with ground color brown of reddish tinge; femora of first pair of legs black, the succeeding femora similar but pale beneath and with the black divided above the proximal end by a brownish cross-band, this annulus becoming more distinction the posterior legs, and the extreme distal end of all femora pale; all tibiæ with a subbasal and a subapical ring of black; metatarsi less distinctly annulate, there being a median annulus, often more or less diffused, and on posterior pairs also a subbasal and a subapical band. *Abdomen* appearing black above and at sides, minutely dotted with yellow; the dorsum in front paler, reddish yellow, the paler area enclosing a lanceolate black-margined outline, and followed behind by a row of light spots with black dots at center on each side, these being connected in pairs by black angular cross-lines the angles of which are directed backward; opposed to the black cross-lines is a series of light chevron-lines with angles forward; venter pale brown, immaculate or sometimes with a few short transverse marks along each side.

Form of *cephalothorax* and *face* much as in *rugosa*.

Anterior row of *eyes* a little shorter than the second, gently procurved; anterior median eyes their radius or a little more apart, closer to the lateral eyes which are but slightly smaller, less than their radius from eyes of second row; anterior lateral eyes less than their diameter from eyes of second row; eyes of second row their radius apart, rather less than more; quadrangle of posterior eyes as wide in front as long, the cephalothorax 5.5 times longer; eyes of third row unusually small. *Labium* longer than wide (5.3 : 4.8); basal excavation one-fourth total length; sides slightly convex, strongly converging distally; front margin convexly rounded, more rarely straight.

For spines of anterior tibiæ see Pl. X, fig. 3.

The *epigynum* nearly identical in form with that of *A. degesta* (Pl. XXIII, fig. 5).

Total length, 5.2 mm. Length of cephalothorax, 2.7 mm.; width, 2 mm.

Length of leg I, 6 mm.; tib. + pat., 2 mm.; met., 1.2 mm.
Length of leg II, 5.7 mm.
Length of leg III, 5.3 mm.
Length of leg IV, 8.25 mm.; tib. + pat., 2.5 mm.; met., 2.4 mm.

Syn.—1875. *Lycosa funerea* Hentz, J. Bost. Soc. Nat. Hist., 4, p. 393.
1890. *Lycosa funerea*, Marx, Proc. U. S. N. M., 12.
1897. *Lycosa funerea*, Banks, Proc. Ent. Soc. W., 4.
1902. *Lycosa sublata* Montgomery, Proc. Acad. Nat. Sci. Phila., 539.
1904. *Trochosa sublata*, Montgomery, *ibid.*, p. 308.

Type locality.—Alabama.

Known localities.—Alabama, Georgia!, Louisiana!.

"This species abounds on the ground. It has the habits of a *Herpyllus*, and runs with great rapidity" (Hentz).

Allocosa degesta Chamberlin, 1904.

(Can. Entomologist, p. 287.)

Female.—*Cephalothorax* shining black of reddish luster. *Chelicerœ* the same. *Labium* and *endites* brown. *Legs* nearly as in *funerea*, but light marks on *femora* more obscure and less contrast on other joints between the light and dark rings. *Sternum* reddish brown, dark about margins, lighter, more yellowish, over middle area. *Abdomen* above nearly as in *funerea*; venter yellow with a few faint dark dots at sides. *Spinnerets* yellow. *Epigynum* brown, weakly reddish at borders.

Chelicerœ nearly twice as long as the *face* is high. Anterior row of eyes a little longer than the second, nearly straight, anterior median eyes much larger than the lateral (at least 3 : 2), at most one-fifth their diameter apart, still closer to the lateral eyes, not fully one-third their diameter from eyes of second row; anterior lateral eyes not fully their diameter from front margin of clypeus, some closer to eyes of second row; anterior median eyes three-fourths as large as those of second row (Pl. X, fig. 2); eyes of second row about their radius apart; quadrangle of posterior eyes as wide in front as long, only one-sixth as long as cephalothorax. *Spines* of anterior tibiæ greatly reduced, minute, none at all on either anterior or posterior side of joint (Pl. X, fig. 1).

Epigynum nearly the same as that of *funerea* (Pl. XXIII, fig. 5).

Total length, 6.6 mm. Length of cephalothorax, 3.2 mm.; width, 2.25 mm.

Length of leg I, 7.2 mm.; tib. + pat., 2.5 mm.; met., 1.6 mm.
Length of leg II, 6.3 mm.

Length of leg III, 6.3 mm.

Length of leg IV, 9.4 mm.; tib. + pat., 3 mm.; met., 2.8 mm.

Syn.—1904. ?*Trochosa noctuabunda,* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 301.

Locality.—Louisiana.

One mature and one immature female collected at Baton Rouge by Mr. B. H. Guilbeaux.

Allocosa parva (Banks), 1894.

(Sub *Trochosa*, J. N. Y. Ent. Soc., II, p. 52.)

Male.—*Cephalothorax* with a wide paler median band, anteriorly wider than eye area; eye region blackish; sides deep brown to shining black; a row of indistinct dots on each side; the paler band clothed with sparse gray pubescence, especially anteriorly; dark parts with sparse gray and brown hairs intermixed; tending to be glabrous except about eyes and face. *Chelicerœ* reddish brown. *Labium* and *endites* brown. *Sternum* blackish, brown at middle and along sides clothed with gray pubescence and long blackish bristles. *Coxœ* of legs beneath yellow. *Legs* yellow with distinct black rings on all joints except tarsi. *Abdomen* above grayish or yellowish gray, being clothed with light gray and some yellow hair; dorsum at base with a black lanceolate outline and behind with a number of black chevron-shaped marks and also laterally with some dark spots; venter gray, immaculate. *Spinnerets* brown. *Palpi* brown, not ringed, the tarsi darker than other joints.

Cephalothorax wide behind and much narrowed anteriorly, being only about one-half as wide across eyes as behind. *Face* with sides convex and slanting, in height one-half the length of the chelicerœ; in profile dorsal line is seen to be highest near third eye row, and gently convex between eyes and posterior declivity.

Anterior row of *eyes* slightly procurved, as long as the second row; anterior median eyes clearly larger than the lateral, more than their radius apart, close to lateral eyes; anterior lateral eyes their diameter from front margin of clypeus and from eyes of second row; eyes of second row not large, nearly their diameter apart; quadrangle of posterior eyes one-fifth the length of cephalothorax.

Tarsi and metatarsi of the first and second pairs of *legs* scopulate as usual; tarsi of the third and fourth pairs setose, not at all scopulate; patella of second legs armed in front with a single spine; tibia + patella of fourth legs a little shorter than cephalothorax, longer than metatarsi of fourth leg; patella of third leg of about the same length as the tibia; metatarsus of first leg longer than tibia of first; femur of fourth leg about same length as width of cephalothorax.

Patella of *palpus* clearly longer than the tibia; tarsus not fully as long as the tibia + patella.

For structure of palpal organ see Pl. XX, fig. 7.

Total length, 6 mm. Length of cephalothorax, 3 mm.; width, 2.1 mm.

Length of leg I, 6.5 mm.; tib. + pat., 2.1 mm.; met., 1.4 mm.

Length of leg II, 5.8 mm.

Length of leg III, 6.1 mm.

Length of leg IV, 8.4 mm.; tib. + pat., 2.8 mm.; met., 2.3 mm.

Female.—Coloration similar to that of male.

Epigynum of general type of that of *funerea*, but epigynal plate more elongate and more strongly narrowed at posterior end; with posterior margin concave or indented mesally, not bowed caudally.

Total length, 8.5 mm. Length of cephalothorax, 3.4 mm.; width, 2.7 mm.

Length of leg IV, 9.7 mm.; tib. + pat., 3.1 mm.; met., 2.8 mm.

1895. *Trochosa parva* Banks, Ann. N. Y. Acad. Sci., Vol. VIII, p. 430.
1901. *Trochosa parva*, Banks, Proc. Acad. Nat. Sci. Phila., p. 587.
1902. *Trochosa parva*, Banks, Proc. U. S. N. M., p. 217.

Type locality.—Colorado.

Known localities.—Colorado!, Arizona, New Mexico!, Utah!.

Allocosa evagata sp. nov.

Female.—*Cephalothorax* blackish brown; rather paler above; on each side a marginal line of clear black; in front of dorsal furrow a faint polygonal figure outlined in black, with an angle in middle of front margin produced toward eye region as a line and a similar one on each side produced obliquely along side of *pars cephalica*; the cephalothorax rather paler in front of this figure than elsewhere; color deeper about eyes. *Chelicerae* reddish brown, an indistinct blackish mark across middle which mesally continues obliquely upward on inner face. *Legs* yellow with distinct dark rings of which there are three on the femora, the apical one being about twice as broad as the others; these rings incomplete above but continuous laterally and ventrally. The second and third rings on femora IV are confluent along the anterodorsal side. The tibiae each with two dark rings, of which at least the distal one is interrupted above. The metatarsi with three indistinct rings. *Labium, endites, coxae* and *sternum* yellow, the labium and sternum dusky. Front part of dorsum of abdomen obscure reddish yellow, this area embracing some small, ill-defined dark dots. Posteriorly are pairs of ocellate light spots which are united transversely by inverse chevron-lines, between which are indicated pale chevron-lines with the apices directed forward. The dorsum elsewhere and the sides covered with a dense network of black over the obscure yellow background, *i.e.*, appearing black marked with numerous small dots of yellow. Venter yellow with some short transverse marks of dark color toward the sides. *Epigynum* reddish yellow. *Spinnerets* yellow.

First row of *eyes* evidently shorter than the second. Anterior median eyes larger than the lateral (4 : 3), at most their radius apart, half as far from the lateral eyes. Anterior lateral eyes a little less than their diameter from front margin of clypeus, two-thirds their diameter from eyes of second row. Eyes of second row two-thirds their diameter apart. Dorsal eye area of same length as the width in front which is but little less than that behind, the area being subquadrate. Dorsal eye area one-fourth as long as the cephalothorax.

Legs of but moderate length. Tibia + patella IV shorter than the cephalothorax, longer than the metatarsus. Metatarsus IV some longer than tibia + patella of leg I. Spines of anterior tibiæ rather short, slender and prone. None of the tarsi truly scopulate, sparsely clothed with bristles of ordinary form.

Lower margin of furrow of *chelicerœ* with three teeth as in *Lycosa*, the teeth conical and well spaced, the median one being largest. The upper margin with but two teeth which are stout and conical, the first being larger than the second and also larger than those of the lower margin which are of about same size as the second one above.

Labium attenuated anteriorly, its front margin concave.

For structure of *epigynum* see Pl. XXIII, fig. 4.

Total length, 5.2 mm. Length of cephalothorax, 2.8 mm.; width, 2 mm.

Length of leg I, 6.1 mm.; tib. + pat., 2 mm.; met., 1.3 mm.

Length of leg II, 5.8 mm.

Length of leg III, 5.8 mm.

Length of leg IV, 7.5 mm.; tib. + pat., 2.5 mm.; met., 2.2 mm.

Syn.—1898. *Aulonia*(?) *funerea* Banks, Proc. Cal. Acad. Sci., p. 273.

Locality.—Baja California.

Described from a specimen loaned by California Academy of Sciences and bearing label by Banks of *Aulonia*(?) *funerea* Htz.

While not yet reported actually from within our borders, the form will doubtless be found to occur in the Southwest and is therefore included.

(?)**Allocosa exalbida** L. Becker, 1881.

(*Loc. sup. cit.*, figs. 3, 3*a*, 3*b*.)

Only figures were published. A pale species about 11 mm. long, with very long legs. The figure of the eyes would seem certainly to prove this species not to be a *Lycosa*. The epigynum is not that either of *Lycosa* or a *Pardosa*, being like that of some Piratas and much like that of *Allocosa* (*funerea*).

The eyes also resemble those of this latter genus, but this form is placed here with much doubt.

Locality.—New Orleans.

The genus **SOSIPPUS** E. Simon, 1888.

(Ann. Ent. Soc. Fr., p. 205.)

Entire body densely clothed with rather long *pubescence*. Anterior *tibiæ* armed beneath with three pairs of spines which are basal, median or submedian, and apical in position respectively; these spines long and apically slender and aculeate, much longer than the diameter of the joint (Pl. XI, fig. 4). Anterior *eyes* well separated, equidistant or very nearly so; the lateral ones on protruding tubercles, as large as or (as in ours) larger than the median; the anterior row longer than the second (Pl. XI, fig. 2); clypeus as wide as the diameter of an anterior lateral eye; eyes of second row considerably less than their diameter apart; quadrangle of posterior eyes trapeziform, distinctly broader behind than in front. *Cheliceræ* armed below with four stout conical teeth. *Labium* longer than wide, the basal excavation (in ours) one-third the total length. Posterior *spinnerets* distinctly and considerably longer than the anterior, the second joint of the former being long and conical (Pl. XI, fig. 5). *Epigynum* with a guide which in the known species is subclavately enlarged distally (Pl. XXIII, fig. 2). Alveolar area of male *palpus* comparatively small; a simple (in ours) process from basal lobe present in an exterior position, extending distally and free except at base; no pit or fold at base of process (Pl. XXIII, fig. 1).

Syn.—1898. *Sosippus* Simon, Hist. Nat. Araign., 2, p. 326.
1902. *Sosippus* Cambridge, Biol. Cent. Amer., pp. 315–332.
1903. Comstock, Classif. of N. A. Spiders.

Cephalothorax long and rather low, the pars cephalica not elevated. *Face* rounded forward to the front eye row, the clypeus from above below more or less retro-oblique, its sides convex and slanting outward (Pl. XI, fig. 4). Quadrangle of posterior *eyes* one-fifth as long as the cephalothorax. *Cheliceræ* long and robust, the upper margin armed as usual with three teeth of which the median one is much stoutest; in the armature of the lower margin of the furrow with four stout teeth the genus resembles *Dolomedes*; the statement made by Simon that the two middle teeth of the lower margin are longer than the others does not hold for *S. floridanus*, in which the fourth tooth is distinctly longest; in immature specimens sometimes but three teeth are present on the lower margin. *Legs* with the tarsi and metatarsi densely and widely scopulate for their entire lengths from base to apex, the scopulæ long; the scopulæ of the posterior pairs divided by a median narrow line of bristles; distal joints of legs with long aculeate bristles.

Spiders of large size, in general appearance similar to *Lycosa*. In the character of the mouth parts they suggest some of the *Pisauridæ*. In the structure of the spinnerets and in the color markings of the abdomen and especially in habits they show close affinities with the *Agelenidæ*. The habits of the species of this genus so far as observed are very similar to those of *Hippasa* and *Porrima*, the two most closely related genera. The three genera are all composed of species which are sedentary in habit, building large webs of fine silk with a central funnel-shaped tubular retreat, precisely as do the Agelenas and other *Agelenidæ*. In rushing out to seize their entangled prey they run upon the lower surface of the web. Like other *Lycosidæ*, however, they suspend their cocoons to the spinnerets where they are maintained constantly, never depositing them upon the web. They do not desert their webs during the cocooning season. According to Cambridge, the movements of a *Sosippus* which he observed upon the Amazon were exceedingly quick, like those of *Agelena*.

Sosippus is known only from the Americas, having been found in Florida, Lower California, Mexico, Central America and Brazil. But one species occurs within our limits.

Sosippus floridanus Simon.

Female.—*Cephalothorax* deep reddish brown or reddish black without distinct light markings in the tegument; behind the eye region a median stripe of yellow hair and on each side a wider marginal band of white hair intermixed anteriorly with some of yellow color, these marginal bands extending forward to the clypeus but not joining across it; pubescence elsewhere dark. *Cheliceræ* shining black sparsely clothed above with blackish hair and densely clothed below with grayish-brown hair of which there is a fringe along the furrow. *Labium* and *endites* rather dark reddish brown, paler distally. *Sternum* reddish-brown, the *coxæ* of legs a little paler and less reddish, clothed with cinereous hair intermixed with longer brown bristles. *Legs* fuscous, varied with some reddish-brown lines and marks, the femora darker than the other joints clothed with brown and cinereous pubescence. *Abdomen* blackish above, the venter brown; on each side of dorsum a row of spots of white hair and the median part of dorsum behind crossed by narrow white lines similarly formed by pubescence; outer part of dorsum and sides densely covered with minute spots and streaks of white hair; venter densely clothed with brown and cinereous hair, two darker lines converging from the epigynum backward and uniting before attaining the spinnerets, these lines being covered with the dark hair unmixed.

Face with the sides convex and widely slanting, in height only about half as great as the length of the chelicerae.

Anterior row of *eyes* clearly longer than the second, rather strongly procurved; anterior median eyes some less than their diameter apart, and less than their diameter from eyes of second row; anterior lateral eyes a little larger than the median, their tubercles prominent, their diameter from front margin of clypeus, fully one and one-third their diameter from eyes of second row; eyes of second row large, two-thirds their diameter apart; quadrangle of posterior eyes half again as wide behind as in front, a little more than one-fifth the length of the cephalothorax (4.8 : 1). Lower margin of furrow of *chelicerae* with the teeth nearly equidistant, the fourth evidently largest. *Labium* but slightly longer than broad (13 : 12.8); basal excavation one-third length of labium; sides below hardly converging, but above strongly rounding and converging; front margin very slightly widely concavate to straight (Pl. XI, fig. 1). *Legs* with tibiæ armed as described under the genus, the two basal pairs long and slender, apically bristle-like, the apical pair stout and abruptly pointed (Pl. XI, fig. 4); tarsi, metatarsi and distal part of tibiæ I and II densely scopulate, the posterior ones differing as usual. For spinnerets see Pl. XI, fig. 5.

For the structure of the *epigynum* see Pl. XXIII, fig. 2.

Total length, 14.2 mm. Length of cephalothorax, 7 mm.; width, 5 mm.

Length of leg I, 17.8 mm.; tib. + pat., 6.1 mm.; met., 4 mm.

Length of leg II, 16 mm.

Length of leg III, 15.5 mm.

Length of leg IV, 22.9 mm.; tib. + pat., 7 mm.; met., 6.2 mm.

Male.—Coloration as in the female, or a little lighter; palpus clothed with fulvo-cinereous pubescence.

Tibia of *palpus* longer than the patella, the tarsus nearly equalling the combined length of the two preceding joints; tarsus much wider than the tibia (3 : 2). For structure of the palpal organ see Pl. XXIII, fig. 1.

Total length, 11.2 mm. Length of cephalothorax, 6 mm.; width, 4.2 mm.

Length of leg I, 18.5 mm.; tib. + pat., 6.3 mm.; met., 4 mm.

Length of leg II, 18 mm.

Length of leg III, 17.8 mm.

Length of leg IV, 23.7 mm.; tib. + pat., 7.1 mm.; met., 7 mm.

Locality.—Florida!.

The female described above is one of the type specimens.

The genus TRABEA Simon, 1876.

(Arachn. Fr., 3, p. 356.)

Anterior tibiæ and metatarsi armed beneath with very long *spines* which are much longer than the diameter of the joint; of these spines there are on the tibiæ three or four pairs (Pl. XII, fig. 2). Anterior *eyes* in a very strongly procurved row which is shorter than the second; anterior median eyes much closer to each other than to the lateral which are but little or sometimes not at all smaller; clypeus narrow, the anterior lateral eyes being separated from its front margin by their diameter or but little more, always farther from the eyes of second row; eyes of second row at upper exterior angles of face, strongly convex and protruding, less than their diameter apart; eyes of third row likewise strongly convex, divergent, facing outward and backward, quadrangle of posterior eyes but little wider behind than in front. *Labium* wide, attenuated anteriorly, the basal excavation short. Posterior *spinnerets* (at least in ours) evidently longer than the anterior, the second joint distinct though not long. *Epigynum* with a guide; in ours, strongly chitinized only on each side about the spermatheceal openings, elsewhere less dense, clothed with hair as tegument elsewhere. Male palpus bearing a *scopus* in a median position; basal spur extremely large, much longer than the erect branch (in ours).

Syn.—1885. *Aulonia* Emerton (*A. aurantiaca*), Tr. Conn. Acad. Sci., 6, p. 498.
1898. *Trabæa* Simon, Hist. Nat. Araign., 2, p. 349.
1903. *Trabæa* Comstock, Classification of North American Spiders.

Pars cephalica long, but little inclined anteriorly. Sides of *face* straight and vertical or nearly so; face protruding above over its basal portion (Pl. XII, fig. 1). Quadrangle of posterior *eyes* relatively long. Posterior eyes seen from above touching or protruding beyond the lateral margins of pars cephalica (Pl. XI, fig. 8). *Chelicerœ* with the lower margin armed either with two or with three teeth, the upper with three. *Legs* rather long; tarsi either very sparsely scopulate on anterior pairs or the scopulæ quite absent.

Spiders of small size, readily distinguished by the extreme convexity of the eyes of the second and third rows and by the strongly procurved first row with its median eyes closer to each other than to the lateral. The very long straight spines of the anterior legs form a prominent feature. The quadrangle of posterior eyes is relatively much longer than in any other known North American *Lycosidœ*.

Trabea aurantiaca (Emerton), 1885.

(Trans. Conn. Acad. Sci., 6, p. 499, Pl. 49, figs. 6 to 6*b*.)

Female.—Sides of *cephalothorax* black or blackish brown; a bright yellow supramarginal band on each side extending forward to the clypeus and touching the inferior edges of eyes of second and third rows; a yellow median band nearly as wide as third eye row just behind the latter, extending broadly between the third eyes nearly to those of second row, posteriorly rapidly narrowing to a point at the dorsal groove over which it is obscure or absent, becoming again visible on the posterior declivity on which it begins above at a point and widens clavately downward to the posterior margin; eyes surrounded by black; clypeus yellow. *Chelicerœ* smoky brown or blackish above, yellowish distally. *Labium* and *endites* brown, often dusky, pale distally. *Sternum* and *coxœ* of legs yellow to brown. *Legs* with background yellow; femur I black; femur II like I, but with the black more or less broken by yellow, especially so above; the posterior femora more largely yellow, the black marks often faint; patellæ dark or black distally; tibiæ with a basal and an apical dark ring, and the metatarsi more or less darkened at proximal end; the markings of all these joints becoming more indistinct or disappearing on the posterior pairs, the last pair being often clear bright yellow. *Abdomen* orange-brown, the sides marked by a series of parallel black bars which pass obliquely downward and caudad, the most anterior of which on each side bends forward across the corresponding antero-lateral angle; these black bars connected at upper ends on each side by narrow angular lines with angles directed mesad; these angles, excepting the first, are connected into pairs by black chevron-lines across dorsum; anterior area of dorsum showing more indistinctly a lanceolate figure outlined by a fine black line; venter unmarked except for a narrow inwardly bending dark line each side of middle, the two of which are united by a cross-bar just at base of spinnerets. *Spinnerets* dusky orange. *Epigynum* reddish brown about spermathecal openings, elsewhere concolorous with the venter.

Pars cephalica long and high, highest anteriorly and visibly descending caudad to the pars thoracica. *Chelicerœ* a little longer than height of *face*. Anterior row of *eyes* as described for genus; anterior median eyes two-thirds their diameter apart, fully their diameter from the lateral eyes which are about two-thirds as large, their diameter from eyes of second row; anterior lateral eyes their diameter or some less from front margin of clypeus, one and one-half times their diameter from eyes of second row; quadrangle of posterior eyes one-third or more the length of the cephalothorax (Pl. XI, fig. 8). Lower margin of the furrow of *chelicerœ* armed with two stout conical teeth which are subequal; upper margin with three teeth of usual character. *Labium* clearly wider than long (5 : 4); the basal excavation little or not at all more than one-fifth the total length; sides strongly converging anteriorly; front margin truncate or slightly convexly rounded. *Legs* having tarsi bent or curved down at distal end but not at base as in male; tarsi sparsely setose and scopulæ entirely absent. Posterior *spinnerets* widely separated; distinctly longer than the anterior, but in alcohol often bent toward each other and then inconspicuous; the second joint distinct but short, bluntly pointed.

For form of *epigynum* see Pl. XII, fig. 2.

Total length, 3.4 mm. Length of cephalothorax, 1.6 mm.; width, 1 mm.

Length of leg I, 4 mm.; tib. + pat., 1.4 mm.; met., .95 mm.

Length of leg II, 3.8 mm.

Length of leg III, 3.8 mm.

Length of leg IV, 5.5 mm.; tib. + pat., 1.7 mm.; met., 1.5 mm.

Male.—Lighter than female, markings of legs (excepting the anterior femora) and of abdomen less distinct or absent. *Palpi* black; the tip of tarsus yellow, in life clothed, like legs, with white hair

All tarsi of *legs* distinctly curved downward distally, the anterior ones strongly so, those of the third and fourth pairs also bent at proximal end. *Palpus* with the sides of tibiæ parallel, not at all enlarged distally; tibia longer than patella by one-fourth its length; tarsus of about same length as tibia + patella, much wider than the tibia (4 : 2.5).

For palpal organ (drawn out from alveolus) see Pl. XII, fig. 3.

Total length, 2.6 mm. Length of cephalothorax, 1.5 mm.; width, 1 mm.

Length of leg I, 3.6 mm.; tib. + pat., 1.3 mm.; met., 9 mm.
Length of leg II, 3.4 mm.
Length of leg III, 3.3 mm.
Length of leg IV, 4.8 mm.; tib. + pat., 1.5 mm.; met., 1.5 mm.

Syn.—1890. *Aulonia aurantiaca*, Marx, Proc. U. S. N. M., 12.
1892. *Aulonia aurantiaca*, Marx, Proc. Ent. Soc. W., 2.
1892. *Aulonia aurantiaca*, Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 73.
1898. *Trabea aurantiaca*, Simon, Hist. Nat. Araign., 2.

Type locality.—Massachusetts and Connecticut.

Known localities.—Massachusetts!, Connecticut, New York, District of Columbia!.

The genus **SOSILAUS** Simon, 1898.

(Hist. Nat. d. Araign., Vol. 2, p. 350.)

"Cephalothorax convex behind, in front long slanting and attenuated, the face rather narrow, oblique and obtuse. Four anterior eyes subcontiguous, in a gently recurved row, the median at least twice as large as the lateral. Eyes of the second row moderate, approximate, occupying a transverse space much narrower than the anterior eye row (Pl. XII, figs. 5, 6). Cheliceræ rather weak, the inferior margin of the furrow tridentate. Labium longer than wide, attenuated and obtuse. Legs rather long; the metatarsi and tarsi slender and long, not scopulate; anterior tibiæ armed beneath with 5–5 prone spines and the metatarsi with 3–3 similar ones, there being smaller lateral spines" (Simon).

In the character of cephalothorax and eyes this genus is very similar to *Tricca* and similarly much suggests *Allocosa*, from which it differs most conspicuously in the armature of the anterior tibiæ. The posterior eyes are situated upon a very oblique plane. The eyes of the second row are relatively small.

But one species of this genus is known and that by a single specimen (*S. spinger* E. S.).

Syn.—1903. *Sosilaus* Comstock, Classification of North American Spiders.

Sosilaus spiniger Simon, 1898.

(Hist. Nat. Araign., 2, p. 350.)

"Length of male 3.7 mm.—Cephalothorax fulvo-rufous, smooth and subglabrous, a narrow marginal fuscous line and the pars thoracica marked irregularly with short radiating stripes. Abdomen fusco-testaceous, paler in front and below. Legs lurid, tarsi infuscated. Palpi lurid, the tarsus infuscated, sides parallel, setose with long bristles below; tibia a little longer than the patella, terete, gently curved; tarsus shorter than the tibia with patella, narrowly ovate, acuminate; bulb simple."

Locality.—Louisiana.

I have not found in collections from Louisiana and neighboring States any specimens referable to this species, which remains known only from M. Simon's diagnosis and comments.

The genus **PIRATA** Sundevall, 1833.

(Subgenus sub *Lycosa*, Consp. Arachn. p. 24.)

Body clothed sparsely with short hairs, in life never cloaking and concealing the tegument as is commonly the case in *Pardosa* and *Lycosa*. Anterior tibiæ in the female armed beneath with two pairs of *spines*, respectively basal and submedian in position, never with an apical pair; these spines very long and overlapping, much longer than the diameter of the article; rarely with three pairs beneath, the third pair midway between the median pair and the distal end of the joint; tibiæ in the male with the long spines as in the female, but in addition with an apical pair (Pl. X, fig. 7). Anterior row of *eyes* as long as or but little shorter than the second, a little procurved or straight, the eyes subequal or with the median a little larger than the lateral; clypeus rather narrow, the anterior lateral eyes separated from its front margin at most by their diameter, a little farther from eyes of second row; eyes of the second row large, less than their diameter apart; dorsal eye area trapeziform, wider behind than in front. *Labium* longer than wide, attenuated anteriorly in varying degrees; basal excavation short, nearly always but one-fourth or less the length of the labium, only rarely longer. Posterior *spinnerets* much longer than the anterior, their second joint distinct and conical. *Epigynum* presenting no true guide, usually consisting behind of two strongly chitinized lobes or tubercles upon which are the openings of the spermatheca. Bulb of male *palpus* with no true scopal fold or one but slightly indicated; conductor as a conspicuous erect apophysis or process, in a mostly medio-apical position, and its principal branch reaching to or extending beyond the front margin of the alveolus; a basal spur or branch of considerable size always present on conductor; the embolus small, short, nearly concealed usually; lunate plate very large, one-third as long as the bulb.

Syn.—1848. *Lycosa* subgen. *Potamia* C. Koch, Die Arachn., 14, p. 98.
1876. *Pirata* Simon, Arachn. Fr.
1876. *Pirata* Keyserling, Verh. z. b. Ges. Wien, 26, p. 610.
1885. *Pirata* Emerton, Trans. Conn. Acad. Sci., 6, p. 492.

1890. *Pirata* Marx, Proc. U. S. N. M., 12, p. 564.
1898. *Lycosa* Simon (ad. part), Hist. Nat. Araign., 2, p. 345.
1902. *Pirata* Montg., Proc. Acad. Nat. Sci. Phila., p. 536.
1903. *Lycosa* Comstock (ad. part.), Class. N. A. Spiders, p. 51.
1904. *Pirata* Chamberlin, Can. Ent., p. 177.
1904. *Aulonia,* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 265.

Cephalothorax moderately low; the pars cephalica not elevated being nearly level with the dorsal line of the pars thoracica, in front broadly obtusely rounded, the sides rounded and considerably sloping. *Face* mostly low, much shorter than the length of the cheliceræ, trapeziform, the sides in most convexly rounded and widely sloping, rarely sub-straight and very steep or nearly vertical, the eyes of second row more or less distant from its upper exterior angles. Except in the few species with the sides of the face very steep, the posterior eyes when viewed from above are removed from the lateral margins of the pars cephalica by more than their diameter as is the case in *Lycosa* (Pl. X, fig. 5). Quadrangle of posterior eyes one-fourth, or usually less, the length of the cephalothorax, rarely longer. *Cheliceræ* robust, the lower margin with three teeth similar to those of *Lycosa,* but with the third often conspicuously reduced as in *Pardosa;* upper margin with three teeth of the usual character; fringe of hair of upper margin more sparse than in *Lycosa;* posterior line with long but sparse hairs. *Legs* robust; tarsi in most cases simply setose on all pairs, very rarely with the anterior ones with thin lateral scopular lines as in *Pardosa,* the bristles, however, being often serried (Pl. X, fig. 7); tibia + patella of leg IV sometimes longer than, at others shorter than, the cephalothorax, longer than the metatarsus or more rarely of the same length. The cephalothorax always presents a median pale stripe, which begins on the posterior declivity as a narrow line and then continuously widens to the third eye row, there more abruptly widening, passing below the posterior eyes of each side and attaining the clypeus; the eyes are mostly upon black; the median stripe encloses in its anterior half a bifurcate or V-shaped dark mark, the undivided median part being at the anterior end of the dorsal furrow and sending an arm forward to the inner margin of the third eye on each side (Pl. X, fig. 5); marginal light stripes may or may not be present; many species are marked on the abdomen with lines and spots of bright white hair.

The Piratas are spiders of small or of medium size. The males are in most cases as large as or larger than the females.

In habits they are much like the *Pisauridæ.* They occur in damp meadows or more especially at the margins of streams, ponds and other bodies of water, upon which they run with great ease. Many forms in case of danger dive readily beneath the surface of the water and hide under stones, leaves, etc., at the bottom. The cocoon is carried about attached to the spinnerets, though when the females are at rest it is commonly held in the cheliceræ. The cocoons are clear white in color and spherical in shape, marked at the equator by a seam less strong than that on the cocoons of *Pardosa*. The female constructs a temporary retreat under stones and other suitable places, spinning a small irregular web of very delicate texture. The greater length of the superior spinnerets would seem to be associated with this web-spinning habit.

Key to Species of Pirata.

1. Lower margin of the furrow of the chelicerae armed with but two teeth, ... 2.
   Lower margin of furrow armed with three teeth, ... 3.
2. Cephalothorax less than 2 mm. long, ... *minutus* Em.
   Cephalothorax 3 mm. or more long, ... *marxi* Stone.
3. Cephalothorax with no submarginal light stripes, . *montanus* Em.
   Cephalothorax with submarginal light stripes, ... 4.
4. Cephalothorax less than 2 mm. long, or at most not longer, . 5.
   Cephalothorax much more than 2 mm. long, ... 6.
5. All joints of legs except tarsi distinctly ringed with black (female), *aspirans* Chamb.
   Femora dark at distal ends, other joints of legs light, not at all marked with dark, ... *humicolus* Mtg.
6. Cephalothorax in life or when dry showing on each side a marginal stripe of bright white hair, ... 7
   Cephalothorax showing no such stripe, ... *insularis* Em.
7. A black marginal stripe below each pale lateral stripe, *piratica utahensis*, new var.
   No such black marginal line, ... *febriculosa* (Beck.).

The key above does not include *prodigiosa* Keys. or *bilobatus* Tullg.

Pirata minutus Emerton, 1885.

(Trans. Conn. Acad. Sci., 6, p. 493, Pl. 48, figs. 10–10*c*.)

Female.—Sides of *cephalothorax* dark brown to gray-brown; a yellow median stripe of more or less greenish hue which begins caudally as a narrow line, but expands continuously forward to the eye region, continuing as a narrow stripe on each side below eyes to the clypeus as usual; within the median light band are two dark lines or narrow stripes extending backward from eyes of third row and uniting together into one line at the dorsal groove, forming thus the typical V-shaped mark; a marginal light stripe on each side with uneven upper border, not extending forward beyond third eye row; in life a marginal line of white hair much narrower than light stripe of the tegument with which it is coextensive in length. *Cheliceræ* black-brown, yellow distally; subsparsely clothed with rather long light gray hairs. *Labium* and *endites* dark brown, paler distally. *Sternum* deep brown to blackish, in most cases with a yellow median line and a number of yellow spots along each lateral margin; clothed with comparatively long light gray hairs. *Coxæ* of legs beneath yellow. *Legs* light brown or yellow, all joints excepting the tarsi annulate with black; the femora have usually a submedian ring and a broader ring at distal end, the latter sometimes partially divided by light; the tibiæ and metatarsi have a wide annulus at each end, leaving especially on the tibiæ a relatively narrow yellow ring at the middle; tibiæ sometimes entirely black. *Abdomen* above black, sometimes with and sometimes without narrow lanceolate yellow mark at base; dorsum clothed with sparse light brown or grayish hair, with a series of five or six spots of white hair along each side for the entire length, and posteriorly with narrow cross-lines of similar white hair, these lines sometimes indistinct; sides a little paler than the dorsum, with some streaks and dots of white pubescence; venter dark gray, more densely clothed with hair than the sides and dorsum, the hair being gray. *Epigynum* reddish brown, usually nearly or quite concealed by long gray hairs. *Spinnerets* dark brown.

Face but little more than two-thirds as high as the chelicerae are long, sides substraight and nearly vertical as in *Pardosa*.

Anterior row of *eyes* nearly as long as the second, more strongly procurved than is usual in this genus; anterior median eyes about their radius apart, a little larger than the lateral; anterior lateral eyes rather less than their diameter from front margin of clypeus, farther from eyes of the second row; quadrangle of posterior eyes one-fourth the length of the cephalothorax.

Lower margin of furrow of *chelicerae* with but two teeth which are relatively long and slender, the second one a little smaller than the first, the latter evidently representing the second of the three typically present in the *Lycosidæ*.

Legs with tibia + patella of the fourth pair a little longer than the cephalothorax, which is of the same length as the metatarsus of the same legs; tibiæ of first legs armed ventrally with a basal and a submedian pair of spines which are very long, overlapping as usual.

For structure of *epigynum* see Pl. XXII, fig. 7.

Total length, 3.3 mm. Length of cephalothorax, 1.8 mm.; width, 1.3 mm.

Length of leg I, 4.5 mm.; tib. + pat., 1.6 mm.; met., 1 mm.
Length of leg II, 4.4 mm.
Length of leg III, 3.8 mm.
Length of leg IV, 6.3 mm.; tib. + pat., 2 mm.; met., 1.8 mm.

Male.—Femora of first two pairs of legs black, others dusky yellow; all other joints clear yellow, without indications of any dark marks; palpi entirely black, except the patellæ which often are paler above; coloration otherwise nearly as in female, but in general darker.

Tibia of palpus considerably longer than patella, and narrower than tarsus; main process of apophysis of conductor with its upper half bent outward at right angles to lower half at or a little in front of front margin of alveolus; basal spur ending apically in an acute point (Pl. XXI, fig. 9).

Total length, 2.9 mm. Length of cephalothorax, 1.6 mm.; width, 1 mm. Length of leg I, 4.4 mm.

Syn.—1890. *Pirata minuta* Em., Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 72.
—— *Pirata exigua* Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 72, Pl. 1, fig. 48.
1890. *Pirata minuta* Em., Marx, Proc. U. S. N. M., 12, p. 564.
Non-syn.—1892. *Pirata minuta* Em., Fox, Proc. Ent. Soc. W.
Syn.—1898. *Pirata minutus* Em., Simon, Hist. Nat. Araign., II, p. 335.

Type locality.—Massachusetts and Connecticut.

Known localities.—Massachusetts!, Connecticut, New York (Ithaca!).

I have found females of this species with egg-sacs fairly common in certain damp meadows about Ithaca, New York, late in the summer. A few were taken at the margins of ponds. The male above described, from Massachusetts, was kindly loaned me by Mr. J. H. Emerton.

Pirata aspirans Chamberlin, 1904.

(Can. Ent., Vol. XXXVI, p. 286.)

Female.—Sides of *cephalothorax* dark brown crossed by radiating lines of black; a pale median band beginning at posterior margin narrows to caudal end of thoracic furrow, then widens gradually to eyes of third row where it more or less abruptly widens and encloses the eye area, below which on each side it attains the clypeus as usual; within the median pale band a median line at front of furrow bifurcates, sending a branch to eyes of each side as usual; eyes surrounded by black; clypeus yellow; a marginal band of yellow on each side, limited below by a line of black, these side stripes extending forward only to opposite the third eyes. *Chelicerœ* reddish yellow, smoky over middle region and with branching lines of black over basal area. *Labium* yellow. *Endites* yellow above, and darker, dusky-brown below.

Sternum and *coxæ* of legs beneath immaculate yellow. *Legs* yellow; all joints except the tarsi more or less distinctly banded with black rings; these dark rings on femora of first legs confluent and also semi-confluent on other joints; femora with four rings, of which the apical one may be indistinct. Dorsum of *abdomen* black, at sides minutely punctate with yellow; at base a lanceolate yellow mark, on each side of which just behind middle is a small ovate yellow spot with black dot at center, and each side of apex a larger triangular yellow spot; behind is a series of yellow transverse bowed or chevron-shaped transverse marks which become successively shorter caudad, the last few being diamond shaped and contiguous by their apices; sides of abdomen above like sides of dorsum, but below becoming more and more yellow, the black being first reduced to spots and then quite disappearing at venter; venter yellow, dusky in front of the genital furrow and also with a dusky interrupted median band extending back from epigynum two-thirds the distance to the spinnerets, and on each side of venter a narrow irregularly edged black line which does not extend all the way to the spinnerets behind. *Spinnerets* yellow. *Epigynum* reddish yellow.

Sides of *face* of moderate steepness; face a little more than half as high as the cheliceræ are long. Seen in profile, the dorsal line of the cephalothorax is straight and horizontal or nearly so between the eyes and the posterior declivity, the pars cephalica not being elevated at all above the pars thoracica. Lower margin of furrow of *cheliceræ* with three teeth, of which the middle one is much stoutest and longest, the first one clearly the smallest; the upper margin with three teeth of the usual proportions. *Labium* slightly longer than broad (5 : 4.8), four and five-tenths times longer than its basal excavation strongly converging anteriorly; anterior margin indented mesally with its side parts convexly rounded. *Legs* with tibia + patella of the fourth pair much longer than the cephalothorax, which is of the same length as the tibia + patella of the first pair; spines of anterior tibiæ very long, those of the first pair to or a little beyond the middle of the joint.

Anterior row of *eyes* but slightly procurved, shorter than the second; anterior median eyes about two-thirds their diameter apart, closer to the lateral eyes which are two-thirds as large, hardly two-thirds their diameter from eyes of second row; anterior lateral eyes three-fourths their diameter from front margin of clypeus, their diameter or slightly more from eyes of second row; eyes of second row two-thirds their diameter apart; quadrangle of posterior eyes slightly wider in front than long, longer behind than in front in ratio of 9 : 7 (nearly), one-fourth as long as the cephalothorax.

Epigynum with the lateral tubercles widely rounded behind, being mesally shallowly angularly excavate (Pl. XXII, fig. 6).

Total length, 4 mm. Length of cephalothorax, 1.9 mm.; width, 1.4 mm.

Length of leg I, 5.4 mm.; tib. + pat., 1.9 mm.; met., 1.2 mm.

Length of leg II, 5.1 mm.

Length of leg III, 4.7 mm.

Length of leg IV, 7.3 mm.; tib. + pat., 2.3 mm.; met., 2 mm.

Male.—For structure of palpal organ see Pl. XXII, fig. 5.

Syn.—1890. *Pirata minuta* Fox (at least ad. part.), Proc. Ent. Soc. W.

Locality.—Washington, D. C.!.

Pirata humicolus Montgomery, 1902.

(Proc. Acad. Nat. Sci. Phila., p. 575, Pl. 30, figs. 40, 41.)

Female.—Sides of the *cephalothorax* brown to black with lighter radiating lines; a yellow median band widening from behind, where it is a mere line, forward and enclosing the usual dark bifurcate mark in its front half; on each side a yellow supramarginal stripe which does not extend upon the pars cephalica and which is limited below by a black marginal line; in life there is a marginal line of white hair. *Chelicerœ, labium* and *endites* dark reddish brown. *Sternum* dark brown, paler along middle and darker at lateral margins. *Legs* brown, often of greenish hue, the *coxæ* beneath paler, yellow. *Palpi* like the legs, paler at the base. *Dorsum* of *abdomen* brown of greenish tinge; a basal lanceolate median stripe; two rows of light spots clothed with white pubescence on each side of the basal stripes and extending to the spinnerets behind, the outer line often evidently only caudally, the spots of the inner lines largest anteriorly connected by some thin cross-lines of white hair; sides of abdomen yellowish brown tinged with green; venter clear yellow, sometimes a few small black dots in front of spinnerets. *Epigynum* reddish brown. *Spinnerets* yellow.

Chelicerœ one and one-third times the height of the *face*, the sides of which are subvertical as in *Pardosa*. Anterior row of *eyes* a little shorter than the second, a little procurved; eyes of second row nearly their diameter apart; quadrangle of posterior eyes one-fifth as long as the cephalothorax. Lower margin of the furrow of the *chelicerœ* armed below with three teeth.

Total length, 4 mm. Length of cephalothorax, 1.8 mm.

Length of leg I, 4.8 mm.

Length of leg II, 4.3 mm.

Length of leg III, 4.2 mm.

Length of leg IV, 6.1 mm.

Male.—Coloration darker than in the female. *Cephalothorax* nearly black. *Abdomen* nearly as in female but the venter darker. *Cheliceræ* black. *Legs* yellow except the femora of the first two pairs which are black. Femur of *palpi* black, the other joints paler.

Total length, 2.9 mm. Length of cephalothorax, 1.7 mm.

Syn.—1903. *Pirata humicolus* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 654.
1904. *Aulonia humicola,* Montgomery, Proc. Acad. Nat. Sci. Phila., p. 265, Pl. XX, fig. 33.

Locality.—Pennsylvania.

Known localities.—Pennsylvania!, New Jersey.

Pirata montanus Emerton, 1885.

(Tr. Conn. Acad. Sci., p. 493, Pl. 48, fig. 9.)

Female.—Sides of *cephalothorax* deep brown or blackish with no lighter marginal stripes ; a yellow or reddish-yellow median stripe beginning at the clypeus enclosing the dorsal eyes and then narrowing caudad, ending as a pointed line on the posterior declivity; median band enclosing in front of dorsal groove a dark stripe which bifurcates, sending one of its branches forward to and along the inner margins of the eyes of each side; eyes enclosed with black; in life on each side a marginal line of white hair. *Cheliceræ* dark brown, paler distally, the tips of claws reddish. *Labium* and *endites* brown, lighter distally as usual. *Sternum* brown, a dark line or row of dark spots on each side, the two converging caudad. *Legs* yellow, without markings excepting sometimes faint annuli on femora. *Abdomen* above black; a reddish-brown median lanceolate stripe at base extending to middle; each side of apex of this stripe a reddish spot and behind a number of chevron-shaped transverse marks; all these marks may be indistinct and sometimes the basal stripe alone is distinguishable; in life there is on each side a series of about six spots of light yellow hair; sides colored like the dorsum but in life more densely pubescent; a short line of yellow hair passing back across each antero-lateral angle, the sides elsewhere being clothed with black hairs with more scattered ones of yellow; venter brown, clothed with yellowish gray pubescence. *Spinnerets* brown. *Epigynum* reddish black.

Sides of *face* steep, but evidently diverging outward below.

First row of *eyes* nearly as long as the second, a little procurved ; anterior median eyes more than half their diameter apart (nearly three-fourths), nearly the same distance from the smaller lateral eyes (about 3 : 4); anterior lateral eyes their diameter or rather a little less from the front margin of clypeus, more than their diameter from eyes of second row; eyes of second row less than their diameter apart; quadrangle of posterior eyes more than one-fifth the length of the cephalothorax (1 : 4.5).

Lower margin of the furrow of *chelicerœ* with three teeth, of which the middle one is usually a little longest.

Legs with tibia + patella IV longer than the cephalothorax, which latter is longer than tibia + patella I; anterior tibiæ beneath with three pairs of very long overlapping spines, the third pair being between the middle pair and the distal end of the joint and truly ventral in position (Pl. X, fig. 9); patella II armed in front.

Epigynum with the posterior margin nearly straight; not excavated mesally; the bulbs of the spermathecæ contiguous mesally. (Pl. XXII, fig. 9.)

Total length, 2.4 mm. Length of cephalothorax, 5 mm.

Length of leg I, 6.5 mm.; tib. + pat., 2.2 mm.; met., 1.5 mm.

Length of leg II, 6.2 mm.

Length of leg III, 6.1 mm.

Length of leg IV, 9.4 mm.; tib. + pat., 3 mm.; met., 2.8 mm.

Syn.—1890. *Pirata elegans* Stone, Proc. Acad. Nat. Sci. Phila., 42.
—— *Pirata montanus*, Marx, Proc. U. S. N. M., 12, p. 564.
1892. *Pirata agilis* Banks (ad. part), Proc. Acad. Nat. Sci. Phila., 44, p. 72, Pl. I, fig. 47.
1902. *Pirata elegans*, Montg., *op. cit.*, p. 581, Pl. XXX, fig. 36.
—— ?*Pirata nigromaculatus* Montg., *ibid.*, p. 579, Pl. 30, figs. 44, 45.
1904. *Pirata elegans*, Montgomery, *ibid.*, p. 310.
——. ?*Pirata nigromaculatus*, *ibid.*, p. 310.

Type locality.—New Hampshire (White Mountains) and New York (Adirondack Mountains at Long Lake).

Known localities.—New York!, New Hampshire, Pennsylvania, Utah!.

Pirata marxi Stone, 1890.

(Proc. Acad. Nat. Sci. Phila., 42.)

Female.—Sides of *cephalothorax* in fresh specimens obscure brown to gray-black, crossed by many radiating lines of black; a yellow median band of the typical form enclosing the usual bifurcate mark in front of the dorsal groove, the mark coalescing on each side just in front of the groove with the dark area of the sides; there is thus between the arms of the V-mark a narrow median yellow stripe or line which extends forward to the second eye row, and on each side of pars cephalica also a narrow line which extends forward beneath the eyes to the clypeus, but which is disconnected with the median stripe behind; on each side a supramarginal yellow stripe with uneven upper margin, and limited below by a black marginal line; no marginal stripe of white hair. *Chelicerœ* reddish brown. *Endites* brown, pale distally, the *labium* in most darker, dusky-brown to blackish. *Sternum* brown. *Coxœ* of legs beneath yellow. *Legs* clear yellow, darker distally, entirely without dark rings or markings. *Abdomen* yellow with markings in black as follows: at base above a lanceolate outline; along each side of dorsum a wavy or zigzag stripe, the two converging to spinnerets, each united with lanceolate basal mark at its base and again at its middle; the outwardly directed angles of these dark stripes often more or less extended down the sides as narrow lines; along the median line of dorsum behind several short black marks, sides of abdomen antero-ventrally with a dark area composed of a close network of black lines, and postero-dorsally with a number of isolated dark areas formed of similar reticulations, leaving thus in most a clear yellow stripe of varying width curving from the dorso-anterior angle obliquely downward and backward between the two darkened areas described; a row of spots of yellow hair on each side of dorsum behind; venter with some scattered minute black dots, a few usually just behind the epigynum and more numerous ones in front of spinnerets, the latter usually forming two short lines close together which may extend forward to middle or even to the spots behind epigynun, sides and venter clothed with yellow hair. *Spinnerets* yellow. *Epigynum* pale brown, reddish marginally, darker caudad.

Face rather low and wide, sides well rounded and slanting. *Cephalothorax* high; highest at third eye row, from there convexly rounded to the dorsal groove; posterior declivity steep.

Anterior row of *eyes* as wide as the second, nearly straight, the centers of the lateral eyes being but little lower than those of the median; anterior median eyes a little larger than the lateral, scarcely one-third their diameter apart, their radius from eyes of second row; anterior lateral eyes four-fifths their diameter from front margin of clypeus, the same distance from eyes of second row; eyes of second row less than their radius apart (2:5); quadrangle of posterior eyes less than one-fifth as long as cephalothorax (1:5.5), wider in front than long, very wide behind, being wider than in front in ratio of 8.4:5.6.

Lower margin of furrow of *chelicerœ* with but two teeth. *Labium* longer than wide, the basal excavation longer than is common; front margin substraight, or but slightly convex. *Legs* with the tibia + patella of the fourth pair longer than the cephalothorax; the corresponding joints of the first pair slightly shorter than the cephalothorax; anterior tibiæ armed below with two pairs of spines in the usual position, shorter than usual in this genus, those of the first pair not overlapping the bases of the second, to which they usually do not fully extend; all tarsi subsparsely setose.

The *epigynum* is a large quadrangular area which is somewhat wider in front than behind, the lateral margins being substraight and a little converging caudad; the posterior border is angularly excavated at the middle and the spermatheca open on each side caudad directly into the excavation, their terminal portions often showing darkly through the chitinous wall. (Pl. XXII, fig. 8.)

Total length, 7.2 mm. Length of cephalothorax, 3.2 mm.; width, 2.2 mm.

Length of leg I, 8.7 mm.; tib. + pat., 3.1 mm.; met., 2 mm.

Length of leg II, 8.1 mm.

Length of leg III, 7.9 mm.

Length of leg IV, 10.6 mm.; tib. + pat., 3.5 mm.; met., 3 mm.

Male.—Coloration as in the female.

Tibia of the *palpus* longer than the patella, of the same thickness (seen from above); tarsus much broader than the tibia. Principal branch of apophysis of conductor long, curving outward above; basal branch relatively large; base of apophysis farther caudad than usual. (Pl. XXI, fig. 8.)

Total length, 5.6 mm. Length of cephalothorax, 3 mm.; width, 2.3 mm.

Length of leg I, 8.5 mm.; tib. + pat., 3.1 mm.; met., 2.1 mm.

Length of leg II, 7.9 mm.

Length of leg III, 7.3 mm.

Length of leg IV, 10.4 mm.; tib. + pat., 3.2 mm.; met., 3 mm.

Syn.—1885. *Pirata piratica* Emerton (non Cl.), Tr. C. Acad. Sci., 6, p. 492, Pl. 48, figs. 7 to 7*b*.
1890. *Pirata piratica* Marx, Proc. U. S. N. M., 12, p. 564.
1891. *Pirata piratica* Marx, Proc. Ent. Soc. W., p. 161.
1892. *Pirata piratica* Banks, Proc. Acad. Nat. Sci. Phila., 44.
1902. *Pirata piratica* Emerton, Com. Sp. U. S., p. 84, figs. 208, 209.
1902. *Pirata marxi*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 582, Pl. XXX, fig. 47.
1904. *Pirata marxi*, Montgomery, *ibid.*, p. 309, Pl. XIX, fig. 27.

Type locality.—Pennsylvania (York County).

Known localities.—Massachusetts!, Connecticut, Rhode Island!, New York!, District of Columbia.

Pirata insularis Emerton, 1885.

(Tr. Conn. Acad. Sci., 6, p. 492, Pl. 48, figs. 8, 8*a*.)

Female.— Sides of *cephalothorax* brown crossed by radiating lines of black; a median reddish-yellow band of the usual form enclosing the V-shaped mark in front; on each side also a yellowish supramarginal stripe with uneven upper edge and limited below by a narrow dark marginal stripe, this stripe not extending forward beyond the cervical furrow; cephalothorax with sparse, short dark hairs, no marginal lines of white pubescence. *Chelicerœ* reddish yellow, clothed sparsely with light gray hair. *Labium* and *endites* reddish yellow, paler distally. *Sternum* and *coxœ* of legs beneath reddish yellow, sparsely provided with mostly stiff blackish hairs, the former often blackish along sides and pale mesally. *Legs* brownish yellow, all joints excepting the tarsi with more or less distinct dark annulations, or these sometimes very indistinct on or absent from the metatarsi. *Abdomen* above blackish; at base above a yellow lanceolate median stripe extending caudally to the middle; each side of the apex of the lanceolate stripe is a yellow spot and behind is a number of transverse yellow marks, each of which has in most cases the shape of an open angle with the apex directed forward, but more rarely the marks are nearly straight; each side of the median markings of the dorsum above described is in life a series of white spots formed of bunches of white hair, the dorsum elsewhere being sparsely clothed with short yellowish hairs and more scattered long dark bristles; a narrow yellow stripe or row of yellow spots passing over each antero-lateral angle caudally, breaking up over the side into more scattered yellow dashes; this yellow stripe on front of sides often partly masked by white hair, but this hair never forming a very distinct or extensive line or stripe; venter pale yellow to grayish, a darker median line behind epigynum, hair of entire venter yellow. *Spinnerets* light brown.

Seen in profile the dorsal line of the *cephalothorax* is nearly horizontal, notched at dorsal groove. The chelicerœ about one and one-fourth times the height of the *face*.

First row of *eyes* nearly as long as the second, nearly straight; anterior median eyes less than their radius apart, closer to the evidently smaller lateral eyes: anterior lateral eyes less than their diameter from front margin of clypeus, some more than their diameter from eyes of second row; quadrangle of posterior eyes one-fifth as long as the cephalothorax.

Labium longer than wide (7 : 6); basal excavation a little more than one-fourth as long as the labium; sides below straight and but slightly converging, more strongly converging and more rounded above; front margin substraight, being very slightly bowed forward. *Legs* with the tibia + patella of the fourth pair clearly longer than the cephalothorax, the corresponding joints of the first legs being also a little longer; anterior tibiæ armed beneath as usual; patella of leg I unarmed, that of leg II with a spine in front; tarsi setose.

Epigynum presenting two more or less divergent tubercles caudad, upon the ventral face of which the spermatheca open; these tubercles, at first angular, may become more rounded with age. (Pl. XXII, fig. 4.)

Total length, 6.5 mm. Length of cephalothorax, 3.1 mm.; width, 2.2 mm.

Length of leg I, 9.2 mm.; tib. + pat., 3.3 mm.; met., 2.2 mm

Length of leg II, 8.4 mm.

Length of leg III, 7.7 mm.

Length of leg IV, 11.6 mm.; tib. + pat., 3.7 mm.; met., 3.6 mm.

Male.—Coloration nearly as in female except that the femora and tibiæ are indistinctly annulate and the other joints clear yellow; the palpi are brown of reddish tinge.

For structure of palpus see Pl. XXII, fig. 3.

Total length, 4.5 mm. Length of cephalothorax, 2.2 mm.

Syn.—1890. *Pirata insularis*, Marx, Proc. U. S. N. M., 12, p. 564.
1892. *Pirata insularis*, Banks, Proc. Acad. Nat. Sci. Phila., 44, p. 71.
1902. *Pirata liber* Montgomery, *op. cit.*, p. 578, Pl. 30, figs. 42, 43.
1904. *Pirata liber*, *ibid.*, p. 311.

Type locality.—Long Lake, Adirondack Mountains, New York.

Known localities.—Rhode Island!, New York!, Pennsylvania!.

This is a common species which is subject to considerable variation, both in some of its structural characters and, more noticeably, in depth of coloration. In some the annulations are very deep and distinct and the body parts are correspondingly dark, while in others the annulations may be very indistinct.

Pirata febriculosa (Beck), 1881.

(Ann. Soc. Ent. Belg., 25, Pl. 3, figs. 2, 2*a*.)

Female.—Sides of *cephalothorax* dark brown to blackish of usually greenish tinge; a reddish yellow median band narrow caudally and widening anteriorly to the eye region, where it expands and passes below the eyes of each side and attains the clypeus; in front of dorsal furrow a median black line which bifurcates sending a branch forward to inner side of third eye of each side in the usual manner; on each side a moderately wide yellow or reddish-yellow marginal band which extends forward as far as the cervical furrow; clypeus yellow; eye region black; along each lateral margin in life a distinct line of white hair much narrower than the light band in tegument; the sides of the cephalothorax are sparsely clothed with short black hairs. *Cheliceræ* yellowish brown, distally reddish yellow, clothed subsparsely with long light gray hair. *Labium* pale brown, lighter distally. *Sternum* and *coxæ* of legs beneath yellow, clothed sparsely with blackish hairs. *Legs* greenish yellow, more reddish distally, sometimes without evident markings, but in the great majority with faint dark annulations showing most distinctly on the femora and tibiæ of the posterior pairs; these annuli usually broken above. *Abdomen* above black or blackish brown; at base is a narrow lanceolate reddish-yellow stripe which ends at middle and is margined with a line of black, outside and parallel with the black edge being in life a line of white hair, the two white lines meeting at a truncate angle on posterior portion of dorsum, these lines sometimes each reduced to a row of spots or less commonly entirely absent; a narrow stripe of white hair passing caudad over each antero-lateral angle and spreading out usually in streaks over the upper part of side and connecting behind with the white of opposite side above spinnerets; lower portion of sides brown and, like most of dorsum, clothed with brown hair; venter brown to gray, paler in front of genital furrow. Tubercles of *epigynum* reddish. *Spinnerets* pale brown.

Face a little more than half as high as the length of the cheliceræ.

Anterior row of eyes nearly as long as second, slightly procurved; anterior median eyes their radius apart; much closer to the lateral eyes; anterior lateral eyes considerably smaller than the median, their diameter or nearly so from the front margin of clypeus, more than their diameter from eyes of second row; eyes of second row considerably less than their diameter apart; quadrangle of posterior eyes less than one-fifth as long as the cephalothorax (1 : 5.5).

Cheliceræ armed as usual. *Labium* longer than wider (10.5 : 10); basal excavation short, scarcely more than one-fifth as long as labium; lower part of sides nearly straight, only slightly converging, but for upper third more strongly rounded and converging; front margin truncate. *Legs* with the tibia + patella of the fourth pair longer than the cephalothorax; the corresponding joints of the first pair shorter than the cephalothorax; tarsi of first two pairs of legs scopulate laterally, those of the posterior pairs simply setose; anterior tibiæ below with the usual basal and submedian pairs of legs which are long, the first well overlapping the second; patellæ of first legs unarmed, those of second with a spine on anterior face.

Epigynum presenting behind two angular tubercles, the inner or mesal faces of which are nearly parallel and are more than usually close together leaving the excavation between them narrow; their outer faces clearly more strongly diverging than the inner. (Pl. XXII, fig. 2.)

Total length, 7.2 mm. Length of cephalothorax, 3.3 mm.; width, 2.6 mm.

Length of leg I, 8.5 mm.; tib. + pat., 3 mm.; met., 2 mm.

Length of leg II, 7.6 mm.

Length of leg III, 7.3 mm.

Length of leg IV, 11.2 mm.; tib. + pat., 3.6 mm.; met., 3.2 mm.

Male.—For structure of palpal organ see Pl. XXII, fig. 1.

Syn.—1904. *Lycosa wacondana* Scheffer, The Industrialist, Kansas, p. 13, Pl. I, fig. 7.
1904. *Pirata sedentarius*, Montgomery, Proc. Acad. Nat. Sci. Phila., p. 312.

Type locality.—Kansas.

Known localities.—New York!, Kansas!, Iowa!, Texas!.

Apparently this species is close to *L. piratica.* The palpal organs are similar, but in *febriculosa* the superior horn of the apophysis is at once seen to be longer and straighter and more outwardly directed.

Pirata piratica (Clerck) var. **utahensis**, new.

Male.—Palpal organ agreeing in detail with that of the European species or nearly so.

Cephalothorax with the median pale stripe and dark V-shaped enclosure as usual, the arms of the latter parallel anteriorly back to posterior third, then converging to a point. Laterial pale stripes reaching pars cephalica, each bordered below with a dark marginal stripe. A marginal line of bright white hair showing in life or in dry specimen as in *febriculosa* and *piratica* of type form. Femora of all legs with dark annuli, these most distinct on second and third pairs, showing clearly on the ventral surface of the latter; other joints unmarked, distal ones some darker. *Sternum* and *coxæ* beneath pale. *Abdomen* black above, the usual pale mark at base; a white stripe of hair over each antero-lateral angle; a narrower line of white hair each side of basal mark, followed behind by a row of white spots similarly formed; venter pale, with three narrow stripes of brown converging caudally.

Length, 6.2 mm. Length of cephalothorax, 3.4 mm.; width, 2.5 mm.

Locality.—Utah!.

Likely to be found throughout the Pacific States.

Pirata prodigiosa Keyserling, 1876.

(Verh. z. b. Ges. Wien, 26, p. 669, Pl. 8, fig. 44.)

Female.—*Cephalothorax* brown with a narrow black line along each lateral margin, above which is an uneven edged, wavy yellow stripe; a similarly colored median band, which beginning narrow behind widens cephalad, is constricted a little behind the eyes and then again widens to enclose the eyes as usual, embracing in its anterior half two dark elongate marks which beginning at the two posterior eyes converge and unite at the front end of the median furrow; eyes enclosed in black. *Cheliceræ* reddish yellow. *Labium* brownish yellow with paler tip. *Sternum* blackish with a yellow median stripe and on each side three similarly colored elongate spots. *Legs* yellow, a little darker distally, with faint indications of light rings. *Palpi* yellow, distal joints brown. *Abdomen* above dark gray; anteriorly with a yellow stripe, near this two small spots, and behind this and extending to the spinnerets a number of paired successively smaller and smaller spots of the same yellow color; sides marked with small streaks and dots of yellow; venter smoky white with three brown longitudinal stripes and several similarly colored streaks at the sides of these. *Epigynum* clear reddish brown. *Spinnerets* brownish yellow. In a second specimen the sternum has two dark, indistinct, parallel longitudinal lines over its middle region.

Cephalothorax shorter than the tibia + patella of the fourth pair of legs, as wide as the metatarsus of the same legs, not highly arched, the entire back apparently of similar height, toward the lateral margins flat and toward the nearly straight caudal margin rather steeply sloping; cephalic furrows indistinct, the head in front low and sloping flatly at the sides.

Anterior row of *eyes* straight, somewhat shorter than the second, separated from the latter and from the margin of the clypeus by not fully the diameter of one of the somewhat larger median eyes; eyes of the second row nearly their diameter apart, more than this from the two-thirds as large eyes of the third, distinctly wider row; entire eye area wider behind than in front. Chelicerae somewhat enlarged in front, not entirely twice as wide as the *labium*, which is somewhat longer than wide and is anteriorly somewhat excavated. *Sternum* somewhat longer than broad, moderately arched and clothed with a few black bristles. *Legs* moderately slender, the fourth pair somewhat more than three and one-half times as long as the cephalothorax and about twice the length of its tarsus longer than the first; tibia + patella IV somewhat longer than metatarsus which is longer than the femur; principal claws of tarsi with 6–7 teeth, the middle one with none; only a thin scopula on tarsi of the two first pairs, none on the posterior; spines of femur I above 1, 1, 1, within 1, without none, of patella I none, of tibia I below 2, 2, 2, within 1; spines of second legs the same as for I. Posterior *spinnerets* twice as long as the anterior and distinctly two-jointed; the middle pair very slender but as long as the anterior.

Total length, 6.2 mm. Length of cephalothorax, 2.8 mm.; width, 2.2 mm.

Length of leg I, 7.9 mm.; tib. + pat., 2.8 mm.; met., 1.7 mm.
Length of leg II, 7.3 mm.
Length of leg III, 6.8 mm.
Length of leg IV, 10.1 mm.; tib. + pat., 3.3 mm.; met., 3 mm.

Syn.—1890. *Pirata prodigiosa* Marx, Proc. U. S. N. M., 12, p. 64.

Locality.—Illinois (Peoria).

Types in collection of Dr. Koch.

Pirata bilobata (Tullgren), 1901.

(Bih. till sv. Vet.-Akad. Handl., B. 27, Abd. 4, No. 1, p. 22, Plate, fig. 12.)

Female.—*Cephalothorax* light brown, clothed with short dark adpressed hairs and strewed with long dark upturned bristly hairs; the pars cephalica with three lighter bands and at the margins of pars thoracica a broad light band. *Chelicerœ* light brown and strewed with long bristly hairs. *Endites* yellow and clothed by long bristly hairs. *Sternum* light brown, clothed by long black bristly hairs. *Legs* pale brown. *Abdomen* above dark brown with a lighter middle band and three pairs of very small white spots; the venter light yellowish brown. *Epigynum* dark corneous.

Cephalothorax with a long and distinct central furrow on pars thoracica; in length a little shorter than the length of tibia and patella and the breadth shorter than the length of tibia of the fourth pair of legs. Front row of *eyes* distinctly procurved; the intervals about equal; the central eyes nearly twice as large as the lateral eyes; the interspace between the central eyes and the margin of the clypeus as long as the diameter of the eyes; eyes of the middle row separated from each other by an interspace about as broad as their diameter and separated from the central anterior eyes by an interspace about as long as the diameter of these eyes; the distance from the posterior eyes a little longer than the diameter of the middle eyes. *Chelicerœ* about twice as long as the face, tapering at the apex. *Endites* about twice as long as labium.

The *epigynum* bilobate, the lobes rounded.

Total length, 3.8 mm. Length of cephalothorax, 2.5 mm.; width, 1.8 mm.

Length of leg I, 6.8 mm.

Length of leg IV, 8.6 mm.

Locality.—Florida. Two adult females from Lake Leonore in Orange County.

Although this species was described as a *Pardosa,* it seems very clear from the structure of the epigynum, as shown in the figure accompanying the original description, taken in connection with several points in the description, that it is a *Pirata.* The statement that the pars cephalica is marked with "three lighter bands" indicates the presence of the peculiar *Pirata* marking of the cephalothorax.

Explanation of Plates VIII–XXIII.

Plate VIII.—General Characteristics of the Genus Pardosa.

Fig. 1.—Right chelicera of *P. sternalis.*
Fig. 2.—Dorsal view of the cephalothorax of *P. lapidicina.*
Fig. 3.—Right chelicera of *P. atra.*
Fig. 4.—Labium of *P. lapidicina.*
Fig. 5.—Face of same.
Fig. 6.—Labium of *P. emertoni.*
Fig. 7.—Ventral view of tarsus of first leg of *P. sternalis.*
Fig. 8.—Labium of *P. atra.*
Fig. 9.—Tibia of first leg of *P. sternalis* seen from behind and slightly below.

Plate IX.—General Characteristics of the Genus Lycosa.

Fig. 1.—Right chelicera of *L. gulosa.*
Fig. 2.—Dorsal view of cephalothorax of *L. helluo.*
Fig. 3.—Right chelicera of *L. kochii.*
Fig. 4.—Tibia of first leg of same viewed from behind and a little below.
Fig. 5.—Face of *L. helluo.*
Fig. 6.—Tarsus of fourth leg of same seen from the side.
Fig. 7.—Side view of tarsus of first leg of *L. helluo* showing scopula.
Fig. 8.—Labium of *L. erratica.*
Fig. 9.—Labium of *L. aspersa.*

Plate X.—General Characteristics of the Genera Allocosa and Pirata.

Fig. 1.—Tibia of first leg of *A. degesta* viewed from the side and a little below.
Fig. 2.—Face of same.
Fig. 3.—Tibia of first leg of *A. funerea* seen from the side and a little below.
Fig. 4.—Labium of same.
Fig. 5.—Dorsal view of cephalothorax of *P. montanus.*
Fig. 6.—Labium of same.
Fig. 7.—Tibia of first leg of same viewed from the side and a little below.
Fig. 8. Spinnerets of same viewed from the side.
Fig. 9.—Tarsus of first leg of *P. montanus* viewed from the side.

Plate XI.—General Characteristics of the Genera Sosippus and Trabea.

Fig. 1.—Labium of *S. floridanus.*
Fig. 2.—Face of same.
Fig. 3.—Right chelicera of same.
Fig. 4.—Tibia of first leg of same viewed from in front and a little below.
Fig. 5.—Spinnerets of same.
Fig. 6.—Tarsus and part of metatarsus of first leg of same viewed from the side.
Fig. 7.—Right chelicera of *T. aurantiaca.*
Fig. 8.—Dorsal view of cephalothorax of *T. aurantiaca.*
Fig. 9.—Labium of *T. aurantiaca.*

PLATE XII.—GENERAL CHARACTERISTICS OF THE GENUS TRABEA (continued) AND SOSILAUS.

Fig. 1.—Face of *T. aurantiaca.*
Fig. 2.—Epigynum of *T. aurantiaca.*
Fig. 3.—Male palpal organ of *T. aurantiaca* drawn out from the alveolus.
Fig. 4.—Tibia of first leg of *T. aurantiaca* viewed from the side and below.
Fig. 5.—Dorsal view of front part of pars cephalica of *S. spiniger.*
Fig. 6.—Face of *S. spiniger.*

PLATE XIII.—COPULATORY ORGANS OF SPECIES OF PARDOSA.

Fig. 1.—Epigynum of *P. saxatilis.*
Fig. 2.—Palpus of same.
Fig. 3.—Epigynum of *P. milvina.*
Fig. 4.—Palpus of same.
Fig. 5.—Epigynum of *P. sternalis.*
Fig. 6.—Palpus of same.
Fig. 7.—Epigynum of *P. banksi.*
Fig. 8.—Epigynum of *P. atra.*
Fig. 9.—Epigynum of *P. pauxilla.*

PLATE XIV.—COPULATORY ORGANS OF SPECIES OF PARDOSA (CONTINUED).

Fig. 1.—Epigynum of *Pardosa emertoni.*
Fig. 2.—Epigynum of *P. sternalis*, immature (*P*=. *coloradensis* Bks.).
Fig. 3.—Epigynum of *P. xerampelina.*
Fig. 4.—Palpus of same.
Fig. 5.—Epigynum of *P. californica.*
Fig. 6.—Epigynum of *P. grœnlandica.*
Fig. 7.—Epigynum of *P. lapidicina.*
Fig. 8.—Palpus of same.
Fig. 9.—Epigynum of *P. moesta.*

PLATE. XV.—COPULATORY ORGANS OF SPECIES OF PARDOSA (CONTINUED).

Fig. 1.—Epigynum of *P. modica*, typical form.
Fig. 2.—Palpus of *id.*, typical form (after Emerton).
Fig. 3.—Epigynum of *P. modica* var. *brunnea.*
Fig. 4.—Palpus of same.
Fig. 5.—Epigynum of *P. mackenziana.*
Fig. 6.—Palpus of same, front view (after Emerton).
Fig. 7.—*Id.*, side view (after Emerton).
Fig. 8.—Epigynum of *P. distincta* (after Emerton).
Fig. 9.—Palpus of same (after Emerton).

PLATE XVI.—THE GENUS SCHIZOCOSA.

Fig. 1.—Epigynum of *S. ocreata.*
Fig. 2.—Palpus of *S. saltatrix.*
Fig. 3.—Epigynum of *S. bilineata.*
Fig. 4.—Epigynum of *S. saltatrix.*
Fig. 5.—Palpus of *S. ocreata.*

PLATE XVII.—COPULATORY ORGANS OF SPECIES OF LYCOSA.

Fig. 1.—Epigynum of *L. helluo.*
Fig. 2.—Palpus of same.
Fig. 3.—Epigynum of *L. erratica.*
Fig. 4.—Palpus of same.
Fig. 5.—Epigynum of *L. riparia.*
Fig. 6.—Palpus of same.
Fig. 7.—Epigynum of *L. aspersa.*
Fig. 8.—Palpus of same.
Fig. 9.—Epigynum of *L. scutulata.*

PLATE XVIII.—COPULATORY ORGANS OF SPECIES OF LYCOSA (CONTINUED).

Fig. 1.—Palpus of *L. scutulata.*
Fig. 2.—Epigynum of *L. punctulata.*

Fig. 3.—Palpus of same.
Fig. 4.—Epigynum of *L. frondicola*.
Fig. 5.—Palpus of same.
Fig. 6.—Epigynum of *L. coloradensis*.
Fig. 7.—Palpus of same.
Fig. 8.—Epigynum of *L. lenta*.
Fig. 9.—Palpus of same.

PLATE XIX.—COPULATORY ORGANS OF SPECIES OF LYCOSA (CONTINUED).

Fig. 1.—Palpus of *L. albohastata* (type).
Fig. 2.—Epigynum of *L. fumosa* (type).
Fig. 3.—Palpus of same (type).
Fig. 4.—Palpus of *L. beani* (type).
Fig. 5.—Epigynum of same (type).
Fig. 6.—Palpus of *L. pictilis* (type).
Fig. 7.—Epigynum of *L. quinaria* (type).
Fig. 8.—Epigynum of *L. pictilis* (type).
Fig. 9.—Epigynum of *L. rubicunda*.

PLATE XX.—COPULATORY ORGANS OF SPECIES OF LYCOSA (CONTINUED).

Fig. 1.—Palpus of *L. avara*, side view.
Fig. 2.—Epigynum of same.
Fig. 3.—Palpus of same, ventral view.
Fig. 4.—Epigynum of *L. avara* var. *gosiuta*.
Fig. 5.—Palpus of *L. cinerea*.
Fig. 6.—Epigynum of same.
Fig. 7.—Palpus of *Allocosa parva*.
Fig. 8.—Epigynum of *L. fatifera*.
Fig. 9.—Epigynum of *L. arenicola*.

PLATE XXI.—COPULATORY ORGANS OF SPECIES OF LYCOSA (CONTINUED) AND OF SPECIES OF PIRATA.

Fig. 1.—Epigynum of *L. carolinensis*.
Fig. 2.—Palpus of same.
Fig. 3.—Epigynum of *L. pratensis*.
Fig. 4.—Palpus of *L. kochii*.
Fig. 5.—Epigynum of same.
Fig. 6.—Palpus of *L. gulosa*.
Fig. 7.—Epigynum of same.
Fig. 8.—Palpus of *P. marxi*.
Fig. 9.—Palpus of *P. minutus*.

PLATE XXII.—COPULATORY ORGANS OF SPECIES OF PIRATA (CONTINUED).

Fig. 1.—Palpus of *P. febriculosa*.
Fig. 2.—Epigynum of same.
Fig. 3.—Palpus of *P. insularis*.
Fig. 4.—Epigynum of same.
Fig. 5.—Palpus of *P. aspirans*.
Fig. 6.—Epigynum of same.
Fig. 7.—Epigynum of *P. minutus*.
Fig. 8.—Epigynum of *P. marxi*.
Fig. 9.—Epigynum of *P. montanus*.

PLATE XXIII.—COPULATORY ORGANS OF SPECIES OF SOSIPPUS AND ALLOCOSA.

Fig. 1.—Palpus of *S. floridanus*.
Fig. 2.—Epigynum of same.
Fig. 3.—Palpus of *A. rugosa*.
Fig. 4.—Epigynum of *A. evagata*.
Fig. 5.—Epigynum of *A. degesta* (that of *funerea* similar).
(See also Pl. XX, fig. 7.)

DESCRIPTION OF TRACHYPTERUS SELENIRIS, A NEW SPECIES OF RIBBON-FISH FROM MONTEREY BAY, CALIFORNIA.

BY JOHN OTTERBEIN SNYDER.

Early in June of last year a large Ribbon-fish was found almost stranded on the beach at Monterey, California. It was secured by Mr. Frederick A. Woodworth, of Pacific Grove, and through his kindly interest sent to Stanford University for identification. Its close resemblance to *Trachypterus ishikawæ*[1] of Japan was at once apparent, but a detailed examination was impossible at that time on account of the decayed condition of the specimen, the delicate silvery skin leaving the body at a touch of the finger, and the muscles almost parting from the bones. After a long immersion in a mixture of strong alcohol and formalin, it may now be handled without further injury.

When the Monterey specimen is compared with the type of *Trachypterus ishikawæ*, certain differences appear which indicate that we have to deal with two distinct species, one of which, being unknown, is here described as *Trachypterus seleniris*. The latter differs from *T. ishikawæ*, the most nearly allied form, in having a more slender body, a smaller head, a smaller eye, and a weaker armature of the body. The chief differences may be tabulated thus:

	T. seleniris.		*T. ishikawæ.*	
Length in millimeters	1520		1650	
Head in length	$9\frac{1}{2}$	times.	$8\frac{3}{5}$	times.
Depth near middle of body	11	"	$7\frac{4}{5}$	"
Depth at beginning of posterior third	$18\frac{1}{2}$	"	14	"
Diameter of eye	32	"	25	"
Length of maxillary	25	"	22	"

Trachypterus seleniris n. sp.

Head, $9\frac{1}{2}$ in the length; depth, $9\frac{1}{3}$; eye, $3\frac{1}{2}$ in head; dorsal rays, 168; pectoral, 9.

Length of head greater than its depth, about equal to depth of body in region of pectoral; snout 3 in head; width of interorbital space 2 in diameter of eye; lower jaw projecting slightly beyond the upper;

[1] *Trachypterus ishikawæ* Jordan and Snyder, *Journal of the College of Science*, Imperial University, Tokyo, Vol. XV, Pt. 2, p. 310, Pl. XVII, fig. 10, Smithsonian Miscellaneous Collections, 45, p. 240, Pl. LXIII.

process of maxillary extending to a vertical through posterior border of eye; maxillary with a leaf-like flap a fourth of its length longer than diameter of eye, and with branched striations radiating from its point of attachment; opercular bones conspicuously striated. Teeth weak; loosely attached ones on vomer, a row of 4 on maxillary, and 4 on each side of symphysis of lower jaw, the posterior of which is 2 times the length of the anterior. Gill-rakers on first arch 5 + 10, provided with tooth-like setæ on the inner side; filaments of pseudobranchiæ equal in length to those of gills.

Origin of dorsal above upper edge of gill-opening, the rays highest near beginning of posterior third of body where they are about $1\frac{3}{4}$ times the diameter of eye; anterior rays not separated from the posterior ones nor lengthened. Length of pectoral slightly more than diameter of orbit. Ventral fins absent, or possibly represented by a mere filament, the place of insertion indicated by a spot on the breast below base of pectoral, where the skin, colored and sculptured, looks much like a pair of folded fins. Caudal projecting upwards; short fragmentary filaments present; several small spines projecting downwards and backwards from the broadened end of the caudal peduncle.

Head naked; scales of body in the form of minute pads or plates containing a varying amount of bony matter; those on median ventral surface pointed, hard and white like enamel, covering a narrow ridge and lying in a single row near extremity of tail; among those on dorsal part of body, some are enlarged and arranged in vertical rows parallel with the interneurals. Lateral line with small, quill-like tubes; beginning at upper edge of gill-opening, bending rather abruptly downwards and extending along body somewhat below the median line; not armed at any point.

Color bright silvery.

Type No. 13,080 Stanford University collection.

Called *seleniris* on account of a fancied resemblance of the long, flat, silvery body to the colorless lunar rainbow.

SOME POLYCHÆTOUS ANNELIDS OF THE NORTHERN PACIFIC COAST OF NORTH AMERICA.

BY J. PERCY MOORE.

This paper is a final report embodying the results of a study of all of the Polychæta submitted to me by the U. S. Bureau of Fisheries from the collections made by the steamer Albatross during the summer of 1903. From June 19 to August 24 of that year, while in the service of a special Commission appointed by the President to investigate the salmon fisheries of Alaska, the Albatross cruised northward along the coast from Port Townsend and Vancouver on the south, through part of the labyrinth of straits and passages which separate the islands of southeastern Alaska, as far as Shelekof Strait on the north and west, occupying meanwhile 112 dredging stations and a number of additional hydrographic and towing stations. Some little shore collecting was also conducted.

During the cruise the vessel was under the command of the late Lieut. Franklin Swift, U.S.N., to whose skill in handling her must be largely credited the large number of successful hauls made with trawl and dredge. The extent of the collection and the generally excellent preservation of the annelids similarly attest the energy and ability which Prof. Harold Heath devoted to collecting the invertebrates, placed under his immediate charge.

In all 107 species of Polychæta are represented. Of this number 41 species are considered to be previously undescribed. The descriptions of only two of these, however, appear for the first time in this paper, the remaining 39 having been published, with the courteous approval of the Commissioner, Hon. George M. Bowers, in these *Proceedings* for 1905, pp. 525–569, 846–860, and for 1906, pp. 217–260, together with plates illustrating important diagnostic features.

Supplementing the results of the study of the Albatross collections are added some notes on a few polychætes in the collection of this Academy, gathered by Dr. Benjamin Sharp at Icy Cape[1] and Unalaska,

[1] The northernmost point of that name.

Alaska; by Mr. A. E. McIlhenny at Point Barrow, Alaska, and by Mr. George Dawson at Admiralty Inlet, Washington. From this source are added 7 species not otherwise represented, 2 of them having been described as new in these *Proceedings* for 1906, pp. 352–355. The total number of species considered is, therefore, 114.

After deducting the 43 new species, the 71 remaining may be classified from the point of view of geographical distribution as follows: 16, so far as known, are confined to the region under consideration, having been reported from some part of it, but not elsewhere, by previous writers; 12 occur to the southward along the coast of California, though most of them have already been recorded from Puget Sound or the Gulf of Georgia by Johnson and others; 8 have been described as occurring off the coast of Japan, and probably all of the latter have, as several are known to have, a wide distribution throughout the North Pacific; 4 are scattering; and the remaining 31 are well-known inhabitants of northern Europe, Greenland and the Arctic regions generally. Many of the latter are established circumpolar forms and have been already reported by Marenzeller or Wiren as belonging to the fauna of Bering Sea, or by others as occurring in the North Pacific.

In not a few cases it is evident that the individuals referred to such species differ in certain respects from their European representatives. In a few species like *Terebellides strœmii* individuals of almost every colony present certain characteristic differences. In the belief that the future will show that such wide-ranging species split up into many geographical subspecies just as land animals do, and that such subspecies cannot be satisfactorily discriminated until our knowledge of the distribution and variation of annelids shall have been very greatly augmented, it has been thought best to merely mention such differences, without giving to them nomenclatorial importance.

In this report it has been thought sufficient to the purpose to record only the general location of the stations, together with the depth of water and the character of the bottom. The full data relating to each station, including its exact location, have been carefully compiled by Mr. Henry C. Fassett and published in the *Report of the U. S. Fish Commission* for 1903, pp. 123 to 138.

Except in the two or three cases where it is stated otherwise, all types have been forwarded to the U. S. National Museum. Cotypes, whenever such exist, are deposited at the Academy of Natural Sciences of Philadelphia. The references given under each species are either to its original description or to later accounts furnished with good figures and synonymies.

SYLLIDÆ.

Syllis armillaris (Müller) Malmgren.

> *Nereis armillaris* Müller, Zoologiæ danicæ prodromus, 1776, p. 217.
> *Syllis armillaris*, Malmgren, Annulata Polychæta, 1867, p. 42, Tab. VII, fig. 46.
> *Syllis borealis* Malmgren, *ibid.*, p. 42, Tab. VI, fig. 42.
> *Typosyllis armillaris*, Marenzeller, Ann. K. K. Naturh. Hofmuseums, V (1890), p. 3.

Two small and immature examples 11 mm. long agree well with the descriptions cited above and bear out fully Marenzeller's conclusions concerning the synonymy of the species and confirm his record of its occurrence in Bering Sea. One specimen is beautifully marked with dainty transverse lines of dark brown or black pigment; there being two lines across each segment as far as XV and beyond that point one line to the middle of the body. The accessory tooth at the tip of the setæ, which was overlooked by Malmgren, is almost always present. The median tentacle has 15 joints, the paired tentacles 11 to 14 joints, the dorsal and ventral peristomial cirri 15 and 10 respectively, the first dorsal cirrus (somite II) 18 joints, the middle dorsal cirri 9 to 14 joints, with the greatest diameter at the 4th or 5th, and the caudal cirri 14 joints. In one specimen the gizzard extends from somite XIII to XXII.

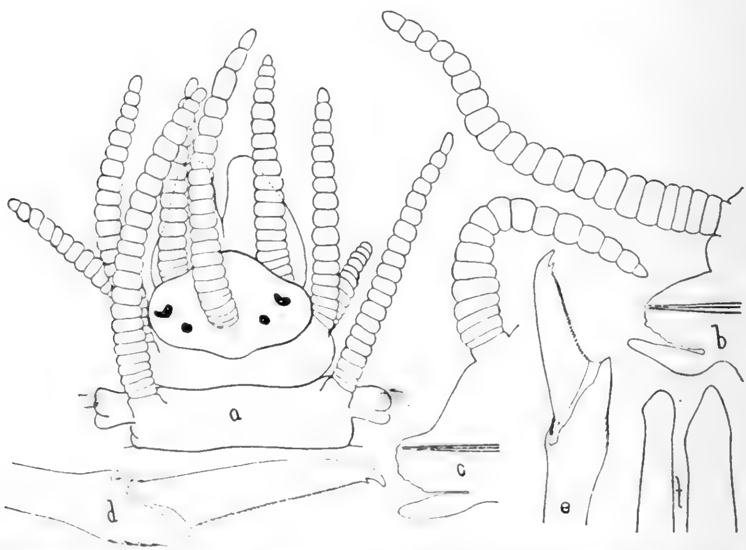
Stations 4261, Dundas Bay, Icy Strait, Alaska, July 24, 8½–10 fathoms, green mud and rocks; 4289, Uyak Bay, Kadiak Island, Alaska, 74–80 fathoms, gray mud.

Syllis alternata new species.

The type and largest example (from Station 4228) is 30 mm. long with 160 segments, the posterior 28 of which are filled with eggs, without, however, exhibiting any sign of stolonization. Other examples are from 16 to 20 mm. long with from 116 to 125 segments. The form is slender and the diameter nearly uniform, the body slightly widened to about XX, strongly arched above and flattened below. The segments are all sharply defined and very short, usually 6 to 8 times as wide as long.

The prostomium (*a*) is about 1½ times as wide as long, as shown in the figure of a cotype, but may be partly concealed beneath a fold of the peristomium. Slight anterior and posterior contractions give the effect of prominently bulging sides. The palpi are about twice the length of the prostomium, project prominently straight forward and are narrow distally. Of the two pairs of small reddish-brown eyes, the anterior are larger, decidedly farther apart and crescentic or bean-shaped as seen from above. In the type specimen the two pairs of eyes are closer together but not larger than in the smaller specimens.

All of the appendages are strongly moniliform. The tentacles are rather stout but gently tapered. The median arises between the eyes, is nearly twice the length of prostomium and palpi and consists of 22 to 30 joints. The lateral tentacles arise from the antero-lateral face of the prostomium, are $1\frac{1}{2}$ times as long as the latter plus the palps and consist of about 20 joints. The peristomial cirri are quite similar in form, the dorsal consisting of about 20 to 25 joints and equalling the median tentacle and the ventral consisting of 15 joints and equalling



Syllis alternata.—*a*, cephalic region from above, × 24; *b*, parapodium X, × 32; *c*, parapodium LI, × 32; *d*, a moderately long-bladed seta from the dorsal part of parapodium X, × 600; *e*, a short-bladed seta from the ventral part of the same, × 600; *f*, ends of two acicula, × 600.

the lateral tentacle in length. The first dorsal cirrus is very long, especially on the type, in which it has about 35 joints.

The parapodia (*b* and *c*) are rather stout and short, blunt and broadly rounded distally. Ventral cirri are slender, unjointed, little tapered and reach beyond the end of the neuropodium. The dorsal cirri, on the other hand, are all very strongly moniliform and gently tapered throughout. They are longest and nearly uniform on the anterior 15 segments, on which they nearly equal the diameter of the body. Farther back they are alternately long and short, but never equal to the anterior ones. From about 25 and 18 respectively in this region the number of joints becomes reduced at the caudal end quite rapidly until on the last but one remains. In the several specimens the caudal cirri have from 16 to 25 joints.

No notopodial aciculum is present, but there are usually 3 neuropodials (*f*) with knobbed ends of various forms. The neuropodial setæ usually number about 10, disposed in 3 or 4 ranks. They are colorless, homogeneous, and rather milky vitreous in appearance. The rather stout stems have 4 or 5 minute teeth on the convexity of the enlarged ends (*d* and *e*) which are strongly oblique and possess a well-developed socket. The appended blades of the dorsalmost setæ (*d*) are quite long, some of those of the anterior segments exceeding by ¼ the one figured. The ventral and posterior ones are shorter (*e*), and some of the shortest are claw-like and little exceed the obliquity of the end of the shaft in length. The end is strongly hooked, the accessory tooth well developed, and the marginal fringe very fine.

In one specimen the protruded proboscis is a short and nearly cylindrical cup bearing 10 prominent soft marginal papillæ. In another the gizzard lies in somites IX to XXI, in still another in XIX to XXXVII. The cuticle of this species is noticeably thick. No trace whatever of color remains.

Station 4228 (type), vicinity of Naha Bay, Behm Canal, southeastern Alaska, 41–134 fathoms, gravel and sponges; 4235, vicinity of Yes Bay, Behm Canal, 130–193 fathoms, gray mud; 4261, Dundas Bay, Icy Strait, Alaska, 8½–10 fathoms, gray mud and rocks.

Syllis (Chætosyllis) quaternaria Moore.

Syllis quaternaria Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 352–354 (text fig.).

This epitokous form of the type for which Malmgren established his genus *Chætosyllis* is probably a true *Syllis*, though it cannot be correlated with any known non-sexual form. The type and about a score of other specimens are No. 1091 of the Academy's collection. They were taken by A. E. McIlhenny at the "surface in a lead four miles from shore" at Point Barrow, Alaska.

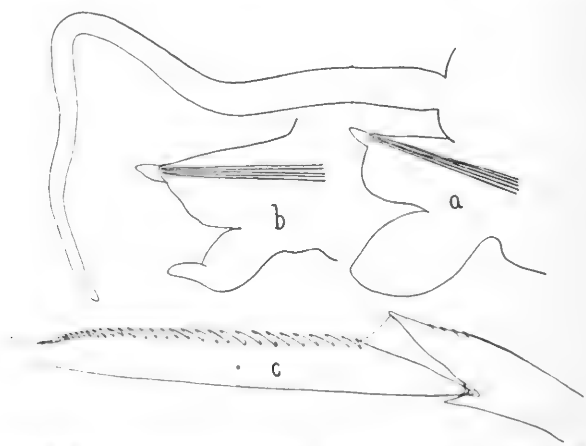
Pionosyllis magnifica Moore.

Pionosyllis magnifica Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 223–225, Pl. X, figs. 9–11.

This large and handsome syllid is represented by two specimens, one (the type) coming from Station 4219, Admiralty Inlet, vicinity of Port Townsend, Washington, 16–26 fathoms, green mud, sand and broken shells; the other from Station 4244, Kasaan Bay, Prince of Wales Island, southeastern Alaska, 50–51 fathoms, green mud.

Pionosyllis gigantea new species.

Three fragments of the anterior end, the largest comprising but 40 segments, represent a species much larger than *P. magnifica*, from which it is distinguished by numerous characters. The type, consisting of 40 segments, is 16 mm. long, 4 mm. in width of body and 7 mm. between the tips of the setæ. The prostomium is nearly quadrate but slightly wider anteriorly, where the angles are rounded; it is quite deeply cut into two lobes by a median cleft posteriorly. The palpi are broad, flattened, broadly rounded at the ends and slightly exceed the prostomium in length; at the base they are coalesced but diverge widely and curve ventrad distally. The eyes of both pairs are reddish brown, small and round, the anterior very little larger than the posterior and directly in front of them or but little farther apart. The dorsal cephalic appendages are imperfect on all of the specimens, but are evidently slender, tapering, smooth and flagelliform. The middle tentacle is apparently about 3½ times and the lateral tentacles about twice the length of the prostomium and palpi. The former arises



Pionosyllis gigantea—*a*, parapodium XXV, without setæ, × 24; *b*, parapodium L, without setæ, × 24; *c*, a seta with blade of average length, from XXV, × 360.

from the center of the prostomium, the latter from the anterior lateral margins. The very short, slightly flaring proboscis bears 9 or 10 marginal papillæ and apparently is unprovided with a strongly cuticular region.

The peristomium is extremely short above, where it is represented chiefly by a fold of integument which conceals the posterior lobes of the prostomium. At the sides it is better developed and ventrally is crowded forward with the next two segments beneath the prostomium. Its tentacular cirri are similar to the prostomial appendages, the dorsal about 5 times the length of the head and the ventral only about twice that length. Remaining somites are very short anteriorly, but from the twentieth onward are only 6 or 7 times as wide as long. Dorsally they are strongly arched, ventrally flattened. The intersegmental furrows are well marked, perhaps exaggerated by contraction of the longitudinal muscles.

All of the parapodia (*a* and *b*) are prominent and spring from the lowest level of the sides of the body. Notopodia are entirely wanting, even the acicula appearing to be absent. The neuropodia, on the other hand, are stout, those at the anterior end being nearly truncated, while the more posterior ones are bevelled from the dorsal or acicular angle. All, however, possess slender and prominent presetal papillæ at this angle. Ventral cirri are remarkably large and swollen on the anterior parapodia and end bluntly, but farther back they become reduced in size and more slender and an annular constriction may separate the pointed end as a separate piece.

The most striking characteristic of the species is the great length of the anterior dorsal cirri which form a tangled mass at the sides of the body; they are so easily detached that few of them remain. They arise from rather stout but short cirrophores (*a*) which are not sharply distinguished from the sides of the somites. The styles are smooth, tapering and very slender toward the end, like whiplashes. On one of the smaller specimens, which has 29 segments measuring 8 mm. long, and a maximum body width of 3 mm., the dorsal cirrus of somite IV measures no less than 14 mm. long. The cirri are alternately longer and shorter, and after about the first ten those borne on the even numbered somites are regularly 2 to 2½ times the body width, while those on the odd numbered somites little exceed the body width.

Neuropodia are supported by 5 or 6 acicula which taper gradually almost to the end, where they are slightly curved and end abruptly in short conical points. The setæ (*c*) project rather prominently in usually 5 subacicular ranks of 3 or 4 each. In any one parapodium they are remarkably uniform in length of blade, etc., but the blades become gradually shorter and wider and the shafts stouter from before backwards. The shaft (*c*) exhibits but a slight distal enlargement, but is conspicuously and very unequally bifid, the larger and longer process ending quite acutely and being provided along the front with 4 or 5 obscure teeth. The blades or appendages are rather long, strongly hooked and bifid at the end, and especially noteworthy for the coarseness of their marginal serrations.

With the exception of the prostomium and the dorsal cirri these annelids are much pigmented both above and below with chocolate brown.

Stations 4199, Queen Charlotte Sound, off Fort Rupert, Vancouver Island, B. C., 68–107 fathoms, soft green mud and volcanic sand; 4228 (type), vicinity of Naha Bay, Behm Canal, southeastern Alaska, 41–134 fathoms, gravel and sponges; 4300, off Shakan, Sumner Strait, southeastern Alaska, 185–218 fathoms, rocks and mud.

Trypanosyllis gemmipara Johnson.

Trypanosyllis gemmipara Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, 1901, pp. 405, 406.

This species is represented in the collection by two specimens. As one of them permits the verification of Johnson's very interesting discovery of collateral budding in this genus, it is unfortunate that the preservation is altogether too imperfect to enable me to describe the conditions fully. The buds are all quite young and occur in several close tufts arranged in a transverse row about 35 segments anterior to the anus, and all on the ventral surface, where the integuments are split open at their place of origin. Collateral budding of a type similar to that described by Johnson in *T. gemmipara* and *T. nigens* has recently been found by Izuka in a Japanese species, *T. misakiensis*, also.

Taken only at Station 4197, Gulf of Georgia, Halibut Bank, 31–90 fathoms, sticky green mud and fine sand.

PHYLLODOCIDÆ.

Phyllodoce citrina Malmgren.

Phyllodoce citrina Malmgren, Ofvers. Kgl. Vet.-Akad. Förh., 1865, p. 95.

Two poorly preserved specimens which agree closely with the descriptions of this species were taken at Afognak Island. The eyes are much larger than shown in Malmgren's figures and both specimens are filled with eggs. Marenzeller reports this species from Bering Sea.

Stations 4271, Afognak Bay, Afognak Island, 11½–20 fathoms, hard gray sand and rocks; 4272, the same, 12–17 fathoms, sticky mud.

Phyllodoce mucosa Oersted.

Phyllodoce mucosa, Oersted, Ann. Dan. Consp., p. 31.

A single much relaxed specimen of this species, 75 mm. long, including the protruded proboscis, closely resembles the figures and descriptions of this species, but possesses a greater number of setæ than is usually attributed to it.

This example is No. 281, Coll. Acad. Nat. Sci. Phila., collected by Dr. Benjamin Sharp at Icy Cape, Alaska.

Eulalia longicornuta Moore.

Eulalia longicornuta Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 222, 223, Pl. X, figs. 7, 8.

Two specimens found among serpulid tubes taken at the Quarantine Station dock near Port Townsend, Washington, on June 27, 1903. The type is filled with eggs. In both the color has faded to a nearly uniform olive with brown striations on the dorsal cirri.

Eulalia quadrioculata Moore.

Eulalia quadrioculata Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 220, 221, Pl. X, figs. 4–6.

The two specimens, one of them a female filled with large eggs, were taken at Quarantine Rock, Port Townsend, Washington, on June 27, 1903.

Notophyllum imbricatum Moore.

Notophyllum imbricatum Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 217–219, Pl. X, figs. 1–3.

The type comes from Station 4289, Uyak Bay, Kadiak Island, 74–80 fathoms, gray mud; the cotype from Station 4269, Afognak Bay, 14–19 fathoms, hard gray sand and rocks.

POLYNOIDÆ.

Hololepida magna Moore.

Hololepida magna Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 541–544, Pl. XXV, figs. 24–29.

A single example of this very large and remarkable species was taken at Station 4247 (not 4198 as erroneously recorded in the original description), Kasaan Bay, Prince of Wales Island, southeastern Alaska, 95–114 fathoms, green mud, fine sand and broken shells.

It was taken from the interior of a large vase-shaped sponge, and according to the label the color during life was "creamy white changing to pinkish along dorsal surface." Dr. Heath tells me that on the living worm the elytra were very easily detached and not coherent as after preservation; though of gelatinous consistency they were very brittle.

Halosydna pulchra (Johnson).

Polynoë pulchra Johnson, Proc. Cal. Acad. Sci. (3), I, (1897), p. 177.

Single specimens of this interesting species were taken at several Alaskan localities. A few notopodial setæ usually occur on most of the parapodia. The specimens vary much in color, some being colorless, others with the elytra more or less completely speckled with brown, and one, found living commensally on a holothurian, is recorded on the label as having been poppy red on the dorsal surface, lighter beneath.

The cephalic appendages may possess a filamentous distal part. An incomplete example filled with eggs, and taken at Station 4215, has the median tentacle twice as long as the lateral and is referred doubtfully to this species.

Stations 4219, Admiralty Inlet, vicinity of Port Townsend, Washington, 16 fathoms, soft green mud, from starfish; 4222, same region, 39 fathoms, gray sand and broken shells, from holothurian (*Stichopus californica*); 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud, young; 4272, Afognak Bay, Afognak Island, 12–17 fathoms, sticky mud, one very beautiful specimen and one smaller and colorless one, both from the ten-armed starfish (*Solaster decemradiata*).

Halosydna lordi Baird.

Halosydna lordi Baird, Journ. Linn. Soc. London, VIII, (1865), p. 190.

A single imperfect specimen without elytra represents this species. In the same bottle is an arm of a starfish (*Luidia columbiæ* Gray), upon which it was presumably commensal. Nanaimo Bay, Vancouver Island, B. C., 12 fathoms, on fish line.

Halosydna insignis Baird.

Halosydna insignis Baird, Journ. Linn. Soc. London, VIII, (1865), p. 188.

Johnson in his paper on the Polychæta of Puget Sound has already noted the occurrence of this species as far north as Kadiak Island. Johnson also describes in the *Proc. Cal. Acad. Sci.* for 1897 some most interesting variations in relation to habitat.

Of the several specimens in this collection scarcely two are alike in color, and they also differ in the extent to which the back is covered by the elytra, the tuberculation of the elytra and the shape of the end of the dorsal cirri—whether abruptly terminating in a short filament or not. None of the specimens is recorded as commensal.

Union Bay, Vancouver Island, B. C.; Port Townsend, Washington, at Quarantine Dock; Stations 4209, Admiralty Inlet, Port Townsend, Washington, 24–25 fathoms, rocks, coarse sand and shells; 4253, Stephens Passage, Alaska, 131–188 fathoms, rocks and broken shells.

Lepidonotus robustus Moore.

Lepidonotus robustus Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 544–546, Pl. XXXVI, figs. 32–35.

The only known specimen of this noteworthy species was taken from the shell of a hermit crab at Station 4291, Shelikof Strait, 48 to 65 fathoms, bottom of blue mud, sand and gravel.

Lepidonotus cæloris Moore.

Lepidonotus cæloris Moore, Proc. Acad. Nat. Sci. Phila., 1903, pp. 412–414, Pl. XXIII, fig. 12.

This species, originally described from specimens dredged off the coast of Japan, proves to be one of the most abundant and generally distributed species of Polychæta throughout the region covered by these explorations. It represents in the North Pacific the widely spread *L. squamatus* of the Atlantic, but is quite distinct from that species. The detached submarginal tuft of cilia that is so conspicuous and constant a feature on the elytra of the latter species is quite absent in the former, in which, also, the marginal flask-shaped sense organs are very much fewer and smaller. The outer surface of the elytra is less hairy and bears more numerous and rather smoother papillæ. Much variation is evident in the size, number, arrangement and sculpturing of the papillæ and in the color of the elytra, some specimens being nearly black, others reddish brown, and still others orange or yellow. The neuropodial setæ are quite distinct from those of *L. squamatus*, being more slender, less strongly hooked, more extensively ctenate and in a greater number of rows.

All of these differences are most apparent in the adults, especially when individuals of equal size are compared. The young of *L. cæloris* much more closely resemble the Atlantic species, especially in the greater hairiness of the elytra, and it seems not improbable that the small specimens of *L. squamatus* recorded by Johnson from Puget Sound and California and by Marenzeller from Japan may be of this species. It is also not improbable that intermediate forms may be found to connect the two in the Arctic regions, in which case *L. cæloris* would become a well-marked subspecies.

Represented in the collections by a greater number of individuals than any other species, *Lepidonotus cæloris* was found at many points between Vancouver and Kadiak Islands, at depths ranging from 18 to 313 fathoms and on most kinds of bottom, though naturally most often on mud. It was most abundant on muddy bottoms in the Gulf of Georgia, on a gravelly bottom with sponges at Station 4228, near Naha Bay in the Behm Canal, and on a bottom of rock and broken shells at Station 4253 in Stephens Passage, Alaska.

The stations at which *Lepidonotus cæloris* was taken are 4192, 4193, 4197, 4198, 4227, 4228, 4234, 4235, 4239, 4245, 4253, 4258 and 4274.

Polynoë tuta Grube.

Polynoë tuta Grube, Arch. f. Naturges., XXI, 1855, Bd. I, p. 82.
Harmothoë tuta Johnson, Proc. Bos. Soc. Nat. Hist., XXIX (1901), pp. 394, 6.

Of the three examples of this species in the collection, the one from

Fort Rupert agrees exactly with the description given by Johnson; the other two have the cephalic appendages and the dorsal cirri longer and more slender, the eyes farther back, and the neuropodial setæ more slender. All of them exhibit marked asymmetry in the arrangement of the elytra.

Fort Rupert, shore of Union Bay, Vancouver Island, B. C., and Stations 4193, Halibut Bank, Gulf of Georgia, B. C., 18–23 fathoms, green mud and fine sand; 4197, same locality, 31–90 fathoms, sticky green mud and fine sand.

Polynoë fragilis (Baird) Johnson.

Lepidonotus fragilis Baird, Proc. Zool. Soc. Lon., 1863, p. 108.
Polynoë fragilis, Johnson, Proc. Cal. Acad., Vol. I, Zoology, pp. 179–181.

Three complete examples from near Port Townsend alone represent this most interesting commensalistic species. The margins of the elytra are frequently more complexly folded than is indicated by Johnson. Dr. Heath's label states that the color in life is "entire surface of body light yellow, the elytra allowing the color of the body to show through." It is stated that the specimens were taken from *Asterias* sp. The resemblance of these worms to the arms of the starfish is most remarkable and is a subject well worth careful and detailed study by someone on the ground.

Station 4222, Admiralty Inlet, vicinity of Port Townsend, Washington, 39 fathoms, gray sand and broken shells.

Hermadion truncata Moore.

Harmathoë truncata Moore, Proc. Acad. Nat. Sci. Phila., 1902, pp. 272–274, Pl. XIV, figs. 21–28.

This species was originally described from the anterior end of a specimen in the collection of the Academy of Natural Sciences of Philadelphia, at that time supposed to have been collected in Greenland, but now believed to have been taken by Dr. Benjamin Sharp at Icy Cape, Alaska. It is well represented in this collection from the more southern stations. The completeness of some of the examples permits the addition of the following notes to the original description. A length of 80 mm. is attained, the posterior region of the body being slender and tapering. There are 63 segments with 15 pairs of elytra, borne on segments II, IV, V, VII, IX, XI, XIII, XV, XVII, XIX, XXI, XXIII, XXVI, XXIX and XXXII, and leaving the posterior part of the body unprotected except by the bristling setæ. The cephalic peaks are rudimentary, being coalesced with the bases of the lateral tentacles, and the anterior eyes are farther forward than in the type. The style of the median tentacle is slender, about twice the length of the prostomium and has a scarcely perceptible subterminal enlargement. The lateral tentacles are very short, the short, conical styles with their terminal filaments scarcely exceeding the ceratophores. The extended palpi taper regularly to the end, are slender and 7–8 times the prostomial length. Anterior elytra are circular, the others broadly elliptical, with weak attachment laterad of the center. Their texture is soft and flexible, the surface smooth and punctate and entirely lacking cilia or papillæ of any sort, but with the margin slightly thickened and upturned. The inner half is brown, the outer white in agreement with the color of the body. Dorsal cirri are rather stout with prominent cirrophores and the styles reach beyond the tips of the parapodia. They taper regularly to a subterminal enlargement, beyond which is a short filament. Posterior cirri are longer and more slender and the anal cirri are stouter and very long, equalling the last 9 somites. Usually but one anal cirrus is fully developed. A broad rich brown stripe marks the dorsum, being more or less broken in the middle of the body and spreading over the entire back posteriorly where a median white line sometimes divides it. Dorsal cephalic appendages and dorsal cirri chiefly brown with subterminal and terminal white rings All other parts, including entire venter, white.

Stations 4193, Halibut Bank, Gulf of Georgia, B. C., 18–23 fathoms, green mud and fine sand; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4199, Queen Charlotte Sound, off Fort Rupert, Vancouver Island, B. C., 68–107 fathoms, sticky green mud and volcanic sand; 4208, Admiralty Inlet, vicinity of Port Townsend, Washington, 83–99 fathoms, rocky; 4216, same region, 79–101 fathoms, rocky; 4227, vicinity of Naha Bay, Behm Canal, Alaska, 62–65 fathoms, dark green mud and fine sand.

Eunoë depressa Moore.

Eunoë depressa Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 536–538, Pls. XXXIV, figs. 17, 18; XXXV, figs. 19, 20.

Besides a fragment labelled Union Bay, B. C., 6–22–'03, this species is represented by specimens from Stations 4261 (type), Dundas Bay, Icy Strait, 8½–10 fathoms, green mud and rocks; 4270, Afognak Bay, Afognak Island, Alaska, 14–19 fathoms, hard gray sand and rock. The latter is labelled "Hermit crab, messmate," and many of the papillæ on the elytra bear 2 or 3 spines.

I also refer provisionally to this species under the name of var. *mammillata* a specimen which may represent a distinct but related species. It measures 20 mm. long and has a form similar to but somewhat less broad and depressed than typical *depressa*. The palpi are barely twice the length of the prostomium, but the other cephalic appendages are longer and much more slender than in the typical form. The median tentacle is about 3¼ times and the lateral tentacles nearly 1⅔ times the length of the prostomium. The cirrophores of the dorsal cirri reach to the end of the notopodia and the slender styles possess long filiform tips which reach to the tips of the longest setæ. The elytra are thinner and more membranous and their shape more ovate-reniform. They also have larger, firmer, and more mammiliform papillæ. But the chief distinction is a strong fringe of cilia along the outer margin of each of the elytra. The general color is reddish brown and the elytra bluish pearl with the larger papillæ orange brown.

The label states that this specimen was taken from the branchial chamber of an 11-pound crab. Station 4276, Alitak Bay, Kadiak Island, Alaska, 22–25 fathoms, fine sand and mud.

Harmothoë imbricata (Linn.) Malmgren.

Harmothoë imbricata, McIntosh, Monograph of British Annelids, Part II, 1900, pp. 314–327.

All of the specimens of this ubiquitous species, which is already well known from the North Pacific, are of small size, the largest being 30 mm. long and most of them much smaller. They present the usual color varieties seen in Atlantic Coast specimens, some being more or less strongly mottled, others having a median light or dark brown band of greater or less breadth. The marginal papillæ on the elytra may be numerous or nearly absent. The two specimens from Kilisut Harbor have the smooth tips of the notopodial setæ longer than usual.

Kilisut Harbor, near Port Townsend, Washington; and Stations 4269, Afognak Bay, Afognak Island, Alaska, 14½–19 fathoms, hard gray sand and rocks; 4271, same region, 11½-20 fathoms, hard gray sand and rocks; 4275, Alitak Bay, Kadiak Island, Alaska, 35–36 fathoms, green mud and fine sand; 4289, Uyak Bay, Kadiak Island, 74–80 fathoms, gray mud.

Harmothoë hirsuta Johnson.

Harmothoë hirsuta Johnson, Proc. Cal. Acad. Sci., (3), I (Zoology), pp, 182, 183.

Three examples referred to this species indicate that it is subject to considerable variation. The examination of an extensive series of the Harmothoës from this region will be necessary to establish the exact status of these variants.

Stations 4205, Admiralty Inlet, Port Townsend, Alaska, 15–26 fathoms, rocks and shells, a single specimen which agrees with Johnson's description and figures accurately except that the elytra, although bearing large papillæ, lack distinct marginal areas; 4260, Dundas Bay, Icy Strait, 8½–21 fathoms, coarse sand and rocks, one similar to the last but more distinctly colored; 4259, same region, 21–78 fathoms, gray sand, broken shells and rocks, a small example with well-marked marginal areas on the elytra but few large papillæ and with the intersections of the ridges between the areas sometimes produced into large, coarse cilia.

Lagisca multisetosa Moore.

Lagisca multisetosa Moore, Proc. Acad. Nat. Sci. Phila., 1902, pp. 267–269, Pl. XIV, figs. 29–36.

This is another species which was originally incorrectly attributed to Greenland, the type locality being almost certainly Icy Cape, Alaska. Like *Hermadion truncata* it is rather plentiful in the collections from the Gulf of Georgia to Behm Canal, being represented, mostly by fragmentary specimens, in the collections from the following:

Stations 4193, Halibut Bank, Gulf of Georgia, B. C., 18–23 fathoms, green mud and fine sand; 4194, same region, 111–170 fathoms, soft green mud; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4199, Queen Charlotte Sound, off Fort Rupert, Vancouver Island, B. C., 68–107 fathoms, soft green mud and volcanic sand; 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud; 4228, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 41–134 fathoms, gravel and sponges.

The species appears to be especially common at the last enumerated station and several fragments taken here depart quite widely from the typical form in the character of the elytra. These are designated as variety *papillata*, characterized as follows: The elytra bear more numerous, larger and differently shaped soft papillæ and very much fewer and smaller hard conical papillæ; and instead of the numerous long cilia on the exposed surface and near the outer margin of the elytra of the typical form, these bear only a few very much shorter cilia with thickened ends.

Lagisca rarispina (Sars) Malmgren.

Lagisca rarispina (Sars) Malmgren, Ofvers. Kgl. Vet.-Akad. Förh., 1865, p. 65.

Occurring quite plentifully in the collections from the more northerly points in the Alaskan Gulf, where it apparently largely replaces *L. multisetosa*, this species is represented by two varieties which are, however, connected by intermediates and apparently occur indiscriminately together at the same stations.

The difference is in the presence or absence of the soft marginal papillæ on the elytra. On some examples these are very numerous, especially on anterior elytra, and have exactly the elongated form and the arrangement exhibited by typical representatives of the species from Greenland and other North Atlantic localities. Others have perfectly smooth elytra, altogether lacking these appendages. Between these two extreme categories, into which most of the specimens fall, are some individuals intermediate in either the number or size of the appendages or in both. Some have the papillæ very short and present on many elytra and others very few papillæ of normal or reduced size. One bears a single papillæ on one elytron and another half a dozen papillæ distributed among three elytra.

Stations 4193, Gulf of Georgia, B. C., 18–23 fathoms, green mud and fine sand; 4198, Halibut Bank, Gulf of Georgia, B. C., 157–230 fathoms, soft green mud; 4219, Admiralty Inlet, Port Townsend, Washington, 16–26 fathoms, green mud, sand, broken shells; 4225, Boca de Quadra, southeastern Alaska, 149–181 fathoms, dark green mud—a single example from each of these stations; 4235, vicinity of Yes Bay, Behm Canal, 130–193 fathoms, gray mud; 4253, Stephens Passage, Alaska, 131–188 fathoms, rocks and broken shells; 4258, vicinity of Funter Bay, Lynn Canal, 309–313 fathoms, mud—plentiful at the last two stations; 4263, Dundas Bay, Icy Strait, 6½–9 fathoms, coarse sand and rocks; 4289, Uyak Bay, Kadiak Island, 74–80 fathoms, gray mud.

Antinoë macrolepida Moore.

Antinoë macrolepida Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 538–541, Pl. XXXV, figs. 21–23.

Antinoë macrolepida is plentiful at the more northerly stations, but occurs as far south as the Gulf of Georgia. It is represented in the collections from the following stations: 4192, off Nanaimo, Vancouver Island, B. C., 89–97 fathoms, green mud and fine sand; 4193, Halibut Bank, Gulf of Georgia, B. C., 18–23 fathoms, green mud and fine sand; 4194, same region, 111–170 fathoms, soft green mud; 4230, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 108–240 fathoms, rocky; 4236, vicinity of Yes Bay, Behm Canal, 147–205 fathoms, rocks and coarse sand; 4237, same region, 194–198 fathoms, green mud; 4264 (type and several other specimens), off Freshwater Bay, Chatham Strait, 282–293 fathoms, green mud; 4299, off Shakan, Sumner Strait, southeastern Alaska, 153–218 fathoms, sand and rocks.

Gattyana amondseni (Malmgren).

Nychia amondseni Malmgren, Annulata Polychæta, etc., 1867, pp. 5 and 6.

Three specimens taken at northern stations agree very closely with Malmgren's description and figures of this species. The neuropodial setæ are rather more slender and the bifid papillæ on the elytra rather more deeply cleft.

Stations 4253, Stephens Passage, Alaska, 131–188 fathoms, rocks and broken shells; 4272, Afognak Bay, Afognak Island, 12–17 fathoms, sticky mud; 4274, Alitak Bay, Kadiak Island, 35–36 fathoms, green mud and fine sand.

Gattyana ciliata Moore.

Gattyana ciliata Moore, Proc. Acad. Nat. Sci. Phila., 1902, pp. 263–266, Pl. XIII, figs. 14–19.

The type (No. 28, Coll. Acad. Nat. Sci. Phila.) was taken at Icy Cape, and a single example in this collection comes from Station 4289, Uyak Bay, Kadiak Island, 74–80 fathoms, gray mud.

Gattyana cirrosa (Pallas) McIntosh.

Gattyana cirrosa McIntosh, Monograph of British Annelids, Part II, (1900), pp. 285–291.

The only example taken is from Station 4272, Afognak Bay, Afognak Island, 12–17 fathoms, sticky mud.

Gattyana senta Moore.

Gattyana senta Moore, Proc. Acad. Nat. Sci. Phila., 1902, pp. 259–263, Pl. XIII, figs. 1–13.

This species, the type of which came from Icy Cape and is in the collection of the Academy of Natural Sciences, appears to be quite plentiful on the muddy bottoms of the Gulf of Georgia and equally so on a gravelly bottom at Station 4228 in Behm Canal. Most of the examples have lost most of the elytra and are otherwise mutilated, but one specimen permits the description of the posterior elytra which were lacking on the type. They are nearly circular in outline and of smaller size and softer texture than the anterior elytra, but the most striking difference is in the very great length of the terminal branches of the dendritic spines of the posterior margin, the number of forkings of which is, however, less than on anterior scales.

Stations 4191, Gulf of Georgia, off Nanaimo, Vancouver Island, B. C., 54–89 fathoms, fine dark sand, mud and rocks; 4193, Halibut Bank, Gulf of Georgia, 18–23 fathoms, green mud and fine sand; 4197, same locality, 31–90 fathoms, sticky green mud and fine sand; 4198, same locality, 157–230 fathoms, soft green mud; 4228, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 11–134 fathoms, gravel and sponge.

Melænis loveni Malmgren.

Melænis Loveni Malmgren, Ofvers. Kong. Vet.-Akad. Förh., 1865, pp. 78, 79.

Three examples collected by Dr. Benjamin Sharp at Icy Cape, Alaska, are in the collection of the Philadelphia Academy, No. 279.

SIGALEONIDÆ.

Pholoë minuta (Fabricius) Oersted.

Pholoë minuta (Fabricius), McIntosh, Monograph of British Annelids, Part II, (1900), pp. 437–442.

A perfect example nearly an inch in length was taken at Station 4272, at Afognak Bay, Afognak Island, Alaska, in 12–17 fathoms, on a bottom of sticky mud; and a few fragments of a very small individiual probably of this species from a bottle containing a *Halosydna insignis* from Port Townsend, Washington.

Peisidice aspera Johnson.

Peisidice aspera Johnson, Proc. Cal. Acad. Sci., (3), (Zool.), Vol. I, pp. 184, 185.

Single examples of this curious little polychæte occur at three rather widely separated stations. The elytra are very stiff and rigid, apparently due to a hard brownish secretion which is deposited in layers, thus giving the appearance of concentric lines of growth. Sand grains adhere to and become imbedded in this substance, especially along the ridge of the scale. This same secretion renders the body brittle, but no sand grains are borne on this region of these specimens. The hairs of the marginal fringes are very unequal, the longest being as much as ⅓ of the long diameter of the scale. Many of the elytra are marked with dark brown central spots.

Stations 4228, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 41–134 fathoms, gravel and sponge; 4235, vicinity of Yes Bay, 130–193 fathoms, gray mud; 4253, Stephens Passage, 131–188 fathoms, rock and broken shells.

APHRODITIDÆ.

Aphrodita japonica Marenzeller.

Aphrodita japonica Marenzeller, Denks. K. Akad. Wissensch., Wien, XLI, (1879), pp. 111, 112.

From the Gulf of Georgia to the head of Behm Canal this species is common and especially so wherever muddy bottoms occur. These specimens differ in no respect from those taken in the Albatross dredgings off the coast of Japan in 1900. The neuropodial setæ are unusually prominent and slender and when young their tips are incased in a densely hairy sheath, which later wears away, leaving the point smooth. The notopodial setæ are completely imbedded in the felt and are seldom visible. They are slender, soft, curved, pale brown, roughened toward the end and have the tip hooked. Generally the color is very dark—almost black—and the felt is dull, probably the result of staining by some constituent of the mud in which they live. The palpi are white. The specimens vary in length from 14 to 80 mm.

Stations 4194, Halibut Bank, Gulf of Georgia, B. C., 111–170 fathoms, soft green mud; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4198, same region, 157–230 fathoms, soft green mud; 4224, Boca de Quadra, southeastern Alaska, 156–166 fathoms, dark green mud; 4225, same region, 149–181 fathoms, dark green mud; 4230, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 108–240 fathoms, rocky; 4231, same region, 82–113 fathoms, green mud and fragments of slate; 4235, vicinity of Yes Bay, Behm Canal, 130–193 fathoms, gray mud; 4236, same region, 147–205 fathoms, rock and coarse sand; 4237, same region, 192–198 fathoms, green mud; 4238, same region, 229–231 fathoms, mud and rocks.

Aphrodita negligens Moore.

Aphrodita negligens Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 526–529, Pl. XXXIV, figs. 1, 2; XXXV, fig. 31.

A single large example 60 mm. long, agreeing exactly with the type, was taken at Station 4205, off Port Townsend, Washington, in 15–26 fathoms, on a bottom of rock and shells. The body cavity is filled with egg-strings.

Aphrodita parva Moore.

Aphrodita parva Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 529–532, Pl. XXXIV, figs. 3–7.

This small and very distinct species is known only from two specimens taken at Station 4194, in the Gulf of Georgia, in 111 to 170 fathoms, on a bottom of soft green mud.

EUPHROSYNIDÆ.

Euphrosyne bicirrata Moore.

Euphrosyne bicirrata Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 532–534, Pl. XXXIV, figs. 8–12.

This species, which belongs to the group including *E. borealis* Oersted and *E. longisetosa* Horst, was taken from the Gulf of Georgia to Behm Canal, in depths ranging from 18 to 188 fathoms. It occurs in the collections from the following stations: 4193 (type), Halibut Bank, Gulf of Georgia, 18–23 fathoms, green mud and fine sand; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4228, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 41–134 fathoms, gravel and sponge; 4253, Stephens Passage, Alaska, 131–188 fathoms, rock and broken shells.

Euphrosyne hortensis Moore.

Euphrosyne hortensis Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 534–536, Pl. XXXIV, figs. 13–16.

Much less common than the last, this species was taken at Stations

4272, Afognak Bay, Afognak Island, 12–17 fathoms, sticky mud; and 4274, Alitak Bay, Kadiak Island, 35–41 fathoms, green mud and fine sand. The latter is the type locality.

Euphrosyne arctica Johnson.

Euphrosyne arctica Johnson, Proc. Cal. Acad. Sci., (3), Zoology, Vol. I, p. 159.

A small individual 10 mm. long is believed to represent this species, the original description of which was based upon a probably imperfect and much contracted specimen. There are, however, some points of difference between the two specimens, as the following brief description indicates.

The form is strongly depressed, about equally rounded anteriorly and posteriorly, the somites numbering 21, strongly marked and well developed throughout. The subanal lobes or cirri are large, thick and fleshy. The dorsal smooth field is about $\frac{1}{3}$ the entire width and not subdivided into areas. A black spot or group of spots occurs on the posterior part of each segment behind the second gill.

The caruncle is short and broad, reaching from the anterior margin of II to the posterior margin of IV, and consists entirely of a rather high, thick crest, little free behind. The median tentacle equals the caruncle in length and the stout basal article, which furnishes $\frac{2}{3}$ of its length, nearly equals the caruncle in thickness. The terminal piece is filamentous. The dorsal eyes are very large, elongated and black. The ventral eyes are coalesced and the ventral paired tentacles minute.

The dorsal cirri are very long, much exceeding the length of the caruncle, slender and tapered. The median cirrus arises between the second and third gills and, like the ventral cirrus, is stouter than the dorsal cirrus and equally long. Five pairs of gills occur on the middle region. They are arbusculate and spreading, with some 30 or more slender, lanceolate terminal twigs formed by as many as 5 or 6 irregular dichotomous divisions. The setæ agree exactly with Johnson's figures.

Station 4234, vicinity of Yes Bay, Behm Canal, Alaska, 45 fathoms, gray mud and rocks.

ALCIOPIDÆ.

Callizona angelini (Kinberg) Apstein.

Callizona Angelini (Kinberg) Apstein, Die Alciopiden und Tomopteriden der Plankton Expedition, Kiel, 1900, pp. 18, 19.

The addition of this species to the list of Alaskan polychætes becomes possible through the study of the contents of salmon stomachs submitted by Dr. H. M. Smith. The salmon were taken at Yes Bay, Alaska, on July 27 and 28, 1905, and contained a large number of remains. Many of the worms were already completely disintegrated, but the anterior ends of some were sufficiently intact to remove any reasonable doubt of the correctness of this identification. The only respect in which they differ from the published descriptions is in the presence of as many as 4 stout setæ in the first parapodium (somite IV). A noteworthy characteristic of the species is the considerable length of the cirriform appendage of the parapodia.

Anteriorly the dorsum is a diluted chocolate brown, the surface of the eye cups, the prostomium and a transverse band across each segment being still darker. A brown spot at the base of each dorsal cirrus appears to continue for the entire length of the body. The large numbers in which these worms occur in the salmon stomachs and the evidences that they were filled with sperm and ova indicates that at sexual maturity they must swim in great shoals at the surface.

Originally described by Kinberg from the China Sea, this species has since been twice taken in the Atlantic Ocean, but until now has not been reported from the Pacific.

HESIONIDÆ.

Podarke pugettensis Johnson.

Podarke pugettensis Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, 1901, pp. 397, 398.

This species was taken only in the region of the type locality and probably does not extend much farther northward.

Nanaimo Bay, Vancouver Island, B. C., taken from a starfish (*Tuidia*) brought up on a fish line; Quarantine Rock, near Port Townsend, Washington; Station 4218, Admiralty Inlet, near Port Townsend, Washington, 16 fathoms, soft green mud, on starfish (*Tuidia*).

NEPHTHYDIDÆ.

Nephthys cœca (Fabricius) Oersted.

Nephthys cœca, Ehlers, Die Borstenwürmer, 1868, pp. 588–617.

The presence of this circumpolar species throughout a great extent of both sides of the North Pacific is already well known. Typical examples occur in the collections from the following stations: 4230, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 108–240 fathoms, rocky; 4236, vicinity of Yes Bay, Behm Canal, 147–205 fathoms, rocks and coarse sand; 4240, junction of Clarence Strait and Behm Canal, 248–256 fathoms, coral.

Nephthys ciliata (Müller) Rathke.

Nephthys ciliata, Malmgren, Öfvers. Kgl. Vet.-Akad. Förh., 1865, p. 104.

Whether or not Wiren was correct in considering this and the preceding to be variants of the same species, the considerable amount of material which I have examined exhibits no evidence of intergradation and the two forms are therefore listed separately. It is noteworthy that they were taken on bottoms of quite different character.

Stations 4194, Halibut Bank, Gulf of Georgia, 111–170 fathoms, soft green mud; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4244, Kasaan Bay, Prince of Wales Island, southeastern Alaska, 50–54 fathoms, green mud; 4258, vicinity of Funter Bay, Lynn Canal, 300–313 fathoms, mud; 4286, Chinak Bay, Alaska, 57–63 fathoms, green mud and rock.

Nephthys malmgreni Theel.

Nephthys longisetosa Malmgren, Kgl. Vet.-Akad. Förh., 1865, p. 106; non Oersted.

Nephthys malmgreni Theel, Kgl. Sv. Vet. Akad. Handl., 1879, No. 3, p. 26.

Although recorded at various points in the North Atlantic and Arctic Oceans this species has not previously been taken in the Pacific. It occurs in the collections from the vicinity of Yes Bay, Behm Canal, only, at Stations 4236, 147–205 fathoms, rock and coarse sand, and 4238, 229–231 fathoms, rocks and mud.

Nephthys assimilis Malmgren.

Nephthys assimilis Malmgren, Kgl. Vet.-Akad. Förh., 1865, p. 105.

No representatives of *N. assimilis* occur among the material dredged by the Albatross, but the collection of the Academy of Natural Sciences of Philadelphia contains several examples which agree exactly with the descriptions given by Malmgren and Theel, and which were collected by Dr. Benjamin Sharp in 5 fathoms at Icy Cape, Alaska.

NEREIDÆ.

Nereis pelagica Linnæus.

Nereis pelagica Linnæus, Sys. Nat., Ed. X, p. 654.

Although quite common and represented from nearly the entire region covered by these collections, the individuals are of smaller size than occur on the Atlantic side of the continent.

Stations 4193, Halibut Bank, Gulf of Georgia, B. C., 18–23 fathoms, green mud and fine sand; 4209, Admiralty Inlet, vicinity of Port Townsend, Washington; 4247, Kasaan Bay, Prince of Wales Island, southeastern Alaska, 89–114 fathoms, green mud, fine sand and broken shells; 4253, Stephens Passage, Alaska, 131-188 fathoms, rocks and broken shells; 4274, Alitak Bay, Kadiak Island, 35–41 fathoms, green mud and fine sand. At Port McArthur, on August 23, two small heteronereids were taken at the surface. Also collection of Acad. Nat. Sci. Phila., several collected at Unalaska by Dr. Sharp.

Nereis procera Ehlers.

Nereis procera Ehlers, Die Borstenwürmer, 1868, p. 557.

This little known species is represented by a single incomplete specimen taken at the type locality in the Gulf of Georgia. Station 4193, Halibut Bank, Gulf of Georgia, 18–23 fathoms, green mud and fine sand.

Nereis paucidentata Moore.

Nereis paucidentata Moore, Proc. Acad. Nat. Sci. Phila., 1903, pp. 430, 431, Pl. XXIV, figs. 28–30.

Originally described from specimens dredged in Bering Sea, the present collections show that this species is rather widely distributed along the northern portions of the east side of the Pacific also. At the same time they permit of the verification of the characters originally attributed to the species. Several specimens with the probosces protruded exhibit paragnaths exactly like those of the type, except that groups III and IV vary somewhat, being provided with 3 to 5 denticles arranged in various patterns. One had 5 teeth arranged in a perfect quincunx. The basal ring of one specimen bears 4 cones at VII.

Stations 4198, Halibut Bank, Gulf of Georgia, B. C., 157–230 fathoms, soft green mud; 4228, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 41–134 fathoms, gravel and sponge; 4239, junction of Clarence Strait and Behm Canal, 206–248 fathoms, coarse sand and rocks, one specimen from this station is a large female bursting with eggs, 80 mm. long and having 120 segments; 4253, Stephens Passage, Alaska, 131–188 fathoms, rocks and broken shells; 4300, off Shakan, Sumner Strait, southeastern Alaska, 185–218 fathoms, rock and mud.

Nereis cyclurus Harrington.

Nereis cyclurus Harrington, Trans. N. Y. Acad. Sci., XVI, 1897, p. 214.

This remarkable and interesting species should probably be separated generically from the above. In only one case is it stated that the specimens were taken from a hermit crab (*E. upagurus armatus*), in the shell of which this annelid usually lives as a commensal. The finding of a male heteronereis is of interest, especially as it was taken on the shell of a hermit crab. After an elaborate study of this species Harrington records his failure to find a male, and states his belief that males are strictly pelagic in habit.

Stations 4201, Queen Charlotte Sound, off Fort Rupert, Vancouver Island, B. C., 138–145 fathoms, soft green mud, sand and broken shells, a small specimen, "general color bright pink, in delicate tube composed of mucus attached to sponge"; 4218, Admiralty Inlet, vicinity of Port Townsend, Washington, 16 fathoms, soft green mud, 1 ordinary form and 1 heteronereis (male) from shell of hermit crab; 4220, same region 16–31 fathoms, green mud, sand and broken shells.

Nereis (Alitta) vexillosa Grube.

Nereis vexillosa Grube in Middendorff, Reise in Siberiens, etc., II, 1851, p. 4.
Nereis vexillosa, Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, p. 399.

On the Pacific this species represents the *Nereis limbata*, so abundant along much of the Atlantic coast of North America. It, however, reaches a larger size. As but little shore collecting was done it is not represented in the collection from many points.

Taylor Bay, Gabriola Island, Gulf of Georgia; Quarantine Rock, Port Townsend, and the beach near Shakan, Sumner Strait, southeastern Alaska; collection Acad. Nat. Sci. Phila., Admiralty Inlet, Puget Sound, Washington, by George Dawson.

Nereis (Alitta) virens Sars.

Nereis virens, Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, p. 398.

I have not given very close attention to the specific likeness or distinction of the Atlantic *N. virens* and the Pacific *N. brandti*, but so far as comparisons have been made they appear to confirm Johnson's view that the two are identical. Being chiefly a shore lover like the last it is not well represented in this collection.

Taylor Bay, Gabriola Island, B. C., 11 specimens varying from 9 to 18 inches long. Many are in regeneration posteriorly and the number of segments appear to exceed the average attained by Atlantic specimens. Union Bay, Alaska, a splended example unfortunately incomplete, but which in life must have exceeded 2 feet in length. The tentacular cirri are very short and thick. Also one in the Academy of Natural Sciences, collected by George Dawson at Admiralty Inlet, Washington.

Platynereis agassizi (Ehlers).

Nereis agassizi Ehlers, Die Borstenwürmer, 1868, p. 542.

It seems probable that the Japanese specimens referred to *N dumerilii* by Marenzeller belong to this closely related but perfectly distinct species. A small heteronereid resembling that of the Atlantic *P. megalops* was taken at Quarantine Rock, near Port Townsend, on June 27.

Kilisut Harbor and Quarantine Rock, near Port Townsend, Washington. Stations 4219, Admiralty Inlet, near Port Townsend, Washington, 16–26 fathoms, green mud, sand and broken shells; 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud.

EUNICIDÆ.

Eunice kobiensis McIntosh.

Eunice kobiensis McIntosh, Challenger Reports, Zool., Vol. XII, pp. 278–280.

Several specimens of *Eunice* exhibiting considerable variation *inter se*, but presenting a mean very close to this species originally taken off the coast of Japan, were collected in Alaskan waters. The largest individual is 90 mm. long and 5 mm. wide, being therefore larger than those described by McIntosh. The maximum number of branchial pinnæ exhibited by different specimens varies from 5 to 8 according to the size, and the gills begin on V or VI and end at from XLV to LVIII. The characters of the setæ and acicula are very constant and differ in no respect from those assigned to *Eunice kobiensis*. On the other hand the jaws vary considerably and the large paired plates may exhibit a number of teeth either greater or less than is shown in McIntosh's figure. The cephalic appendages generally average shorter and the peristomium longer than on the Japanese specimens, and the ventral cirri are larger than is usual in this genus.

Stations 4235, vicinity of Yes Bay, Behm Canal, southeastern Alaska, 130–193 fathoms, gray mud; 4253, Stephens Passage, Alaska, 131–188 fathoms, rock and broken shells; 4272, Afognak Bay, Afognak Island, 12–17 fathoms, sticky mud; 4274, Alitak Bay, Kadiak Island, 35–41 fathoms, green mud and fine sand; 4289, Uyak Bay, Kadiak Island, 74–80 fathoms, gray mud. The last recorded specimen is stated to have come from a "tube 11 inches long, formed of small stones and attached to a slab of slate."

ONUPHIDÆ.

Nothria iridescens Johnson.

Nothria iridescens Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, p. 408.

This species was originally described by Johnson from a single specimen lacking the caudal end which was dredged by Prof. Herdman at Victoria, B. C. It proves to be abundant on muddy bottoms in the Gulf of Georgia and much less common northward to Prince of Wales Island, southeastern Alaska. The presence of a posterior end permits the completion of Johnson's description. After gradual reduction in length the branchiæ are totally wanting from the last 30 somites. The pygidium is provided with a thickened circumanal welt, from the ventral side of which arise 4 cirri in a close tuft. The 2 median are about ⅓ longer than the lateral pair and correspondingly stouter. Besides hooded crochets (of which Johnson's figure shows one foreshortened) and capillary setæ, posterior segments contain a tuft of the usual expanded pectinate setæ. All three kinds continue to the last setigerous segment.

A large number of tubes differ from the one described by Johnson. They are 5 to 6 inches long and about 4 mm. in diameter, composed of a tough, membranous, mucoid lining covered with a thick coating of silt, often arranged in two distinct layers of quite different composition.

Stations 4192, Gulf of Georgia, off Nanaimo, Vancouver Island, B. C., 89–97 fathoms, green mud and fine sand; 4193, Halibut Bank, Gulf of Georgia, 18–23 fathoms, green mud and fine sand; 4194, same region, 111–170 fathoms, soft green mud, a great many tubes; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4198, same region, 157–230 fathoms, soft green mud; 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud; 4244, Kasaan Bay, Prince of Wales Island, 50–54 fathoms, green mud; 42 6, same region, 101–123 fathoms, gray-green mud, coarse sand and shells.

Nothria geophiliformis Moore.

Nothria geophiliformis Moore, Proc. Acad. Nat. Sci. Phila., 1903, pp. 445–448.

A single example from Station 4244, Kasaan Bay, Prince of Wales Island, 50–54 fathoms, green mud.

LUMBRINERIDÆ.

Lumbrineris heteropoda Marenzeller.

Lumbriconereis heteropoda Marenzeller, Denks. Kaiserl. Akad. Wissensch. Wien, 1879, Abth. 2, pp. 138, 139.

A species of *Lumbrineris* widely and generally distributed over the field covered by these explorations is assigned with much hesitation as above. The variability of the jaws and the form of the prostomium in species of this genus, taken with the fact that the exact region from which the parapodia described or figured for many species have been selected is often not indicated, renders identification of representatives of this genus very difficult. The smaller examples resemble *L. heteropoda* in every respect, but the larger ones have the prostomium shorter and more broadly rounded; the jaws vary in respect to the form and number of teeth on the individual plates and probably in a greater divergence of the lobes of the posterior parapodia. The presence of a tuft of very long slender winged setæ in the lower part of the supra-acicular tuft of the middle parapodia of some specimens is also a noteworthy character which may indicate specific separation from *L. heteropoda*. One fine example from Station 4251 is 380 mm. long, 7 mm. wide, and has 355 segments. It is filled with nearly mature eggs.

Stations 4201, Queen Charlotte Sound, off Fort Rupert, Vancouver Island, B. C., 138–145 fathoms, soft green mud, sand and broken shells, 4227, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 62–65 fathoms, dark green mud and fine sand; 4235, vicinity of Yes Bay, Behm Canal, 130–193 fathoms, gray mud; 4236, same region, 147–205 fathoms, rocks and coarse sand; 4237, same region, 192–198 fathoms, green mud; 4240, junction of Clarence Strait and Behm Canal, 248–256 fathoms, coral; 4241, same region, 245–238 fathoms, green mud; 4251, Stephens' Passage, Alaska, 198 fathoms, rocky; 4252, same region, 198–201 fathoms, gray mud; 4274, Alitak Bay, Kadiak Island, 35–41 fathoms, green mud and fine sand. Also a doubtful specimen in the Academy of Natural Sciences, collected by Dr. Benjamin Sharp at Icy Cape, Alaska.

Ninoë simpla Moore.

Ninoë simpla Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 547–549, Pl. XXXV, fig. 30; XXXVI, figs. 39–44.

This very distinct species resembles *N. nigripes* Verrill in general appearance, but differs widely from that and other species in having the gills simple instead of palmate and in the presence of a small median tubercle on the prostomium.

It was taken at Stations 4235, 4236 and 4238, in the vicinity of Yes Bay, Behm Canal, Alaska, in 130–231 fathoms, on muddy bottoms.

STAURONEREIDÆ.

Stauronereis annulatus Moore.

Stauronereis annulatus Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 225–227, Pl. X, figs. 12, 13; XI, figs. 18–22.

Taken only at Quarantine Rock, Port Townsend, Washington, June 27, 1903.

GLYCERIDÆ.

Glycera nana Johnson.

Glycera nana Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, p. 411.

Although most of the specimens of this species were taken not far from the type locality in Puget Sound, two were found on the Alaskan beaches.

Stations 4193, Halibut Bank, Gulf of Georgia, B. C., 18–23 fathoms, green mud and fine sand; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud; also beach at Port Ellis and near Shakan, Sumner Strait, southeastern Alaska.

Glycera tesselata Grube.

Glycera tesselata Grube, Arch. f. Naturges., 1863, I, p. 41.

Two small and one large specimens (the latter a fragment measuring 5 mm. across) of this genus are believed to belong to this species, which has not hitherto been recorded at attaining so great a size.

Station 4197, Halibut Bank, Gulf of Georgia, B. C., 31–90 fathoms, sticky green mud and fine sand.

GONIADIDÆ.

Glycinde wireni Arwidsson.

Glycinde wireni Arwidsson, Bergens Museums Aarbog, 1899, No. 11, pp. 53, 54.

This species, taken during the voyage of the Vega at various points in the Arctic Ocean and Bering Sea, ranges as far south as the Gulf of Georgia.

Stations 4192, Gulf of Georgia, off Nanaimo, Vancouver Island, B. C., 89–97 fathoms, green mud and fine sand; 4194, Gulf of Georgia, Halibut Bank, 111–170 fathoms, sticky green mud; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud; 4231, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 82–113 fathoms, green mud and slate fragments; 4235, vicinity of Yes Bay, Behm Canal, 130–193 fathoms, gray mud. The last specimen is a ripe male, distended with sperm.

Goniada annulata Moore.

Goniada annulata Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 549–553, Pl. XXXVI, figs. 45–48.

Most of the specimens are mature and have the posterior region distended with eggs or sperm. There is a distinct tendency to increase in size in correspondence with the location of the station from south northward. The species is quite common from Halibut Bank, in the Gulf of Georgia, northward to Chatham Strait. Stations 4197, Halibut Bank, Gulf of Georgia, B. C., 31–90 fathoms, sticky green mud and fine sand; 4198, same region, 157–230 fathoms, soft green mud; 4235, vicinity of Yes Bay, Behm Canal, 130–193 fathoms, gray mud; 4237, same region, 192–198 fathoms, green mud; 4238, same region, 229–231 fathoms, mud and rocks; 4258, vicinity of Funter Bay, Lynn Canal, 300–313 fathoms, mud; 4264, off Freshwater Bay, Chatham Strait, 282–293 fathoms, green mud.

AMPHARETIDÆ.

Ampharete arctica Malmgren.

Ampharete arctica Malmgren, Kgl. Vet.-Akad. Förh., 1865, p. 364.

Wiren has already recorded this species from Bering Sea. Otherwise it is unknown from the Pacific region. Except that their paleoli have more produced points than Malmgren figures, these specimens agree exactly with his account. A portion of a tube is 6.5 mm. in diameter, with a lumen of 4 mm. and very fragile walls of fine silt.

Stations 4225, Boca de Quadra, southeastern Alaska, 149–181 fathoms, dark green mud; 4258, vicinity of Funter Bay, Lynn Canal, 300–313 fathoms, mud.

Amphicteis alaskensis Moore.

Amphicteis alaskensis Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 846–849, Pl. XLIV, figs. 1–4.

Taken at Stations 4274, Alitak Bay, at a depth of 35–41 fathoms on a bottom of green mud with some fine sand, and 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud.

Amphicteis glabra Moore.

Amphicteis glabra Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 849–851, Pl. XLIV, figs. 5–8.

A small portion of a tube is peculiarly elastic and springy and is covered with a layer of brownish flocculent sediment.

Station 4227, Behm Canal, in the vicinity of Naha Bay, 62 fathoms, bottom of dark green mud and fine sand.

Amphicteis scaphobranchiata Moore.

Amphicteis scaphobranchiata Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 255–257, Pl. XII, figs. 54–61.

Taken at the type locality only, Station 4201, off Fort Rupert, Vancouver, in Queen Charlotte Sound, 138–145 fathoms, soft green mud, sand and broken shells.

Melinna denticulata Moore.

Melinna denticulata Moore, Proc. Acad. Nat. Sci. Phila., 1905, p. 859, Pl. XLIV, figs. 9 and 10.
Melinna cristata Moore, *id.*, pp. 851–853.

The original description of this species was inadvertently placed under the name of *M. cristata*, which, as is well known, has already been employed by Sars. The name *denticulata* was, however, correctly used in the description of the figures on page 857.

The type and only specimen was taken at Station 4258, in the vicinity of Funter Bay, Lynn Canal, on a bottom of mud, 300–313 fathoms.

Melinna cristata (Sars) Malmgren.

Melinna cristata Malmgren, Ofvers. Kgl.-Vet. Akad. Förh., 1865, p. 371.

Two well-preserved specimens in their thick-walled mud tubes represent this species. They were both dredged at Boca de Quadra, southeastern Alaska, at Stations 4224 and 4225, 149–188 fathoms. dark green mud.

Samytha bioculata Moore.

Samytha bioculata Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 253–255, Pl. XLIV, figs. 11–13.

The upper, thickened portion of the mud tube is strengthened by large numbers of siliceous sponge spicules.

Two specimens were taken at Station 4197, Gulf of Georgia, 31–90 fathoms, sticky green mud and fine sand.

TEREBELLIDÆ.

Amphitrite robusta Johnson.

Amphitrite robusta Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, pp. 425, 426.

This species appears to be quite abundant in the Gulf of Georgia and as far north as Naha Bay, Behm Canal. It reaches a larger size than is indicated by Johnson, sometimes exceeding 140 mm. in length and 18 mm. in diameter, the greatest number of segments being 83. The divisions of the branchiæ are often longer than figured by Johnson, whose figure of the uncinus also is somewhat foreshortened. The number of setigerous somites is constantly 17, as stated by Johnson. Some of the specimens bear short cirri or papillæ beneath the setæ of some of the anterior segments. This is probably a secondary sex character, but this could not be ascertained with certainty.

Stations 4193, Halibut Bank, Gulf of Georgia, B. C., 18–23 fathoms, green mud and fine sand; 4194, same region, 111–170 fathoms, soft green mud; 4197, same region, 31–90 fathoms, sticky green mud and fine sand; 4198, 157–280 fathoms, soft green mud; 4228, vicinity of Naha Bay Behm Canal, 41–134 fathoms, gravel and sponge.

Amphitrite radiata nom. nov.

Amphitrite palmata Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 858, 859, Pl. XLIV, figs. 19–22; not *A. palmata* Malmgren, 1865.

Stations 4227, Naha Bay, Behm Canal, 62–65 fathoms, dark green mud and fine sand; 4245 (type locality), Kasaan Bay, Prince of Wales Island, 95–98 fathoms, dark green mud with fragments of shell, rock and sand; 4253, Stephens Passage, 131–188 fathoms, rock and broken shells.

Lanice heterobranchia Johnson.

Lanice heterobranchia Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, p. 427.

The original description is based upon a single specimen which was stated to have no eyes. All of several specimens in the present collection possess very numerous deep brown eyes arranged in a compact narrow band on each side, with a dorsal interval equal to the inter-branchial space and a longer ventral interval. These eyes are ordinarily concealed by the inrolled margin of the prostomial fold. The inequality of the gills seems to be a constant character and the number of setigerous segments is 17, as stated by Johnson. Part of a tube is covered with small pebbles, sea-urchin spines, bits of eel grass, etc.

None of the specimens was found near the type locality in Puget Sound, but all in Alaskan waters at the following stations: 4228, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 41–134 fathoms, gravel and sponge; 4259, Dundas Bay, Icy Strait, 21–78 fathoms, gray sand, broken shell and rock; 4283 Chignik Bay, 30–41 fathoms, black sand and brown sponge; 4289, Uyak Bay, Kadiak Island, 74–80 fathoms, gray mud.

Pista cristata (Müller) Malmgren.

Pista cristata Malmgren, Ofvers. Kongl. Vet.-Akad. Förh., 1865, pp. 382, 383.

The single example of *Pista* referred to this species agrees with those dredged by the Albatross off the coast of Japan, and differs from *P. cristata* as described by European authors in having the upper free angle of the lateral subbranchial membrane of IV much more produced and prominent, quite equalling that of III. Otherwise they agree, so far as can be ascertained, in all features. The handles of the uncini on V are longer than the others, but there is no other difference.

Station 4225, Boca de Quadra, southeastern Alaska, 149–181 fathoms, dark green mud.

?**Pista fasciata** (Grube) Marenzeller.

Pista fasciata Marenzeller, Denks. Kais. Akad. Wissensch., 1885, Abth. 2, pp. 202–204.

Concerning the reference of the fine species of *Pista* found at several stations in southeastern Alaska to the above named, I am in much doubt. Grube's description of *Terebella fasciata* is not sufficiently precise for certain determination, but the excellent accounts and figures given by Marenzeller and McIntosh seem to me to refer to different species. In any event the figure of the branchiæ given by the latter would not answer for these specimens, as the terminal twigs are much more spreading and uneven. About 3 or 4 main branches spring from the trunk, and these immediately branch and rebranch asymmetrically 8 or 10 times, the main stem being always recognizable, but bending at each point of branching and tapering continuously to the end. Usually 3 gills are well developed, and 1 is either very small and entirely without branches or may be altogether wanting. Which are well developed appears to be quite accidental. They may be the two of a pair, or the two of one side, or the left of one and right of the other pair.

All of the specimens exhibit the great flaring wings so well shown in McIntosh's figure, and there is a distinct postbranchial fold across the dorsum of IV. The cirri above and behind the setæ bundles of VI and VII are well developed. In respect to most of their characters the uncini resemble McIntosh's figure closer than those given by Marenzeller, but the former fails to show the guard.

Although none of the specimens is complete, upwards of 100 segments are present, and even incomplete examples measure 160 mm. long and 6 mm. wide across the thorax, being therefore much larger than Marenzeller's specimen. The tube has a thick wall composed of fine silt. The one from Station 4246 is filled with eggs.

Stations 4225, Boca de Quadra, southeastern Alaska, 149–181 fathoms, dark green mud; 4229, vicinity of Naha Bay, Behm Canal, 198–256 fathoms, soft gray mud; 4230, same region, 108–240 fathoms, rocky; 4237, vicinity of Yes Bay, Behm Canal, 192–198 fathoms, green mud; 4246, Kasaan Bay, Prince of Wales Island, 101–123 fathoms, gray-green mud, coarse sand and shells.

Læna nuda Moore.

Læna nuda Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 855, 856, Pl. XLIV, figs. 14, 15.

Known only from the type specimen, a female filled with eggs and preserved in a soft mucous tube coated with a thin layer of foreign materials. It was taken at Station 4279, Kadiak Island, 29 fathoms, dark gray mud.

Thelepus hamatus Moore.

Thelepus hamatus Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 856–858, Pl. XLIV, figs. 16–18.

The type comes from Station 4235, Yes Bay, Behm Canal, 130–193 fathoms, green mud, and a second poorly preserved specimen from Station 4227, Naha Bay, Behm Canal, 62–65 fathoms, dark green mud and fine sand.

Atacama conifera Moore.

Atacama conifera Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 853–855, Pl. XLIV, figs. 11–13.

Type from Station 4194, Gulf of Georgia, 111–170 fathoms, bottom of soft green mud. A second specimen comes from an unknown station.

Terebellides strœmi Sars.

Terebellides strœmii Sars, Beskrivelser og Iagthagelser, etc., 1835, p. 48.

The proper discrimination of the species of *Terebellides* is still a desideratum. While in their more obvious characters the species are very constant, in respect to others they vary greatly. The representatives of the genus found in this collection are in most respects indistinguishable from the widely distributed *T. strœmii* as described by European writers. On the other hand the transitional setæ of somite VIII and the abdominal uncini present slight but quite obvious differences at nearly every station. It seems probable that this species as usually recognized includes a large number of subspecies.

The bent setæ of VIII vary in the length and shape of the bent limb. The uncini usually have 5 teeth in the series above and surrounding the beak; surmounting these is a second row of 3 smaller teeth, and crowning all a single still smaller median tooth. The latter varies in size and in distinctness from the median tooth of the row below, with which it is more or less coalesced; it may even be wanting entirely. The most distinct form occurs on a large example from Station 4247, in which all of the abdominal uncini examined have the median teeth of the second and third rows completely coalesced and that of the first row altogether absent, leaving a gap. The result is that the beak and one nearly equally large tooth occupy the middle line and a large tooth flanked by a smaller one lies on each side of the gap. Most of the specimens are filled with eggs or sperm.

Stations 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud; 4244, Kasaan Bay, Prince of Wales Island, 50–54 fathoms, green mud; 4247, same region, 89–114 fathoms, green mud, fine sand, broken shells; 4281, Chignik Bay, 42–43 fathoms, green mud.

Polycirrus sp.

An undetermined species of *Polycirrus* was taken at Kilisut Harbor.

AMPHICTENIDÆ.

Pectinaria auricoma (Müller).

Amphictene auricoma Malmgren, Ofvers. Kongl. Vet.-Akad. Förh., 1866, pp. 357, 358.

All of the Amphictenidæ in the collection belong to one species which is clearly distinct from any of those hitherto recorded in the Pacific. While closely resembling *P. auricoma* in nearly every respect, there are some points of distinction between these and European examples which may require their eventual specific or subspecific separation. The margin of the cephalic membrane is more obscurely and much more irregularly dentate; the uncini usually have 5 large teeth, and the series of fine teeth on the inferior process is not continued on to the upper part of the process beneath the lower large tooth; the scapha hooks are never as completely circular at the end as figured for European specimens. The paleoli are always 12. In the smaller specimens they have rather long slender tips which wear away, leaving the ends blunt or, in the case of the lateral ones, somewhat pointed.

Stations 4192, Gulf of Georgia, off Nanaimo, Vancouver, B. C., 89–97 fathoms, green mud and fine sand; 4235, vicinity of Yes Bay, Behm Canal, southeastern Alaska, 130–193 fathoms, gray mud; 4244, Kasaan Bay, Prince of Wales Island, 50–54 fathoms, green mud; 4286, Chignik Bay, 57–63 fathoms, green mud and rocks.

CAPITELLIDÆ.

Notomastus giganteus Moore.

Notomastus giganteus Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 227, 228, Pl. X, figs. 24, 25.

The type locality is Station 4264, off Freshwater Bay, in Chatham Strait, 282–293 fathoms, green mud; a larger but incomplete cotype was taken at Station 4197, Gulf of Georgia, 31–90 fathoms, sticky green mud and fine sand.

OPHELIIDÆ.

Ammotrypane aulogaster Rathke.

Ammotrypane aulogaster Rathke, Nov. Act. Acad. Cæs. Leop.-Car. Nat. Cur., (1843), XX, pp. 188–190.

A single individual 27 mm. long and consisting of 49 segments was taken at Station 4235, vicinity of Yes Bay, Behm Canal, 130–193 fathoms, gray mud.

Ammotrypane brevis Moore.

Ammotrypane brevis Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 354, 355, text fig.

The single example on which this species is based is distinguished from the preceding by having the prostomium somewhat depressed dorso-ventrally instead of compressed laterally, by the small number (29) of setigerous somites, and by having the large spoon-shaped anal lobe represented by a slender process only. The type, a female filled with eggs, is No. 284 of the collection of the Academy of Natural Sciences of Philadelphia, and was collected by Dr. Benjamin Sharp at Icy Cape, Alaska.

Travisia forbesii Johnston.

Travisia forbesii Johnston, Ann. Nat. Hist., IV, (1840), p. 373.

Already recorded from Bering Sea by both Wiren and Marenzeller, this species would be expected to occur on the coast of Alaska. While none were taken by the Albatross naturalists, there are six specimens in the collection of the Academy of Natural Sciences, taken by Dr. Sharp at Icy Cape. They vary from 25 to 40 mm. in length and one has the posterior end regenerating. This species is easily distinguished from the next by having smooth setæ, whereas in *T. pupa* they are hispid and also somewhat stouter.

Travisia pupa Moore.

Travisia pupa Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 228–231, Pl. XI, fig. 23.

This is an abundant worm, conspicuous from its large size and widespread on muddy bottoms. Specimens were taken at the following stations : 4192, Gulf of Georgia, 18–23 fathoms, green mud and fine sand; 4194, Gulf of Georgia (type locality), 111–170 fathoms, soft green mud; 4197, Gulf of Georgia, 31–90 fathoms, sticky green mud and fine sand ; 4230, Behm Canal, 108–240 fathoms, rocky; 4235, Behm Canal, 130–193 fathoms, gray mud; 4237, Behm Canal, 192 fathoms, green mud; 4246 Kasaan Bay, Prince of Wales Island, 101–123 fathoms, gray and green mud, coarse sand and shells.

MALDANIDÆ.

Maldane sarsi Malmgren.

Maldane Sarsi Malmgren, Ofvers. Kgl. Vet.-Akad. Förh., 1865, p. 188.

McIntosh and the writer have already recorded this species as occurring in the Pacific off Japan and Wiren in Bering Sea. The posterior capillary setæ have the hairs arranged not in opposite pairs, but spirally.

Stations 4224, Boca de Quadra, southeastern Alaska, 156–166 fathoms, dark green mud; 4264, off Freshwater Bay, Chatham Strait, 282–293 fathoms, green mud; 4286, Chignik Bay, 57–63 fathoms, green mud and rocks. The specimen last listed is a piece of the posterior end, including the pygidium, of a very large individual 3 mm. in diameter.

Maldane similis Moore.

Maldane similis Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 233–236, Pl. XI, figs. 26–30.

The type and one other specimen were taken at Station 4264, off Freshwater Bay, Chatham Strait, 282–293 fathoms, green mud.

Maldanella robusta Moore.

Maldanella robusta Moore, Proc. Acad. Nat. Sci. Phila., 1906, 236–239, Pl. XI, figs. 31, 32.

Specimens of *M. robusta* were taken at Stations 4197, Gulf of Georgia, 31–90 fathoms, sticky green mud and fine sand; 4230, Behm Canal, 108–240 fathoms, rocky battom; and 4246 (type locality), 101–123 fathoms, green mud with coarse sand and shell fragments.

Lumbriclymene pacifica Moore.

Lumbriclymene pacifica Moore, Proc. Acad. Nat. Sci. Phila., pp. 246–248, Pl. XII, figs. 40–42.

Two complete worms and a fragment, together with four or five tubes, were taken at Station 4264, off Freshwater Bay, Chatham Strait, 282–293 fathoms, green mud; and a caudal end at Station 4199, Queen Charlotte Sound, off Fort Rupert, Vancouver, B. C., 68–107 fathoms, soft green mud and volcanic sand.

Clymenella tentaculata Moore.

Clymenella tentaculata Moore, Proc. Acad. Nat. Sci. Phila., pp. 239–242, Pl. XI, figs. 33–35.

Known only from two fragments taken at Station 4264, off Freshwater Bay, Chatham Strait, July 25, 282–293 fathoms, green mud.

Nicomache carinata Moore.

Nicomache carinata Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 242–246, Pls. XI, figs. 36–39; XII, figs. 43, 44.

Fragments of this species occur in the collections from the Gulf of Georgia, Station 4197, 31–100 fathoms, sticky green mud and fine sand; and Station 4198, 157–230 fathoms, soft green mud. The type locality is Station 4227, in the vicinity of Naha Bay, Behm Canal, 62–65 fathoms, dark green mud and fine sand.

SCALIBREGMIDÆ.

Scalibregma inflatum Rathke.

Scalibregma inflatum Rathke, Nov. Act. Acad. Cæs. Leop.-Car. Nat. Cur., XX, (1843), p. 184.

Two specimens, each about 32 mm. long and having 57 segments, seem to be quite typical in every respect.

Stations 4223, Boca de Quadra, 48–57 fathoms, soft green mud, and 4272, Afognak Bay, Afognak Island, Alaska, 12–17 fathoms, sticky mud.

CHLORHÆMIDÆ.

Trophonia papillata Johnson.

Trophonia papillata Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, p. 416.

Silt has adhered to the bases of the cutaneous papillæ to such an extent that they appear mammilliform, and until they were examined under the microscope it was supposed that an entirely new species was in hand.

Stations 4192, Gulf of Georgia, off Nanaimo, Vancouver Island, B. C., 89–97 fathoms, green mud and fine sand; 4272, Afognak Bay, Afognak Island, Alaska, 12–17 fathoms, sticky mud.

Brada villosa (Rathke) Malmgren.

Siphonostoma villosum Rathke, Nov. Act. Acad. Cæs. Leop.-Car. Nat. Cur., XX (1843), p. 218.

No good figures of the setæ of this species have been found and the identification is based on the characters of the papillæ, tentacles, etc. Most of the specimens have the head extended. The number of segments is usually about 30, thus exceeding the number shown in Rathke's figure. The surface is coated with mucous, which becomes hard and to which sand grains adhere, producing a gritty surface, especially on the bases of the papillæ. Marenzeller records the occurrence of this species in Bering Sea.

Stations 4223, Boca de Quadra, 48–57 fathoms, soft green mud; 4272, Afognak Bay, Afognak Island, 12–17 fathoms, sticky mud.

Brada pilosa Moore.

Brada pilosa Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 231–233, Pl. X, figs. 14–17.

This is a rather common species northward. Examples occur in the collections from Stations 4194, Halibut Bank, Gulf of Georgia, 111–170 fathoms; 4198, same region, 157–230 fathoms, soft green mud; 4251 (type locality), Stephens Passage, 198 fathoms, rocky bottom; 4235, Yes Bay, Behm Canal, 130–193 fathoms, gray mud; 4252, Stephens Passage, 198–201 fathoms, gray mud, and 4258, Lynn Canal, 300–313 fathoms, mud.

STERNASPIDÆ.

Sternaspis scutata (Ranzani) Otto.

Sternaspis scutata, Marenzeller, Ann. K. K. Nat. Hofmuseums Wien, V, (1890), p. 6.

These specimens agree exactly with those taken by the Albatross off Japan. Compared with typical examples of the species from the Mediterranean, they appear to have both the cephalic and caudal setæ more slender, and the shorter setæ of the latter region much less hairy. This appears to be due to the hairs having been rubbed off, but may possibly be a normal and constant difference. The form of the caudal plate and branchial area agrees with Marenzeller's figures.

Stations 4235, vicinity of Yes Bay, Behm Canal, Alaska, 130–193 fathoms, gray mud; 4236, same region, 147–205 fathoms, rocks and coarse sand; 4251, Stephens Passage, 198 fathoms, rocks; 4252, same region, 198–201 fathoms, gray mud; 4255, Taiya Inlet, Lynn Canal, 247–259 fathoms, rocky.

?Sternaspis fossor Stimpson.

? *Sternaspis fossor*, Marenzeller, Ann. K. K. Hofmuseums Wien, V, (1890), pp. 5–8.

As Johnson remarks, the *Sternaspis* from the neighborhood of Vancouver Island agrees in all respects with specimens from the Atlantic Coast. Stimpson's *S. affinis* from Puget Sound is with little doubt to be considered a synonym. It is noticeable that the lateral angles of the shield plate become more prominent on examples from the more southern stations. As represented in this collection this species attains a considerably larger size than the last, some of the specimens being 25 mm. long and 9 mm. in diameter.

Stations 4192, Gulf of Georgia, off Nanaimo, Vancouver, B. C., 89–97 fathoms, green mud and fine sand; 4194, Halibut Bank, Gulf of Georgia, 111–170 fathoms, soft green mud; 4201, Queen Charlotte Sound, off Fort Rupert, Vancouver Island, B. C., 138–145 fathoms, soft green mud, sand, broken shells; 4218, Admiralty Inlet, vicinity of Port Townsend, Washington, 16 fathoms, soft green mud; 4223, Boca de Quadra, southeastern Alaska, 48–57 fathoms, soft green mud; 4233, vicinity of Yes Bay, Behm Canal, 39–45 fathoms, soft gray mud and rocks; 4244, Kasaan Bay, Prince of Wales Island, 50–54 fathoms, green mud; 4247, same region, 89–114 fathoms, green mud, sand and broken shells.

HERMELLIDÆ.

Sabellaria cementarium Moore.

Sabellaria cementarium Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 248–253, Pl. XII, figs. 45–51.

This fine species is probably rather common and may possibly be identical with *S. californica* Fewkes, though the description of the latter fails in several respects to apply to this species. This point I hope to clear up later. The tubes, formed of agglutinated sand grains, are remarkable for their strength and hardness, and are found singly or in small clumps attached to stones.

Specimens were taken at the following stations: 4220 (type), Admiralty Inlet, near Port Townsend, Washington, 16–31 fathoms, green mud, sand and broken shells; 4247, Prince of Wales Island, 89–114 fathoms, green mud with sand and broken shells; 4274, Kadiak Island, 35–41 fathoms, green mud and fine sand; 4288, Uyak Bay, Kadiak Island, 67–69 fathoms, gray mud.

SABELLIDÆ.

Sabella formosa Bush.

Sabella formosa Bush, Tubicolous Annelids from the Pacific Ocean, Harriman Alaska Expedition Reports, 1905, pp. 196, 197.

These examples agree well with Miss Bush's description, but differ in having 7, 8 and 9 setigerous thoracic somites respectively. Only one is well preserved and this has nearly the entire branchiæ wine brown, deepest on the radioles and marked with white blotches. The body is 41 mm., the branchiæ 30 mm. long, the former much contracted, the latter extended.

Station 4198, Halibut Bank, Gulf of Georgia, 157–230 fathoms, soft green mud.

Sabella elegans Bush.

Sabella elegans Bush, Tubicolous Annelids from the Pacific Ocean, Harriman Alaska Expedition Reports, 1905, pp. 194, 195.

A fine individual 50 mm. long with 19 pairs of branchiæ has 4 rows of very regular, deep purplish brown spots which occupy the radioles and extend more faintly on to the pinnæ of each branchia. A second smaller one has but 3 sets of spots, and a third still smaller one has them irregularly arranged.

Stations 4227, vicinity of Naha Bay, Behm Canal, southeastern Alaska, 62–65 fathoms, dark green mud and fine sand; 4260, Dundas Bay, Icy Strait, 8½–21 fathoms, coarse sand and rocks.

Pseudopotamilla anoculata Moore.

Pseudopotamilla anoculata Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 566–568, Pl. XXXVII, figs. 28–33.

Known from the type only, taken at Station 4230 in the vicinity of Naha Bay, Behm Canal, 108–240 fathoms, rocky bottom.

Pseudopotamilla splendida Moore.

Pseudopotamilla splendida Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 564–566, Pl. XXXVII, figs. 23–27.

Two specimens were taken at Station 4245, Kasaan Bay, Prince of Wales Island, June 11, 1903, 95–98 fathoms, dark green mud and sand mixed with shell and rock fragments.

Pseudopotamilla intermedia Moore.

Pseudopotamilla intermedia Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 562–564, Pl. XXXVII, figs. 15–22.

The type only is known; originally recorded erroneously as coming from Station 4267, but really from Station 4269, Afognak Bay, Afognak Island, 14–19 fathoms, hard gray sand and rocks.

Pseudopotamilla reniformis (Leuckart) Bush.

Potamilla reniformis Malmgren, Ofvers, Kgl. Vet.-Akad. Förh., 1867, p. 114.

Two specimens are each about 35 mm. long with 16 pairs of branchiæ 6 mm. long. Both have 10 setigerous thoracic segments. The branchiæ are colorless except for a brownish zone covering the basal ⅓, in which all of the eyes, never more than 1 or 2 on each radiole, are aggregated. Several regenerating radioles bear no eyes. The dorsal branchial wing is well developed and there is a slight ventral inflection of the branchial base. The collar has well developed dorsal lobes near the median line, separated by a pair of very deep wide notches from the lateral lobes, which rise abruptly above the collar setæ. There is a little pigment on the dorsum of segments II to IV. The tube is rather soft and flexible and covered with rather coarse sand grains.

Stations 4269, Afognak Bay, Afognak Island, Alaska, 14½–19 fathoms, hard gray sand and rocks; 4271, same region, 11½–20 fathoms, hard gray sand and rock.

Pseudopotamilla brevibranchiata Moore.

Pseudopotamilla brevibranchiata Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 555–559, Pl. XXXVII, figs. 1–7.

Type and cotype taken at Station 4247, Kasaan Bay, Prince of Wales Island, 95–114 fathoms, mixed mud, sand and broken shells.

Pseudopotamilla occelata Moore.

Pseudopotamilla occelata Moore, Proc. Acad. Nat. Sci. Phila., 1905, 559–562, Pl. XXXVII, fig. 8–14.

This species occurs at the following stations: 4202, off Fort Rupert, Vancouver Island, 25–36 fathoms, gray sand; 4261, Icy Strait, 10 fathoms, mud and rock; 4269 and 4270, 14–19 fathoms, hard sand and rock. The largest specimens, among them the type, are yielded by the last station listed.

Pseudopotamilla debilis Bush.

Pseudopotamilla debilis Bush, Tubicolous Annelids of the Pacific Ocean, Harriman Alaska Expedition Reports, 1905, p. 204.

A single specimen lacking the posterior part represents this species. There are 16 pairs of gills 14 mm. long. Eyes appear to be totally wanting and the gills are marked by a pale brown zone near the base and another about midway of their length. The collar is remarkable for its prominent dorsal lobes. The tube is long, slender, flexible, and sparsely covered with sand grains and an occasional small pebble.

Station 4197, Gulf of Georgia, Halibut Bank, 31–90 fathoms, sticky green mud and fine sand.

Chone gracilis Moore.

Chone gracilis Moore, Proc. Acad. Nat. Sci. Phila., 1906, pp. 257–259, Pl. XII, figs. 62–66.

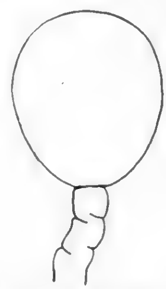
Known through the type, which comes from Station 4274, Alitak Bay, Kadiak Island, 35–41 fathoms, green mud and fine sand; and a smaller specimen taken at Station 4253, Stephens Passage, 131–188 fathoms, rocks and broken shells.

SERPULIDÆ.

Apomatus geniculata Moore.

Protula geniculata Moore, Proc. Acad. Nat. Sci. Phila., 1904, pp. 168, 169, Pls. XI, figs. 17, 18; XII, fig. 38.

A small complete specimen bears 18 pairs of gills, the left dorsal-most one of which is enlarged and flattened and supports only two or three barbs. In the bottle, which contains no other specimens, is a detached operculum which exactly fits the modified radiole and without doubt belongs to this annelid, placing it therefore in the genus *Apomatus*. The operculum has the form shown in the figure, being broadly obovate or egg-shaped and quite smooth, soft and membranous. In all other respects the specimen agrees with the type. Some fragments of tubes indicate that two are sometimes coherent side by side.



Apomatus geniculata—The operculum and part of its stalk in outline, × about 25.

Station 4197, Halibut Bank, Gulf of Georgia, 31–90 fathoms, soft green mud and fine sand.

Serpula columbiana Johnson.

Serpula columbiana Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, pp. 432, 433.

Johnson describes the operculum as having about 100 ribs and marginal denticulations. In these specimens the number is always much greater and varies from 140 to 160. Miss Bush also has noted a larger number on her specimens. The functional operculum is developed sometimes on the right, sometimes on the left side. The accessory operculum is simply clavate. Varying with the size of the specimen the branchiæ number from 36 to 55 pairs. The setæ of the collar have from 2 to 4 large, blunt teeth at the base of the long, slender, curved tip, and the uncini are usually 5- or 6-toothed. Tubes forming a large mass coherent side by side are much thinner and more fragile than tubes found singly.

Port Townsend, on the dock at the Quarantine Station, also Station 4205, Admiralty Inlet, vicinity of Port Townsend, Washington, 15–26 fathoms, rock and shells.

Crucigera formosa Bush.

Crucigera formosa Bush, Tubicolous Annelids of the Pacific Ocean, Harriman Alaska Expedition Reports, 1905, pp. 233, 234.

This species seems very doubtfully distinct from *C. zygophora* (Johnson). The operculum is usually 26- or 27-rayed, but one specimen has 29 and another 32 rays. The tubes are thick and solid and generally much coiled and coherent in clumps. One isolated tube is much coiled at the attached base, with an erect free end.

Stations 4209, Admiralty Inlet, vicinity of Port Townsend, Washington, 24–25 fathoms, rocks, coarse sand and shells; 4261, Dundas Bay, Icy Strait, Alaska, 8½–10 fathoms, green mud and rocks; 4263, same region, 6½–9 fathoms, coarse sand and rocks; 4271, Afognak Bay, Afognak Island, 11½ to 20 fathoms, hard gray sand and rock; 4283, Chignik Bay, 30–41 fathoms, black sand and brown sponge. Empty tubes, apparently of this species, were found at Stations 4202, 4204 and 4289.

Hyalopomatopsis occidentalis Bush.

Hyalopomatopsis occidentalis Bush, Tubicolous Annelids of the Tribes Sabellides and Serpulides from the Pacific Ocean, Harriman Alaska Expedition Reports, 1905, p. 229.

One was found attached to a tube of *Serpula columbiana* from Station 4205, and another to a tube of *Crucigera formosa* from Station 4283.

Spirorbis quadrangularis Stimpson.

Spirorbis quadrangularis Stimpson, Bush, Tubicolous Annelids of the Tribes Sabellides and Serpulides from the Pacific Ocean, Harriman Alaska Expedition Reports, 1905, p. 241.

Found on tubes of *Crucigera formosa* at Stations 4271 and 4289.

Spirorbis spirillum Linn.

Spirorbis spirillum Linn., Bush, *id.*, p. 243.

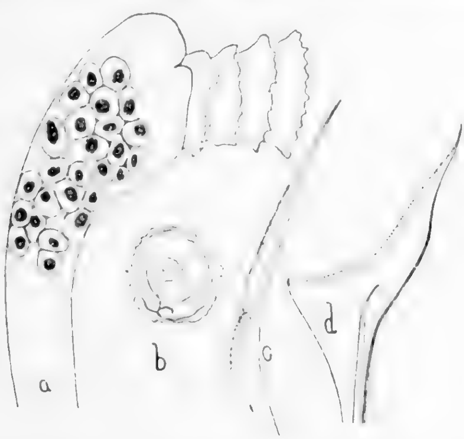
Numerous specimens attached to a piece of giant kelp from Station 4262, Dundas Bay, Icy Strait, 9 fathoms, coarse sand and rocks; also a number in the collection of the Academy of Natural Sciences of Philadelphia (No. 1090), collected by Mr. E. A. McIlhenny at Point Barrow, Alaska.

Spirorbis tridentata Levinsen.

Spirorbis granulata var. *tridentata* Levinsen, Viden. Medd. Naturh. Foren., Kopenhaven, 1882, p. 350; not *S. tridentata* Bush.

The tubes of this very characteristic species agree so closely with Levinsen's figure that I refer them thereto, in preference to giving a new name founded upon the peculiarities of the worm, though it may be that the animal which occupies the tubes figured by Levinsen will prove to be quite different.

The figures of the tubes given by Levinsen would serve equally well for these. They are close, sinistral, discoid coils without any true central opening, the first coils being in contact in the center. As the tubes grow older the outer turns tend to overlap and pile upon the inner, leaving a deep central depression bounded by nearly vertical sides. At the same time the tube, which is perfectly smooth in the early stages, becomes roughened by growth lines, and its walls become very thick, solid and stony, and are ornamented by three thick and stout ridges rounded on the free side and covering most of the outer surface of the shell. Here and there the depressions between them are crossed by transverse spurs and rods. At the aperture of the tube these ridges project as three very strong and prominent teeth. Fully developed tubes are usually 3.5 mm. in diameter and composed of 4 to 4½ turns. The carinæ begin at the end of the third turn and Levinsen's figure very accurately represents one in a half-grown condition in which the ridged whorl is just beginning to turn in upon the inner coils. One more turn, with the ridge characters exaggerated, would



Spirorbis tridentatus—*a*, an operculum in side view, filled with embryos and showing the imperfect four-tiered calcareous plug, × 24; *b*, one of the calcareous plates detached and seen from the inner surface, × 24; *c*, a collar seta, the fin at the base may be somewhat too long, × 600; *d*, the two setæ of an abdominal bundle, × 600.

result in a condition exactly like my full-grown tubes, in which the inner coils are completely concealed from above and the exposed parts bear massive ridges, Where free to grow without restraint the tubes are strictly discoid and the lower surface of all of the coils is in intimate contact with the alga to which they are attached, but when the individuals are crowded the coils are heaped up in various irregular and often angulated forms.

In general form the operculum (*a*) agrees well with that of *S. granulatus*, being a slender cone containing a broad pouch filled with embryos and tapering regularly into a long but rather stout stalk. The calcareous part, however, is remarkable, being built up of 3 or even 4 (*a*) calcareous disks of complex form (*b*). Each has a somewhat grooved rim with thin projecting flanges whose margins appear to be entire when perfect, but are usually jagged as a result of wear. It is very seldom that more than the basal disk and the one next beyond are found entire. An excentric opening prolonged into a tube on the proximal side perforates each disk obliquely dorsal to the center and accommodates the siphuncular ligament, binding all together. The number of branchiæ is about 11, but could not be definitely ascertained, owing to their being so closely matted together.

There are 3 thoracic and about 24 setigerous abdominal segments, the latter region being very short. The winged collar setæ have the form shown at *c*, the basal fin being very long, uniformly serrated and overlapping the base of the blade without an interval. The blade is very finely serrated, long, acute, and tapering. The remaining thoracic setæ are partly limbate capillary and partly serrate and sickle-shaped. Each fascicle of abdominal setæ contains but two, one being a minute aciculum with the end bent, the other having a broadly expanded end much like those of *S. spirillum* (*d*). Nothing distinctive can be detected about the uncinial plates.

The type is No. 80, collection Academy of Natural Sciences of Philadelphia, and was taken along with several cotypes at Dutch Harbor, Unalaska, by Dr. Benjamin Sharp. Attached to a tough alga frond.

AN ORTHOPTEROLOGICAL RECONNOISSANCE OF THE SOUTHWESTERN UNITED STATES. PART I: ARIZONA.

BY JAMES A. G. REHN AND MORGAN HEBARD.

During the summer of 1907 Orthopterological field work was carried on by the authors at a number of stations extending from El Paso, Texas, and Albuquerque, New Mexico, to southern and north-central California, the material and notes secured being very extensive and of great value. In this paper we present the results of our work in Arizona, giving first an idea of the environment of the various localities visited.

A trip to the little known Baboquivari range in southern Pima County was interrupted and of necessity abandoned on account of the flooded condition of the country to be traversed. Much good material, however, was taken before our party was compelled to return to Tucson.

Mr. Otho Poling, the well-known Lepidopterist of Quincy, Illinois, accompanied us through southern Arizona and assisted in collecting much of the material, while all secured in northern Arizona was taken by the junior author. The number of specimens examined was nine hundred and seventy-three, while the species numbered sixty-three.

Several specimens collected at Nogales and Grand Canyon by Dr. P. P. Calvert in 1906 and a small series taken in or near the Huachuca Mountains by Mr. H. A. Kaeber in the summer of 1907 have also been studied and inserted in this paper, but these are not included in the count of species and specimens.

The types of all the new forms are in the Hebard Collection.

Tucson, Pima County, Arizona.—Elevation about 2,400 feet. July 23 and 26. The immediate vicinity of Tucson is a nearly level desert plain, extending from the Santa Catalina to the Tucson Mountains, drained by the Santa Cruz River and other less constant and smaller streams and washes. A considerable portion of this plain is covered with stretches of greasewood (*Covillea tridentata*) and scattered growths of various cacti. In the vicinity of the water courses and washes mesquite (*Prosopis* sp.) is the predominating vegetation, attaining a height of twenty feet or more in favorable localities, especially along the Santa Cruz River. The most successful collecting was found in and about a vacant lot on the edge of the city, in the central part of which was a small pool of water, the outlet of a city drain. About this pool were high cat-tails and other thick growths of plants, in which situation Orthopters were found to be very plentiful, and likewise among a nearby dense thicket of wild sunflowers and bushes. In these situations the following species were taken: *Paratettix toltecus, Syrbula fusco-vittata, Scyllina calida, Encoptolophus texensis, Trepidulus rosaceus, Conozoa carinata, Anconia integra, Schistocerca vaga, Æoloplus tenuipennis, Melanoplus brownii, M. atlanis* and *Œcanthus quadripunctatus.* In the irrigated fields near the river some specimens were found, although by no means as many as might have been expected in a locality apparently so favorable. On the typical desert greasewood plain forms peculiar to a like environment, such as *Heliastus aridus, Ligurotettix kunzei, Derotmema laticinctum* and *Psoloessa texana,* were taken. In the city at night about the arc lights thousands of Gryllids swarmed and could be easily captured in great numbers.

Sonora Road Canyon, Tucson Mountains, Pima County, Arizona.—Altitude about 3,000 feet. July 25. The old Sonora trail after leaving Tucson winds around the southeast base of the rather low Tucson Mountains, then turns sharply and crosses the range by following up an arroyo or torrent bed and traversing a very low pass in a shallow canyon with sloping sides. The canyon is very rough and much of the rock exposure is dull reddish in color. The vegetation is composed in large part of desert foothill types, the most noticeable of which are numerous sahuaro (*Cereus giganteus*), palo verde (*Cercidium torreyanum*), cholla (*Opuntia* sp.) and the peculiar *Koeberlinia spinosa.* Orthoptera were few in number, but the species found were of very great interest and differed noticeably from those of the surrounding plains. These included a new mantis *Yersinia sophronica,* a new Truxalid *Horesidotes papagensis, Ageneotettix australis, Aulocara rufum, Arphia teporata* and *Phrynotettix magnus.* The majority of the specimens taken showed considerable adaptation of their coloring to the reddish exposures.

Sahuaro Slope, Southwest Side of the Tucson Mountains, Pima County, Arizona.—July 25. After crossing the Tucson range the Sonora trail descends the extensive and gentle southwestern slope of the mountains through a numerous growth of sahuaro or giant cactus (*Cereus giganteus*), with attendant greasewood (*Covillea tridentata*) bushes growing thickly and often to a height of over six feet. Many other plants flourish, the intervening ground between them being usually quite bare, as is often the case in this desert country. On the greasewood in this situation *Ligurotettix* was very plentiful and its faint stridulation was to be heard on every side. Most of the collecting was done at an elevation of about 2,500 feet.

Near Sonora Road, Southwest of the Tucson Mountains, Pima County, Arizona.—July 25. Several miles from the Tucson Mountains collecting was carried on for a short time in a grassy area with occasional bunches of rabbit-weed. In this locality Orthoptera were found to be far more plentiful than on the surrounding more truly desert plain. Among the species taken were *Psoloessa texana, Encoptolophus subgracilis, Tomonotus aztecus, Trepidulus rosaceus, Trepidulus melleolus, Derotmema laticinctum* and *Hesperotettix festivus.*

Roeble's Ranch, near Coyote Springs, Pima County, Arizona.—July 24 and 25. This locality is in the lower level of a plain stretching from the Tucson to the Comobabi range, near a large arroyo known as Roeble's Wash. It is in a uniform mesquite and rabbit-weed region, with no striking difference in conditions for a number of miles to the northeast. Two specimens of *Trepidulus melleolus* were the most interesting forms taken.

Yuma, Yuma County, Arizona.—Elevation about 150 feet. July 27 and 28. To the east of Yuma the desert stretches, broken by occasional low volcanic hills, where it is too hot for even the greasewood to thrive and desert Orthoptera are almost wholly absent. Along the Colorado River, however, is a wide strip of willows, and back of these ground heavily overgrown with arrow-wood (*Pluchea sericea*) and other reeds where collecting was more productive. These, although so near the river, were nevertheless parched with the heat. To the east along the Gila River a great expanse of high weeds was found, but so dry that many fell to pieces when touched and insect life was extremely scarce. In the irrigated tract below Yuma *Orphulella compta* was very abundant. In the town at night Gryllidæ and thousands of beetles and other insects swarmed around the arc lights. All of these Gryllids flew rapidly about, and would have been difficult to capture had they not come to the light dazed and confused.

Williams, Coconino County, Arizona.—Altitude, 6,748 feet. September 13. The little collecting done here was accomplished near the station in a field of short weeds and grass, and also near the pine "glades" as they may be called. The whole country about Williams is on nearly the same plane but gently rolling. Over this area pines were thickly scattered, underneath which was practically no underbrush but very green grasses, this vegetation imparting to the whole country a park-like appearance. In the vacant field, where the weeds were more abundant than elsewhere, Orthoptera were found more plentiful than we had expected to find them at this elevation.

Anita, Coconino County, Arizona.—Altitude about 6,500 feet. September 11. At this small station, between Williams and the Grand

Canyon, but very little time was allowed for collecting. It is in the midst of the pine "glades," and, no town being located there, the few specimens taken are typical of the park-like country on the top of the Coconino plateau. The country was in general the same as that outside the town of Williams.

Grand Canyon of the Colorado, Coconino County, Arizona. Rim of the Canyon at Bright Angel and Vicinity.—Elevation, 6,800–7,000 feet. September 11. Back from the edge of the canyon the country is rolling and covered with a forest of pines, under which in most places there is practically no vegetation or soil on the sheet of rock forming the top layer of the plateau.

In this country collecting was almost utterly without result, but along the edge of the canyon, and for a short distance back from it, better results were obtained. An area to the southeast of the hotel was also found where there was some low vegetation under the pines and in this situation *Ageneotettix curtipennis* and *Amphitornus nanus* were taken.

The Bright Angel Trail.—Altitudes, 6,866-2,436 feet. September 12. For some distance on this trail the collecting proved to be much as at the edge of the canyon, but farther down at about 5,850 feet the canyon side became more open, a few junipers appeared and the open places were filled with thickets and grasses. It was here (5,800–4,900 feet elevation) that *Melanoplus canonicus* and *Syrbula modesta* were not uncommon, but more or less difficult to capture owing to the extreme steepness of the location. Farther down (elevation 4,350–3,900 feet) in the grassy valley above the Indian Garden Spring, it was surprising to note that, in spite of the difference of three thousand feet in elevation and the more grassy country, practically the same forms as those occurring at the top of the canyon were found. In the garden of the Indian Spring House one *Paratettix toltecus* was taken. Diligent search failed to disclose more than two specimens of Orthoptera on the wide canyon mesa (3,700–3,800 feet) which was covered with a sage and occasional patches of prickly pear. The *Trimerotropis vinculata* was among sage, while the *Paropomala perpallida* was captured on the very brink of the canyon precipice (elevation 3,750 feet) in a scant bunch of a sort of wire-grass.

BLATTIDÆ.

PERIPLANETA Burmeister.

Periplaneta americana (Linnæus).

A female of this species was taken at Tucson, July 23, and a male at Yuma, July 27, attracted to light in both cases.

This widely distributed species has previously been recorded from Arizona at Yuma, Nogales, Florence and Phœnix.

HOMŒOGAMIA Burmeister.

Homœogamia erratica Rehn.

A single male of this species was attracted to light at Yuma, July 27.

MANTIDÆ

YERSINIA Saussure.

Yersinia sophronica[1] n. sp.

Type: ♀; Sonora Road Canyon, Tucson Mountains, Pima County, Arizona, altitude 3,000 feet. July 25, 1907. Collected by Hebard and Rehn.

This very peculiar species differs from *Y. solitaria* Scudder from the eastern slope and foothills of the Rocky Mountains, western Nebraska and southeastern Arizona in the smaller size, the more compressed head with strongly acute mammiform eyes which are hardly at all divergent and in the shorter cephalic limbs. In the form of the head and eyes this species suggests the structure found in the African and Indian genera *Episcopus* and *Parepiscopus*.

Size small; form very slender; surface smooth. Head strongly compressed; occiput strongly concave, rounded; interantennal region with a pair of median parallel longitudinal carinæ which terminate dorsad in short sharp points before reaching the dorsal line of the head; antennæ filiform, not quite equal to the pronotum in length; eyes very elongate, not divergent, subparallel, strongly produced mammiform. Pronotum rather short, subequal in width without any marked supra-coxal dilation, the width contained nearly three times in the length; cephalic margin rounded, caudal margin truncate; median carina distinct throughout, but very delicate on the collar. Mesonotum and metanotum little expanded, with distinct median carina, no vestiges of tegmina or wings. Abdomen subfusiform, a finely marked median carina present throughout its length, distal third quite narrow; supra-anal plate trigonal; subgenital plate rounded with a median incision dividing it into

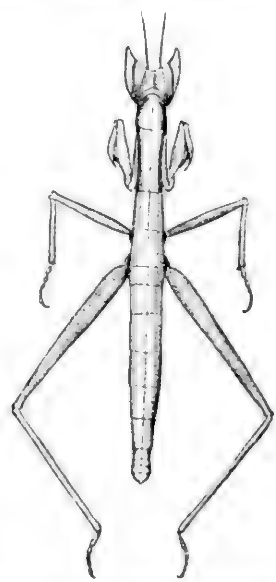


Fig. 1.—*Yersinia sophronica* n. sp. Dorsal view of type. (× 5.)

[1] Σωφρονικη, *discreet*.

two lobes; cerci damaged. Cephalic coxæ about two-thirds the length of the pronotum and not extending caudad of the same; cephalic femora slightly longer than the coxæ, quite robust, external margin armed with six short irregularly placed spines, internal margin with eleven spines, the majority of alternating sizes, largest discoidal spines quite robust; cephalic tibiæ very slightly less than half the length of the femora, armed on the external margin with eight spines, internal margin with about seven spines, terminal claw large; cephalic metatarsi about as long as the tibiæ, slender, remaining tarsal joints about equal to the metatarsi in length. Median limbs rather short, femora very slightly expanded proximad. Caudal limbs moderately slender; femora reaching to the apex of the fifth abdominal segment, distinctly but slightly inflated in the proximal two-thirds; tibiæ equal to the femora in length, very slender; caudal tarsi short.

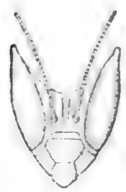


Fig. 2.—*Yersinia sophronica* n. sp. Front view of head. (× 10.)

General color cinnamon-rufous, darkened on the dorsum of the head and the median area of the pronotum; median line of the abdomen vandyke brown. Face burnt umber except antennæ and mouth parts which are pale ochraceous. Apex of abdomen washed with broccoli brown, the tips of the terminal plates ochraceous. Limbs ochraceous, tending to ochraceous-rufous on the median and caudal femora and dorsal edge of cephalic femora.

Measurements.

Length of body,	14 mm.
Length of pronotum,	3.2 "
Length of cephalic femur,	2.6 "
Length of caudal femur,	5.7 "

The unique type was found running actively about among the stones of a bare hillside.

LITANEUTRIA Saussure.

Litaneutria skinneri Rehn.

A male specimen from the Grand Canyon, altitude 7,000 feet, September 11, 1907, belongs to this species, while another male, not quite mature, from Tucson, July 26, is referred to it with some little doubt. The Grand Canyon male has the tegmina slightly shorter than the typical individuals of that sex, while the blackish tegminal maculation of the type is absent.

PSEUDOSERMYLE Caudell.

Pseudosermyle truncata Caudell.

Two male specimens of this species taken at Palmerlee, Huachuca Mountains, Cochise County, July 9 and 16, by Mr. H. Kaeber have been examined. The species is now known to range from the Grand Canyon region south at least to the southern boundary of the Territory and west to southern California. The localities from which it has been recorded are Dos Cabezos, Bright Angel, San Bernardino Ranch and the Huachuca and Santa Rita Mountains.

ACRIDIDÆ.

PARATETTIX Bolivar.

Paratettix toltecus (Saussure).

At Tucson two females of this species were taken on July 26, and a single female was collected by Hebard at 3876 feet elevation on the Bright Angel Trail, Grand Canyon, September 12. These individuals were taken on damp ground near water. All three specimens have the apex of the pronotum failing to reach the tips of the caudal femora.

MERMIRIA Stål.

Mermiria texana Bruner.

A female specimen of this species taken at Palmerlee, Huachuca Mountains, Cochise County, July 6, by Mr. H. Kaeber has been examined.

PAROPOMALA Scudder.

Paropomala acris n. sp.

Type: ♂ ; Railroad Pass, Cochise County, Arizona, altitude 4,386 feet. July 23, 1907. (Hebard and Rehn.)

This species differs from the previously known species of the genus in the following particulars: from *cylindrica* and *calamus* in the much shorter subgenital plate and longer tegmina; from *pallida* in the slenderer form and more acute fastigium; from *dissimilis* and *virgata* in the more produced head, the more acute fastigium and the more elliptical eyes.

Size rather small; form elongate, very slender. Head with the dorsum slightly longer than the dorsum of the pronotum, occiput hardly elevated, very slightly arched, fastigium and interocular region horizontal; interocular region slightly narrower than the greatest width of the fastigium; fastigium longer than broad, distinctly acute-angulate in shape with the immediate apex well rounded, surface of the fastigium with a circular impression covering about two-thirds the circumference of a circle; eye elongate-ovate; angle of face considerably retreating, the interantennal region with the angle less acute and

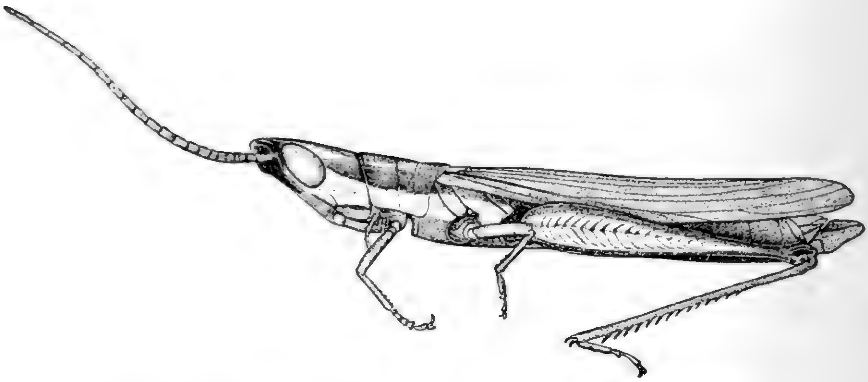


Fig. 3.—*Paropomala acris* n. sp. Lateral view of type. (× 4.)

joining the fastigium in a distinctly but not greatly acute angle, frontal costa narrow, gradually and slightly but rather irregularly expanding caudad, strongly sulcate from the fastigial angle to the clypeus; lateral foveolæ broad linear, slightly arcuate, distinctly impressed; antennæ exceeding the head and pronotum by about the length of the fastigium, distinctly ensiform, tips very slender. Pronotum very slightly constricted mesad, the caudal width of the disk contained about twice in the length; cephalic margin of the disk irregularly arcuate, caudal margin of the disk regularly arcuate; median carina distinct throughout its length, not high; prozona nearly half again as long as the metazona, metazona deeply punctate, lateral lobes distinctly longer than deep, ventral margin nearly straight, cephalic margin straight oblique, metazona of the lateral lobes punctate. Tegmina exceeding the tips of the caudal femora by very slightly more than the length of the fastigium and falling very little short of the tip of the subgenital plate, in shape very narrow with the apex narrowly rounded. Prosternum with a low blunt process. Interspace between the mesosternal lobes very narrow and apparently divided mesad by the lobes which are subcontiguous at that point; metasternal lobes contiguous. Supra-anal plate acute-trigonal, arched transversely, slightly flattened dorsad; cerci simple, styliform, very slightly arcuate ventrad, reaching nearly to the apex of the supra-anal plate; subgenital plate moderately compressed

Fig. 4.—*Paropomala acris* n. sp. Dorsal outline of head. (× 4.)

acute-angulate in outline when viewed from the side, apex well rounded, the dorsum of the plate with a median longitudinal lamellate carina. Cephalic and median limbs very short. Caudal femora half again as long as the head and pronotum together, compressed, moderately slender; tibiæ very slightly shorter than the femora, armed on the external margin with fourteen spines.

General color dorsad and ventrad salmon, a chalk-white bar on each side extending from the caudal and ventral margin of the eye over the entire genæ, ventral half of the lateral lobes of the pronotum, pleura and lateral face of the caudal femora. This white bar is bordered dorsad by one of chocolate which is very narrow at the eye but gradually expands to the middle of the pronotum, whence it as gradually contracts until it is lost dorsad of the articulation of the caudal limbs. Another narrow whitish line is present on each side of the head and prozona between the chocolate bar and the general color and a pair of lunate bars of vinaceous-rufous are present on the occiput. Eyes tawny olive; antennæ and face raw umber. Tegmina buff, humeral vein seal brown.

Measurements.

Length of body,	21	mm.
Length of pronotum,	3	"
Length of tegmen,	14	"
Length of caudal femur,	9.8	"

The type is the only specimen of the species examined and was taken on the desert summit of the Pass, among mesquite bushes and dry grass.

Paropomala perpallida n. sp.

Type: ♂; near Bright Angel Trail, elevation 3,750 feet, Grand Canyon of the Colorado, Coconino County, Arizona. September 12, 1907. Collected by M. Hebard.

This species is closely related to *P. pallida* Bruner from the Salton Basin, California and southwestern Arizona, differing in the considerably smaller size.

Size small; form moderately slender (for the genus). Head very slightly longer than the dorsum of the pronotum; occiput and interocular region regularly but not strongly arcuate from the pronotum to about the middle of the fastigium; interocular region very slightly narrower than the greatest fastigial width; fastigium slightly longer than broad, lateral margins acute-angulate but with the apex very broadly rounded, impressed pattern on the disk of the fastigium semicircular; face very considerably retreating, interantennal region with the angle much less acute and very narrowly rounding into the fastigium, frontal costa subequal in width to below the median ocellus whence it

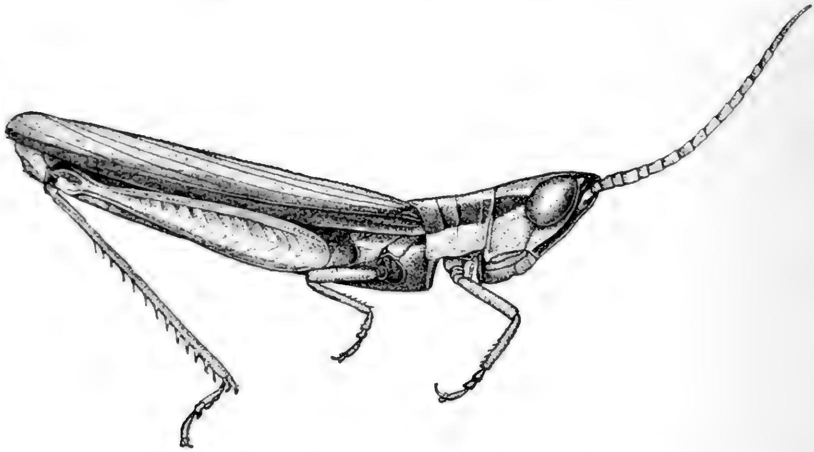


Fig. 5.—*Paropomala perpallida* n. sp. Lateral view of type. (× 5.)

regularly but not greatly expands to the clypeal suture, sulcate throughout its length; eyes narrow-ovate, moderately prominent when viewed from the dorsum; lateral foveolæ sublanceolate, slightly arcuate, deeply impressed; antennæ about three times the length of the pronotum, slightly depressed and expanded proximad, tips very slender. Pronotum with the caudal width of the disk contained slightly less than twice in the length of the disk; cephalic margin of the disk subtruncate, caudal margin arcuate with the median portion somewhat flattened; median carina distinct but low, prozona slightly more than half again the length of the metazona, the latter on the dorsum and lateral lobes thickly but shallowly punctate; lateral lobes slightly longer than deep, ventral and cephalic margins obliquely sublinear. Tegmina reaching to the apex of the subgenital plate, narrow, apex truncato-rotundate. Mesosternal lobes separated by a very narrow space; metasternal lobes attingent. Subgenital plate slightly compressed, apex very slightly rostrate. Cephalic and median limbs very short. Caudal femora failing to reach the tips of the tegmina by more than half the length of the pronotum, moderately slender, compressed; caudal tibiæ slightly shorter than the femora, external margin armed with thirteen spines.

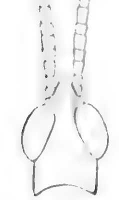


Fig. 6.—*Paropomala perpallida* n. sp. Dorsal outline of head. (× 5.)

General color cream-buff with a barely appreciable greenish tinge. Dark lateral bars vandyke brown, gradually expanding on the head, continued over the lateral lobes and pleura, suffusing the base of the costal field of the tegmina and coloring the proximal half of the discoidal and humeral veins of the same and the dorsal half of the proximal abdominal segments. White lateral bars as in *P. acris*, but not present on the caudal femora. Eyes clay color marbled with bistre; face and mouth parts sprinkled with small spots of brown; antennæ tawny, darker proximad. Caudal femora of the general color with the dorsal half of the lateral face pale vinaceous bordered ventrad by a line of dots of brownish.

Measurements.

Length of body,	16.2	mm.
Length of pronotum,	2.5	"
Length of tegmen,	11	"
Length of caudal femur,	8	"

The type specimen is the only one examined by the authors. It was taken on the extreme edge of the canyon plateau and was found clinging to a wisp of dry grass, the only vegetation along the extreme edge of the plateau above the trail.

SYRBULA Stål.

Syrbula fuscovittata Thomas.

At Tucson on July 26 two males and three females of this species were taken from high weeds growing in damp soil surrounding a pool. An immature female was also taken in Sonora Road Canyon, Tucson Mountains, July 25.

One of the males is in a condition similar to that of the specimen of the same sex recorded by Rehn.[2] Two of the females are in the green phase and the other in the brown phase, with, however, much very pale green on the face and sides of the head, lateral lobes of the pronotum, tegmina and caudal femora. The males are smaller than the average of a series of eight from the Huachuca Mountains.

Syrbula modesta Bruner.

This rather diminutive species was taken at elevations ranging from 4,900 to 5,800 feet in the Grand Canyon, three males and two females being included in the series. Apparently this species has two color phases, as all the specimens seen are in a brown phase of coloration, while Bruner's original description shows that his specimens had green or greenish the predominating color.

---

[2] *Proc. Acad. Nat. Sci. Phila.*, 1907, p. 32.

As far as known this species is found only in the Grand Canyon region. The males of this form, instead of flying straight from one place to another, rise usually very swiftly in a curve which, on account of their size and coloration, makes them very hard to follow. The females rely almost altogether on their powerful saltatorial ability. Often in alighting the males would select the terminal twigs of a juniper as resting places. In distribution it appeared to be very local.

BOÖTETTIX Bruner.

Boötettix argentatus Bruner.

This very interesting species was taken at several localities and always on its favorite shrub, the greasewood (*Covillea tridentata*). At Yuma on July 27 it was found to be numerous and seven males were taken; an immature individual was collected at Sentinel, July 27. An adult male and an immature specimen were taken on the Sahuaro slope southwest of the Tucson Mountains, July 25.

All the specimens collected lack decided spots on the sutural margin of the tegmina, and even traces are present in only one individual.

AMPHITORNUS McNeill.

Amphitornus nanus n. sp.

Type: ♂; Grand Canyon of the Colorado, Coconino County, Arizona, altitude 7,000 feet, in conifer forest. September 11, 1907. Collected by Morgan Hebard.

Closely related to *A. ornatus* McNeill, but differing in the very small size (length of body 14.5 mm.) and the shorter tegmina which hardly surpass the tips of the caudal femora.

Size quite small; form as usual in the genus. Head very slightly shorter than the dorsum of the pronotum, occiput and interocular region regularly but slightly ascending to the fastigium; interocular region but little narrower than the greatest fastigial width; fastigium slightly acute-angulate, the immediate apex narrowly rounded, median carina distinct on occiput, interocular region and fastigium, very low except on the fastigium; face considerably retreating, inter-antennal region rounding to the subrectangulate junction with the fastigium; frontal costa moderately broad and subequal to a very short distance ventrad of the ocellus, considerably broader and subequal thence to the clypeal suture, for its entire length depressed within its margins and punctate; eyes subacute-ovate, hardly prominent when viewed from the dorsum; lateral foveolæ distinct, impressed caudad; antennæ about equal to the head and pronotum in length, rather robust, slightly depressed proximad, tips bluntly acuminate. Pronotum with the disk about half again as long as the greatest caudal width of the same; cephalic margin of the disk subtruncate, caudal margin very obtuse-angulate; median carina moderately elevated, accessory carinæ distinct and parallel with but weaker than the median one; lateral lobes slightly longer than deep. Tegmina exceeding the abdomen by slightly less than the length of the eye and very slightly surpassing the tips of the caudal femora; apices of tegmina rounded; intercalary vein absent. Interspace between the mesosternal lobes subquadrate, but little narrower than one of the lobes; metasternal lobes subattingent caudad. Subgenital plate blunt, somewhat compressed dorsad. Caudal femora slightly more than three times the length of the pronotum, of medium build; caudal tibiæ considerably

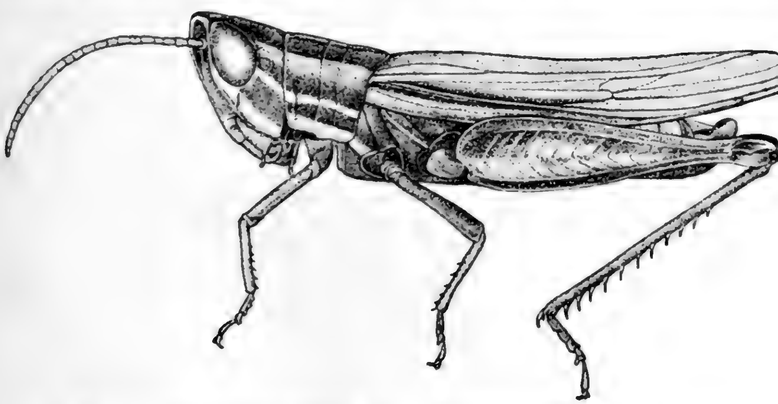


Fig. 7.—*Amphitornus nanus* n. sp. Lateral view of type. (× 5.)

shorter than the femora, armed on the lateral margin with eleven to twelve spines.

General colors vandyke brown, seal brown and pinkish white. A narrow line of white extends from the caudal margin of the eye obliquely ventro-caudad to the pronotal margin, thence transversely across the lateral lobe, curving somewhat ventrad at the caudal margin. Another whitish line extends from the base of each antenna as a narrow line bordering the ventro-cephalic and ventral border of the eye, broadening and extending diagonally across the gena to the ventro-caudal angle of the same, reappearing again as a moderately wide white ventral border to the lateral lobe, separated from the one dorsad of it by a wider bar of seal brown, and vanishing dorsad of the insertion of the median limbs. Head with the dorsal surface, sides and face seal brown, aside from the white bars mentioned above and a bar of mars brown extending from the dorso-caudal margin of the eye to the caudal margin of the pronotum, margining the disk on the latter; eyes and antennæ walnut brown. Pronotum with the disk seal brown, except for the area between the supplementary carinæ which is chocolate.[3] Tegmina vandyke brown, seal brown proximad in the region of the humeral and discoidal veins; area between the mediastine and humeral veins proximad with a bar of whitish. Venter and abdomen naples yellow, stippled on the sides and apex of the abdomen with brownish. Cephalic and median limbs thickly sprinkled with walnut brown on a paler ground. Caudal femora with the dorsal half with ecru drab as a base color, ventral half straw yellow, genicular region seal brown, bar at a third the length from the tips seal brown, distinct and solid dorsad, weak ventrad; dorsal face with the proximal half washed with seal brown and the dorsal half of the lateral face clouded with one extensive proximal maculation and a smaller median one. Caudal tibiæ glaucous blue, blackish at the genicular region and pale between this and the glaucous portion, spines with their distal halves black.

Measurements.

Length of body,	14.5 mm.
Length of pronotum,	2.7 "
Length of tegmen,	11.5 "
Length of caudal femur,	8.7 "

The unique type was found on ground devoid of vegetation but covered with needles in the dense piñon and juniper forest. No other Orthoptera were noticed in this locality.

ORPHULELLA Giglio-Tos.

Orphulella compta Scudder.

This species was exceedingly abundant at Yuma, on irrigated ground along the Colorado River south of the town. On July 28 a series of twenty-six males, sixteen females and two nymphs was taken.

Of this series about half is in the green phase, while the remainder is divided between a full brown phase and one possessing both green and brown in its make-up—a mixed phase. Only one, a female, shows any tendency toward purplish on the tegmina, and in this case it is not strongly marked. There is a considerable amount of variation in size in both sexes, and also in the form of the angle and depth and extent of the excavation of the fastigium.

[3] This bar is very faintly indicated on the head.

The records of this species show its main range to be over the lower part of the Colorado Valley and adjacent Salton Basin, while the occurrence of it at San Bernardino Ranch, Cochise County, in southeastern Arizona, in all probability, is due to the species following up the Yaqui Valley from the Gulf of California section of Mexico.

HORESIDOTES Scudder.

Horesidotes papagensis n. sp.

Type: ♀; Sonora Road Canyon, Tucson Mountains, Pima County, Arizona, altitude about 3,000 feet. July 25, 1907. Hebard and Rehn.

Closely allied to *H. cinereus* Scudder, with topotypes of which it has been compared, but differing in the somewhat smaller size, blunter fastigium, greater interspace between the eyes, less apparent lateral foveolæ, quite distinct and continuous intercalary vein and more

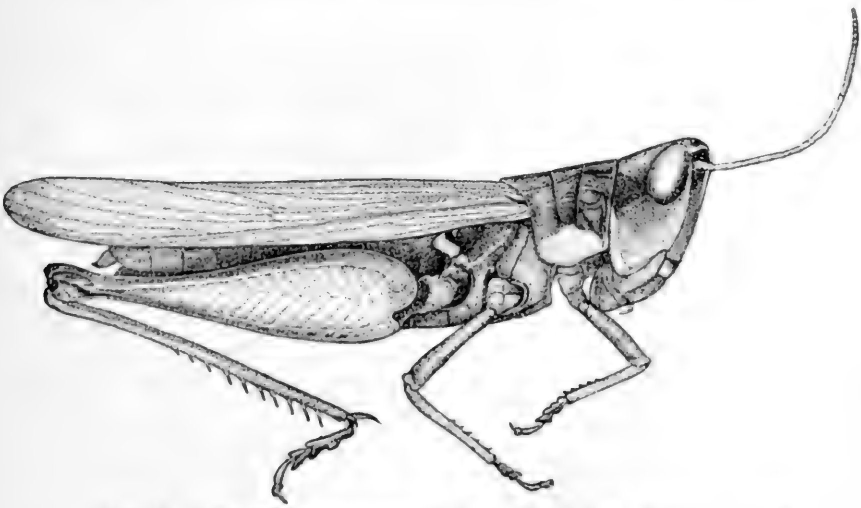


Fig. 8.—*Horesidotes papagensis* n. sp. Lateral view of type. (× 4.)

robust and inflated and proportionately somewhat shorter caudal femora.

Size moderate; form distinctly compressed. Head slightly shorter than the dorsal length of the pronotum, ascending on the occiput to the vertex which is interocular, fastigium well rounded into the facial outline; interocular region subequal to the width of the fastigium, the occiput and interocular region with a weak median and pair of closely placed supplementary carinæ; fastigium slightly broader than long, slightly acute-angulate with the apex blunt, surface but slightly depressed in the form of a crescent; lateral foveolæ entirely visible from the dorsum, sublinear, slightly arcuate, not deeply impressed; face moderately retreating; frontal costa regularly expanding ventrad, sulcate and impressed for a distance ventrad of the ocellus, punctate dorsad; eyes somewhat acute-ovate, not very prominent when viewed from the dorsum; antennæ about as long as the head and pronotum, depressed and slightly expanded proximad. Pronotum somewhat constricted mesad; cephalic margin of disk slightly arcuate, caudal margin obtuse-angulate; median carina distinct and well elevated, severed by the transverse sulcus slightly caudad of the middle, lateral carinæ slightly less elevated than the median, arcuate convergent on the cephalic third of the disk, at a third the length from the cephalic margin they are separated by a space but little more than half that separating them at the cephalic margin, from which point of greatest proximity they diverge in straight line to the caudal margin where they are slightly more distant than cephalad; lateral lobes as deep as long, ventral margin obtuse-angulate. Tegmina exceeding the apex of the abdomen by about the dorsal length of the head, narrow, tips rounded; intercalary vein distinct and continuous, at least distad; lobe on the costal margin small. Interspace between the mesosternal lobes subquadrate, narrower than the width of one of the lobes; metasternal lobes subcontiguous caudad. Cephalic and median limbs of medium build. Caudal femora three times the length of the pronotum, rather robust; caudal tibiæ slightly shorter than the femora, armed on the external margin with ten spines, internal spurs subequal.

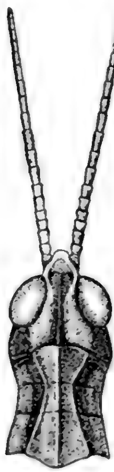


Fig. 9.—*Horesidotes papagensis* n. sp. Dorsal view of head and pronotum. (× 4.)

General dorsal color prout's brown, obscurely sprinkled and mottled with vandyke brown; general ventral color ochraceous-buff becoming very pale yellowish on the abdomen. Head with the face and ventral half of genæ ochraceous-buff sprinkled with vandyke brown, mouth-parts rufous; eyes clay color mottled with vandyke brown; antennæ rufous becoming olive-buff distad. Pronotum with the disk slightly paler than the dorsal half of the lateral lobes, line between dorsal and ventral color slightly below the middle of the lateral lobes, sinuate, sharply defined; an isolated bar of the ventral color is present dorsad of the insertion of the caudal limbs. Tegmina of the dorsal color. Cephalic and median limbs tawny, obscurely and imperfectly annulate and marbled with darker. Caudal femora vinaceous-cinnamon, marbled and washed with vandyke brown; caudal tibiæ very pale glaucous, becoming ochraceous proximad, entirely overlaid with fine purplish-red mottlings, spines and spurs with their apical halves black.

Measurements.

Length of body,	21.2 mm.
Length of pronotum,	4 "
Length of tegmen,	17.6 "
Length of caudal femur,	12.7 "

The male specimen from Yuma County, Arizona, recorded by the senior author[4] as *Horesidotes cinereus*? is seen on re-examination and comparison with the recently acquired material to be nearer *papagensis*, to which we tentatively refer it.

The type of *papagensis* was taken among leaves under bushes on the canyon bottom, and showed no inclination to leave the ground.

SCYLLINA Stål.

Scyllina calida Bruner.

One female specimen of this species was taken at Tucson, July 26, in short grass growing about the end of a drain. Its movements were quite awkward.

The previous records of this species in the United States are from San Bernardino Ranch, Cochise County, and Baboquivari Mountains, Pima County, Arizona.

PSOLOESSA Scudder.

Psoloessa texana Scudder.

The series of specimens of the genus *Psoloessa* taken in Arizona in the summer of 1907 numbers one hundred and six. After considerable study of this and other material, the authors are under the necessity of considering the four nominal species of this genus (*texana*, *ferruginea*, *maculipennis* and *buddiana*) as one, for which they select the name *texana* as it has page priority over *ferruginea* and *maculipennis*, *buddiana* being of much later date.

To some this may appear unwarranted as characters, such as the angle of the face, proportions of the lateral foveolæ of the head and the width of the fastigium, as well as the color pattern, have been used in

[4] *Proc. Acad. Nat. Sci. Phila.*, 1904, p. 563.

keys to separate the "species." To present the reasons for creating the synonymy clearly, it would be best to explain the methods used in reaching the conclusions. The original descriptions of *ferruginea, maculipennis, texana* and *buddiana* were tabulated in parallel columns, and from the mass of material specimens which agreed as nearly as possible with these descriptions were selected. The condensed diagnostic characters of the four "species" are as follows:

Typical *buddiana.* Whole dorsum uniform pale pinkish brown. Lateral bars solid and well marked. Caudal femora with but a faint indication of the dorsal bar at the terminal third.

Typical *ferruginea.* Whole dorsum ochraceous with the usual markings on the dorsum of the metazona. Lateral bars broken. Caudal femora with distinct bar at the terminal third.

Typical *maculipennis.* Dorsum of the closed tegmina and pronotum sprinkled with blackish quadrate or subquadrate spots. Lateral bar with the remains less sharply defined than in *ferruginea.*

Typical *texana.* Dorsum suffused with blackish. Tegmina blackish with the veins dark. Caudal femora with the dorsum of the genicular portion black.

The number of specimens of the total of one hundred and six which appeared to be typical of these forms were: *buddiana,* three; *ferruginea,* ten; *maculipennis,* nine; *texana,* three, while eighty-one or over seventy-five per cent. were typical of none. Of this remaining series twelve share characters of *buddiana, ferruginea* and *maculipennis,* sixty-six characters of *ferruginea* and *maculipennis* and three characters of *maculipennis* and *texana.*

When compared with three Shovel Mount, Texas, females the Arizona females differ uniformly in the narrower fastigium, which is usually more deeply excavated or at least appears to be so. When the Arizona series of both sexes is examined there is seen to be considerable variation in both sexes in the width of the fastigium, irrespective of locality or color phase, and in the degree of constriction of the lateral carinæ of the pronotum. Careful examination of the selected typical females fails to show any difference in the facial angle, and the shape of the lateral foveolæ is of such variability that no reliance can be placed on this character. The long type of foveolæ, supposed to be peculiar to the *texana* form, can be duplicated in specimens picked haphazard from the series of the other three types, and moreover the dark *texana* has as much variability in the few specimens available of the form as one needs to convince them of the variability of this character.

From this evidence there appears but one conclusion to be drawn, and that is to consider the different types forms of one species, as the presence of a seventy-five per cent. intermediate series leaves open to us only this solution or the most arbitrary allotment of this "mixed" body. The latter course has nothing in its favor, as the definition of the "species" would be a practical impossibility.

The localities represented in the series at hand are Tucson, July 26, four ♂, twelve ♀; Sonora Road Canyon, Tucson Mountains, July 25, one ♀; near Sonora Road, southwest of Tucson Mountains, July 25, seven ♂, five ♀; Roeble's Ranch near Coyote Springs, July 24 and 25, twenty-eight ♂, forty-eight ♀. Typical *buddiana* was taken at Tucson, near Sonora Road and Roeble's Ranch, *ferruginea* at Tucson and Roeble's Ranch, *maculipennis* at Tucson and Roeble's Ranch and *texana* at Tucson and near Sonora Road.

This insect appears to be the most difficult to capture of almost any of the desert species encountered, this being due to its remarkable protective coloration and to its great swiftness in springing into the air and taking flight. It was by all odds the most plentiful and widely distributed desert species collected.

AGENEOTETTIX McNeill.

Ageneotettix australis Bruner.

An adult male of this species was taken in Sonora Road Canyon, July 25, and an immature female at Roeble's Ranch, the same date. The mature specimen was captured on the rocky canyon side.

Ageneotettix curtipennis Bruner.

A female specimen from Bright Angel, altitude 7,000 feet, September 11, is referred to this species. The tegmina are very short, not more than one-third the length of the abdomen, and the caudal tibiæ have the proximal third ochraceous clouded and sprinkled with fuscous. The original locality for this species was simply "Southern Colorado," and in consequence this is the first definite record for the species.

The specimen was found on stony ground, among low plants in a forest of piñon and juniper, where *Amphitornus nanus* was the only other species of Orthoptera seen.

AULOCARA Scudder.

Aulocara rufum Scudder.

A single male of this species was taken in Sonora Road Canyon, Tucson Mountains, July 25.

LIGUROTETTIX McNeill.

Ligurotettix kunzei Caudell.

This extremely interesting and peculiar species is represented by a series of forty-five specimens taken at Tucson, July 26 (three ♂, two ♀), Sonora Road near Tucson Mountains, July 25 (twelve ♂, five adult ♀, one immature ♀), Roeble's Ranch, July 24 and 25 (eight ♂, one adult ♀, one immature ♀), Sentinel, Maricopa County, July 27 (one ♂), and Yuma, July 27 (three ♂, eight ♀).

The Yuma specimens are as large as Tucson individuals and do not seem to approach the smaller Californian *L. coquilletti*. In size the whole series is fairly uniform, some slight individual variation being noticed in both sexes. Average specimens from the localities represented in the collection measure as follows:

♂

	Length of body.	Length of tegmina.	Length of caudal femora.
Tucson, ...	18 mm.	16.8 mm.	9.7 mm.
Near Sonora Road, . .	16.4 "	15.2 "	9 "
Roeble's Ranch, . . .	16.5 "	16.1 "	9 "
Sentinel, ...	16 "	15.2 "	9.5 "
Yuma, ...	17.5 "	16.7 "	10.2 "

♀

Tucson, ...	24.2 mm.	22.4 mm.	12.5 mm.
Near Sonora Road, . .	23.5 "	21.7 "	12 "
Roeble's Ranch, . . .	22 "	20.8 "	11.7 "
Yuma, ...	24.5 "	22 "	12.8 "

In color there is a considerable amount of variation, all, however, in conformity with the subdued color pattern of the insect. The most peculiar variation is in the presence of blackish brown on the cephalic half or more of the lateral lobes of the pronotum, and also on the pleura accompanied by a suffusion of the genæ. In its complete form this phase is present in but one female from Yuma, in which the contrast with the pale dorsum and caudal portion of the lateral lobes is very striking, although suggested more or less strongly by a few, chiefly males, from Tucson, Sonora Road and Roeble's Ranch. There is a considerable amount of variation in the sprinkling and lining of the dorsum of the pronotum and head and the tegmina with blackish brown, this being, however, more noticeable in the females than in the males. The Yuma specimens as a series and the Sentinel individual are paler and more ashy than those from the vicinity of Tucson and the Papago country, which may possibly be due to the increased aridity and greater sunlight of southwestern Arizona when compared with the Tucson region. The usual position of specimens on the main branches of *Covillea* would allow reflected light to play a very important part in color bleaching.

At Roeble's Ranch and along the Sonora Road this species was found chiefly on mesquite, where the insects clung tightly to the twigs and trusted so far to their protective coloration that those taken were cautiously approached with the hands and suddenly seized. If not captured they sprang with agility to some other part of the bush and often escaped completely. They stridulated frequently, a faint sikk, sikk, sik-sik-sik. At Yuma the species was found on greasewood (*Covillea*) and was extremely active and wary in spite of the frightful heat.

ARPHIA Stål.

Arphia teporata Scudder.

Three males and a female taken on rocky desert hillside in Sonora Road Canyon, Tucson Mountains, July 25, belong to this species. They are more thickly speckled and variegated with dark brown than a series from Alamogordo, New Mexico, and all are faintly washed with reddish brown.

ENCOPTOLOPHUS Scudder.

Encoptolophus texensis Bruner.

At Tucson along the Santa Cruz River on irrigated land this species was found July 26 in moderate numbers. Eight males and six females were taken, three of the females being in a green phase of coloration, as previously noted in a Phœnix specimen,[5] the green being on the head, pronotum, dorsal face of caudal femora and to a certain extent on the pleura, while another of the same sex is weakly greenish on the same areas. The series exhibits an appreciable amount of variation in size, particularly in the male sex.

Encoptolophus subgracilis Caudell.

A single female with rather short tegmina and wings, taken July 25 in mesquite and rabbit-weed surroundings near the Sonora Road southwest of the Tucson Mountains, is apparently referable to this species. The wings, however, are faintly yellowish proximad, in this respect resembling *texensis*. The measurements of this specimen are as follows:

[5] *Proc. Acad. Nat. Sci. Phila.*, 1907, p. 76.

Length of body,	22.7 mm.
Length of pronotum,	4 "
Length of tegmen,	18.3 "
Length of caudal femur,	11 "

HIPPISCUS Saussure.

Hippiscus corallipes (Haldeman).

A single female of this species, taken at the east base of the Huachuca Mountains, July 6, by H. A. Kaeber, has been examined. The species has previously been recorded from that range by the senior author.[6]

DISSOSTEIRA Scudder.

Dissosteira carolina (Linnæus).

Three males and two females of this widely distributed species were taken at Williams, September 13, while a single female was taken September 11 at Bright Angel, Grand Canyon, elevation of 6,850 feet.

TOMONOTUS Saussure.

Tomonotus ferruginosus Bruner.

A pair of this species from Palmerlee, Huachuca Mountains, Cochise County, Arizona, taken July 5 and 15 by H. Kaeber, has been examined. The range of this form includes localities from Southern California to Fort Grant and the Huachuca Mountains, southeastern Arizona, and from Phœnix, Arizona, to Uruapan, Michoacan, Mexico.

Tomonotus aztecus (Saussure).

A series of seven males and two females of this species were taken July 25 near the Sonora Road, southwest of the Tucson Mountains, on a flat covered with very low weeds with many bare spaces between. A single male was also taken the same day at Roeble's Ranch.

METATOR McNeill.

Metator pardalinum (Saussure).

A single female of this species, taken at Williams, September 13, is the first Arizona record of the genus and species. The specimen has the disk of the wings scarlet and is inseparable from Colorado individuals. It was taken in an open place thickly overgrown with rabbit-weed and other equally low vegetation.

MESTOBREGMA Scudder.

Mestobregma obliterata Bruner.

A series of six males and ten females was taken at Williams, September 13. There is considerable variation in the length of the tegmina

[6] *Proc. Acad. Nat. Sci. Phila.*, 1907, p. 36.

and wings in the females, while the same is true of the caudal femora. The disk of the wings is lemon yellow in all the specimens and the transverse bar is not distinctly marked. The caudal margin of the disk and lateral lobes of the pronotum are distinctly colored with yellowish in a few specimens, while the angle of the tegmina is lined with the same in three specimens and with whitish in two others.

This species was found in the same situation as *Metator pardalinum.*

TREPIDULUS McNeill.

Trepidulus rosaceus (Scudder).

This very interesting species is represented by a series of twenty-nine males and twelve females. The localities at which it was taken are Tucson, July 26 (10 ♂, 9 ♀); near Sonora Road, July 25 (15 ♂, 2 ♀); Roeble's Ranch, July 25 (3 ♂, 2 ♀), and Yuma, July 28 (1 ♂). In size the series exhibits an appreciable amount of variation, while the coloration shows all conditions of ashy washes and blackish speckling and blotching, particularly on the dorsal aspect of the closed tegmina, while the base color ranges in spots from ochre to seal brown. The pale ventral portion of the lateral lobes of the pronotum is, however, sharply defined in every individual, and the two dorsal blotches on the caudal femora are distinct in all but one female specimen. Attention should be called to the fact that the Yuma individual is uniformly more grayish than specimens from the Tucson region, the maculations being sub-obsolete.

This species was found in the same restricted locality along the Sonora Road as *Tomonotus aztecus* and *Trepidulus melleolus,* where it was moderately plentiful; at Yuma the single specimen encountered was taken on a broad flat of high weeds which had been completely dried by the extreme heat. It was found common among desert growth at Tucson, on the outskirts of the Mexican section of the town.

Trepidulus melleolus (Scudder).

Two males from the vicinity of the Sonora Road, July 25, and two males and a female from Roeble's Ranch, July 25, represent this interesting species. It appears from the material in hand, five males and two females, that there is a great amount of individual variation in size in both sexes; the two females before us, one from Roeble's Ranch, the other from San Bernardino Ranch, Cochise County, having a considerable difference in size. The coloration is fairly constant in character.

This species enjoys a range from northeastern New Mexico (La Trementina) to Pima County, Arizona.

This striking form was taken on the desert plain in the two above localities where it was extremely scarce.

DEROTMEMA Scudder.

Derotmema laticinctum Scudder.

On the desert plains of the Papago country this species was collected in numbers, a series of seventy-one males and thirty-three females being before us. It was usually found on exposed areas of adobe soil and associated with *Psoloessa texana*. The series is distributed as follows: Tucson, July 26, twenty-seven males, eleven females (one immature); Sahuaro slope, southwestern side of Tucson Mountains, July 24, one male; near Sonora Road, southwest of Tucson Mountains, July 25, eighteen males, fifteen females (two immature); Roeble's Ranch, July 24 and 25, twenty-five males (one immature), seven females (two immature).

This series is quite variable in the depth of coloration and in the character of the maculations on the anal area of the tegmina. Some specimens have three or four comparatively large blotches on this portion of the tegmina, while others have the same region more or less thickly sprinkled with small quadrate blotches. The fuscous bar on the wing varies in intensity and considerably in extent. One specimen from Tucson has the bar very weak and of little extent.

The specimens from the Baboquivari Mountains previously recorded by the senior author as *Derotmema delicatulum*,[7] prove on second examination and comparison with typical specimens of *delicatulum* to be this species. The range of the species is now known to extend from the west slope of the Organ Mountains of central southern New Mexico to Phœnix, Maricopa County, and the Baboquivari region, Pima County, Arizona.

Derotmema delicatulum Scudder.

This rather remarkable species is represented by four specimens, two of each sex, taken at Sentinel, Maricopa County, July 27. The very prominent eyes, very pale, in fact almost colorless, disk of the wing and much reduced but conspicuous and well-defined transverse blotch on the wing are sufficient to enable one to readily recognize the species. The coloration is very pale, with the darker pattern well defined and comparatively regular.

The habitat of this form is the Mohave and Yuma deserts, ranging from the western edge of the Mohave at Mohave and Lancaster, California, to at least Sentinel, Maricopa County, Arizona. The specimens

[7] *Proc. Acad. Nat. Sci. Phila.*, 1907, p. 72.

listed above were collected during a train stop in a most arid and desolate location.

Derotmema haydeni (Thomas).

A series of five males and four females was taken at Williams, September 13 (two ♂, two ♀), and Anita, September 11 (two ♂, three ♀). The disk of the wing is red in five specimens and yellow in four, regardless of locality. The series from Williams is more blackish than usual in the species, while the Anita individuals are quite reddish. The species has previously been recorded from Flagstaff.

At Anita the species was common on reddish soil in an open field, while at Williams it was taken in an open place heavily overgrown with low vegetation.

CONOZOA Saussure.

Conozoa carinata Rehn.

A series of five males and one female taken at Tucson, July 26, represent this species. These specimens are somewhat paler than the types, while the males have the fastigium very slightly narrower than in the female type. The female specimen has the metazona of the pronotum abnormally humped, probably as the result of an injury.

This species is now known to range from the Huachuca Mountains to the Baboquivari range, north to Tucson.

Conozoa sulcifrons (Scudder).

At Yuma this species was taken in numbers on July 26 and 27, a series of twenty-one males and twenty-three females being secured. When compared with a series from Grand Junction, Colorado, the Yuma specimens are seen to average considerably larger. The Yuma series is as a whole more warm brown in color, with the dorsal aspect of the head, pronotum and anal field of the tegmina paler and more uniform.

The specimens from Florence and Phœnix, Arizona, referred to *C. acuminata* with a query by the senior author[8] belong to this species. In size they are slightly smaller than Yuma individuals of the same sex.

This was the most plentiful species found on the dry earth of the river bed and along its banks. Although an active flyer no great difficulty was experienced in capturing specimens.

TRIMEROTROPIS Stål.

Trimerotropis fascicula McNeill.

A single female of this species was collected at light at Nogales, August 13, 1906, by Dr. Calvert.

---

[8] *Proc. Acad. Nat. Sci. Phila.*, 1904, p. 567.

The specimens recorded by Snow[9] from Oak Creek Canyon and Humphreys Peak, Coconino County, Arizona, as this species prove, on examination of individuals forwarded by Prof. Snow, to be *T. alliciens* Scudder. The two forms, however, are very closely related.

Trimerotropis modesta Bruner.

A female of this form taken on the rim of the Grand Canyon, near Bright Angel, September 11, and a male taken at Williams, September 13, are in the collection. The specific validity of this form appears to be rather questionable, as its relationship to *T. citrina* is so close that it may be nothing more than a race of that species.

Trimerotropis strenua McNeill.

Two specimens of this species were taken at Tucson, July 26, at light. When compared with Salt Lake Valley specimens they are seen to be inseparable. Snow has recorded this species from San Bernardino Ranch, Cochise County, Arizona.

Trimerotropis inconspicua Bruner.

Three males of this species taken at Bright Angel, Grand Canyon, 6,880 feet to 7,000 feet, are before us. Two were taken July 29 to August 2, 1906, by Calvert, and one on September 11, 1907, by Hebard. Two specimens are identical in coloration with the tegminal bars decidedly blackish and strongly contrasting with the pale ochraceous base color, while the other specimen is decidedly reddish, both bars and base color.

This species was described by Bruner from material taken at a number of localities in the Grand River region of western Colorado, this being the first record of the species from any locality outside of that State.

The specimen taken on September 11 was the only individual of the species noticed and was captured in the forest of piñon and juniper.

Trimerotropis vinculata Scudder.

This wide ranging species is represented by eighty-three specimens taken as follows: Tucson, July 26, 27 ♂, 18 ♀; Sonora Road Canyon, July 25, 4 ♂; Sonora Road near Tucson Mountains, July 25, 2 ♀; Roeble's Ranch, July 24 and 25, 13 ♂, 4 ♀; Nogales, August 13 (at light, Calvert), 1 ♂; Yuma, July 28, 1 ♂; Williams, September 13, 1 ♂; Bright Angel Trail, Grand Canyon, elevation 3,000–7,000 feet, July 29–August 2 (Calvert), September 11 and 12 (Hebard), 3 ♂, 9 ♀.

The specimens of the series present a considerable amount of varia-

[9] *Trans. Kansas Acad. Sci.*, XX, pt. 2, p. 37.

tion in size and the usual modifications of width and characters of tegminal bars, as well as differences in the general light base color. As the variability of this species is almost endless, it is hardly necessary to call attention to any types except one which is suffused with ochraceous-rufous, represented by all the Sonora Road Canyon specimens and faintly approached by one from Tucson, and a very dull type, represented by several from Bright Angel rim (7,000 feet) and the single individual from Williams. Other specimens, however, from the rim of the Grand Canyon at Bright Angel are of normal contrast, and one is extremely contrasted with quite pale base color.

Trimerotropis cyaneipennis Bruner.

A series of sixteen males and seven females of this species was taken at elevations ranging from 3,800 to 7,000 feet on and in the vicinity of the Bright Angel Trail, Grand Canyon, September 11 and 12. The majority of the specimens are strongly washed with reddish, the greater portion of these reddish specimens being from elevations not exceeding 5,000 feet, this being evidently due to a protective color modification influenced by the reddish exposure of that portion of the canyon walls. A few individuals possess a more strongly contrasted coloration; the pale color being unsuffused and the bar groups darker. These specimens are from 5,000 and 7,000 feet. On comparing this series with that in the Academy collection I find that specimens from the northern portion of Arizona, south at least as far as Prescott, have the disk of the wings campanula blue in color, while individuals from the ranges of southeastern Arizona (Huachucas, etc.) have the same area glaucous blue. The difference is quite noticeable when the two types are compared. This species makes at will a clatter similar to that of *Circotettix verruculatus*. Especially when alarmed its flight is extremely swift and erratic. It was not plentiful along the canyon edge, but lower on the Bright Angel Trail it was found almost everywhere, most plentiful, however, about bare places near precipices.

CIRCOTETTIX Scudder.

Circotettix undulatus (Thomas).

A series of seven males and nine females taken near the rim of the Grand Canyon at Bright Angel represents this species. Two males and three females were taken July 29 to August 2, 1906, by Calvert, and the remainder September 11, 1907, by Hebard.

The sexes are of practically the same size, and the amount of individual variation of the same character is slight in a series of thirty-six specimens before us. The general color varies from a decidedly blackish type to one distinctly dull reddish brown in general tone.

The previous Arizona records of this species were from Oak Creek Canyon and base of Humphrey's Peak, Coconino County.

This form was not uncommon in the open yellow pine groves near the hotel, while in other places it was very scarce. Individuals of this species seem to be unable to fly without clattering. In the afternoons it was not on the wing.

HADROTETTIX Scudder.

Hadrotettix trifasciatus (Say).

A single male of this species, collected by H. A. Kaeber, July 6, 1907, on the plains at the mouth of Ramsay Canyon, Huachuca Mountains, has been examined.

ANCONIA Scudder.

Anconia integra Scudder.

At both Tucson and Yuma this species was encountered, five males and two females having been taken at the former locality on July 26 and twenty males and two females at the latter on July 27 and 28. In size there is an appreciable amount of variation in the male sex, the four females being quite uniform. All the females and four of the Tucson males are green; all the Yuma males and one Tucson male are hoary white or pale ochraceous more or less thickly overlaid with maculations of olive. Several of the brownish specimens are very pale and but faintly maculate, while five are strongly marked, having the pronotal decussate markings pronounced. The other brownish males are more or less intermediate between the two extreme types.

Tucson is the most eastern record for this species, the previously published Arizona records being from Phœnix and Bill William's Fork.

At Tucson this species was taken among high weeds both in damp and dry locations. They were very wary and alert and when missed flew for some considerable distance. A preference to alighting on the ground when pursued rather than on weeds and bushes was observed, though invariably first discovered among vegetation. At Yuma it was found on the greasewood covered sand flats.

HELIASTUS Saussure.

Heliastus aridus (Bruner).

This extremely variable species is represented by specimens taken at Tucson (July 26, 3 ♀), Sonora Road Canyon (July 25, 2 ♂, 1 ♀, 1 nymph), Sonora Road near Tucson Mountains (July 25, 1 ♀) and Roeble's Ranch (July 24, 1 ♂, 1 ♀). There is a great diversity in the size of the Tucson females, while the coloration is of the usual variability. The three individuals from the Sonora Road Canyon are distinctly suffused with reddish, the males very strongly so, while the Tucson and Roeble's Ranch specimens have hoary white their most conspicuous color tone. The Sonora Road specimen has as its general tint the peculiar blue gray often seen in this species.

This form was found to be a typical desert species, not noticed anywhere in numbers.

PHRYNOTETTIX Uhler.

Phrynotettix magnus (Thomas).

A pair of this species taken July 6 by H. A. Kaeber at Palmerlee and an immature male taken in Sonora Road Canyon, Tucson Mountains, July 25, have been examined.

The Palmerlee male is labelled "Found under manure." The Sonora Road Canyon specimen was found on a rocky hillside.

SCHISTOCERCA Stål.

Schistocerca vaga (Scudder).

At Tucson four males and two females of this species were collected July 26. One female is quite dark in color with strongly contrasted pattern; the other of the same sex shows little contrast and is pale dull brownish. The specimens were found among wild sunflowers and other high plants. In this situation individuals were taken with far greater ease than others previously seen on the desert.

Schistocerca venusta Scudder.

A male and two females taken at Yuma, July 27 and 28, and a male taken at Winslow, Navajo County, September 13, represent this species. The Winslow specimen is more olive and less greenish than the Yuma individuals.

At Yuma a few specimens were seen in the dry stand of arrow-wood on the banks of the Gila River. The species was very plentiful at Winslow, in tall weeds about a water tank.

CONALCÆA Scudder.

Conalcæa huachucana Rehn.

A female of this species, collected at Palmerlee July 6 by Kaeber, has been examined.

HESPEROTETTIX Scudder.

Hesperotettix festivus Scudder.

A series of twenty-two males, twelve females and one nymph represents this species. The localities are: Tucson, July 26, 1 ♂, 1 ♀; Sahuaro slope, southwest of Tucson Mountains, July 24, 1 ♂; Sonora

Road near Tucson Mountains, July 25, 13 ♂, 9 ♀, 1 nymph; Roeble's Ranch, July 25, 1 ♀; Williams, September 13, 1 ♂, 1 ♀.

In size but little variation is noticeable; the tegmina of the two Williams specimens, however, do not exceed the tips of the caudal femora. Five specimens from Sonora Road are decidedly brownish, one strongly so, while all the others are shades of green, in a few cases with a faint bluish tinge to the tegmina. Reddish pregenicular annuli are indicated more or less strongly on the caudal femora of all but three specimens, which latter are either in or approach the brownish phase. The pale medio-longitudinal line on the pronotum is narrower in the Williams specimens than in a number of individuals from southern Arizona.

This insect was one of the few species which was invariably found on or near rabbit-weed. In the rabbit-weed tracts a number of specimens were often found in one small clump of the weed. Relying on its protective coloration the insect often sought shelter in the center of the clump, but when frightened out of its retreat flew very swiftly on almost all occasions to another bunch of the same plant.

ÆOLOPLUS Scudder.

Æoloplus tenuipennis Scudder.

At Tucson this species was found in weeds growing along an irrigating ditch and a series of six males and three females was taken on July 26, while at Yuma a single male was collected on July 27. While agreeing with the original description in all essential points the Tucson individuals are decidedly larger than the type. The extremes of the series measure as follows:

	♂	♀
Length of body, ...	17 –18.3 mm.	17 –19.3 mm.
Length of pronotum, ...	4 – 4.5 "	4 – 4.9 "
Length of tegmen, ...	15.5–19 "	15.5–17.2 "
Length of caudal femur, . . .	9.5–10.2 "	9.8–11.2 "

In color there is an appreciable amount of variation in the depth of the bars and maculations, the specimens with the base color dull ochre having the pattern more marked, while those with the same more yellowish have the pattern weaker. The pink of the proximal two-thirds of the caudal tibiæ varies greatly in depth of color, being very delicate shell pink in some specimens and solferino in others with intermediates of various shades.

This species was described from Fort Grant, Graham County, Arizona, and has since been recorded from Bill William's Fork, western Arizona.

A single female in the Academy Collection was taken at Phœnix (October 4, 1900; Kunzé).

Æoloplus arizonensis Scudder.

In the vicinity of Yuma this species was not uncommon, a series of seven males, fifteen females and one nymph being taken July 27 and 28. Among the high dry weeds on the flood plain of the Gila River fourteen specimens were taken and a number of others seen; one specimen was captured on the summit of a desert hill, one in cultivated alfalfa and seven were taken at night under arc lights.

There is a perceptible amount of variation in size, the length of the tegmina being quite variable; no specimens, however, having these members shorter than the type measurements, while the greater majority have them much longer. The remarks made under *Æoloplus tenuipennis* regarding color variation apply as well to this species, though the paler specimens have the tegmina distinctly light grayish, while in one specimen the pale color on the head and pronotum is almost whitish.

This species has been recorded from Fort Whipple, Yavapai County, Arizona, and the Mohave Desert.

MELANOPLUS Stål.

Melanoplus flabellifer Scudder.

A series of six males and seven females of this species was taken at Williams, September 13. All are typical of *flabellifer*, showing little or no tendency toward *occidentalis* or *cuneatus*. The coloration is quite dark, the pattern much subdued. There is some variation in the depth of the glaucous color of the caudal tibiæ. This is the first record of the species from Arizona.

All of these specimens were taken in a field of low vegetation. The insects were inactive as the dew was yet on the ground. The condition of a number of the specimens shows that their season was well advanced.

Melanoplus herbaceus flavescens Scudder.

Two males of this form were taken at Yuma on July 28, one on cultivated ground, the other on desert growth.

The only previous record of this form from Arizona was from Bill William's Fork, Mohave-Yuma County, specimens from Phœnix being intermediate between *herbaceus* and *flavescens*.

Melanoplus brownii Caudell.

This species was abundant locally at Tucson, where a series of twelve males and nineteen females were taken on July 26. In size there is an appreciable amount of individual variation, the extremes of the series measuring as follows:

	♂	♂	♀	♀
Length of body, . . .	18.6 mm.	21.5 mm.	24.2 mm.	28.4 mm.
Length of tegmen, . .	18 "	20 "	20 "	24.2 "
Length of caudal femur, .	10.8 "	12.5 "	12.2 "	14.8 "

The coloration is quite uniform, only a few specimens being more richly colored than the others, the caudal femora, however, being some shade of glaucous in all the series instead of "yellowish brown" as originally described.

The female specimen recorded by Rehn as *M. canonicus*? from Florence, Arizona,[10] and those of the same sex from the Huachuca range recorded by him as *M. flavidus*[11] are referable to this species. The absence of accompanying males was responsible for the erroneous identifications. The Florence individual has since been compared with the types of *brownii.*

The range of this species now extends from Yuma up the Gila Valley to Phœnix and Florence, southward to Tucson, the Baboquivari and Huachuca Mountains.

The species was found at Tucson, frequenting high weeds near water and cultivated areas.

Melanoplus atlanis (Riley).

A male and two females represent this widely distributed species, the localities being Williams, September 13 (♂), Tucson, July 26 (♀), and Sonora Road near Tucson Mountains, July 25 (♀). These specimens are distinctly larger than eastern individuals of the species, a fact previously noted by Rehn[12] in regard to Florence and Phœnix, Arizona, representatives. The Sonora Road specimen has the coloration strongly contrasted.

Melanoplus aridus (Scudder).

A very interesting series of this species was taken at localities in northern Arizona, a region from which it was previously not reported. Nine specimens from Williams, September 13, five males, four females, average about equal in size to individuals from Florence, Arizona, and are distinctly smaller than Scudder's measurements. Three males and one female taken at Anita, September 11, show a further reduction in size, while a series of fourteen males and eleven females from

[10] *Proc. Acad. Nat. Sci. Phila.*, 1904, p. 572.
[11] *Ibid.*, 1907, p. 54.
[12] *Proc. Acad. Nat. Sci. Phila.*, 1907, p. 78.

the rim of the Grand Canyon at Bright Angel, September 11, are very decidedly smaller than Scudder's measurements, some specimens being hardly more than half the size given by him. The senior author recently called attention[13] to the size variability of this species, citing Huachuca Mountain individuals larger than the original measurements.

The coloration of the Grand Canyon series shows little yellowish, having grays and gray-browns predominating, while the Anita and Williams specimens are somewhat brighter, though by no means as strikingly colored as Florence, Arizona, individuals. The yellow of the ventral surface is pure in some specimens and much soiled and washed with red brown in others.

At Williams and Anita this species was extremely common in the grassy open glades of the pine forest, while at Grand Canyon it was the most abundant species of Orthoptera and was found everywhere in the undergrowth of the heavier pine woods. It was noted to be a very swift jumper, but a series was easily taken on account of its abundance.

Melanoplus femur-nigrum Scudder.

This little known species is represented by a series of two males and three females taken September 11 at the rim of the Grand Canyon at Bright Angel. Here it was taken on an open hillside heavily overgrown with a plant resembling rabbit-weed.

The only previous record of this species is the original one from San Francisco Mountains, July 30, but its range is more extensive as witnessed by a female in the Academy Collection labelled "Albuquerque, N. Mex., July 13, Oslar." It is quite probable that this specimen was taken in the mountains near Albuquerque, as it is hardly likely to occur in the distinctly Sonoran vicinity of the city.

Melanoplus femur-rubrum (DeGeer).

A male of this species was taken at Winslow, Navajo County, 4,848 feet elevation, September 13.

Melanoplus canonicus Scudder.

A series of two males and seven females, taken September 12 along or near the Bright Angel Trail, Grand Canyon, represent this species. These specimens were taken at altitudes ranging from 4,850 to 6,800 feet, one female alone being from above an elevation of 5,800 feet. The species was found only in scattered growths of piñon and juniper, exhibiting a preference for the latter tree. Specimens were found on the ground, in bushes and clinging to the twigs of juniper.

---

[13] *Proc. Acad. Nat. Sci. Phila.*, 1907, p. 51.

In size there is considerable variation in the series, all being smaller than Scudder's original measurements. The extremes of the series in hand are as follows:

	♂	♂	♀	♀
Length of body, . . .	17 mm.	20.2 mm.[14]	22.5 mm.	27 mm.
Length of tegmen, . .	15 "	13.8 "	15.8 "	18.2 "
Length of caudal femur,	10.5 "	9.8 "	11.5 "	13.4 "

The distal portion of the furcula varies in the two males, being rather slender in one and comparatively thick in the other.

The majority of the specimens are strongly overcast with brownish, sometimes with a decided olivaceous tinge, only one specimen being "luteo-testaceous" as originally described.

In addition to the original record from the Grand Canyon, this species has been recorded from Bill William's Fork by Rehn and from Tucson by Snow.

DACTYLOTUM Charpentier.

Dactylotum variegatum Scudder.

A male and two females of this species, taken July 6 on the plains at the east base of the Huachuca Mountains by H. Kaeber, have been examined.

TETTIGONIDÆ.

ARETHÆA Stål.

Arethæa sellata Rehn.

A male of this species, taken at Palmerlee, Huachuca Mountains, July 15, by H. A. Kaeber, has been examined.

SCUDDERIA Stål.

Scudderia furcifera Scudder.

This species is represented by a male taken at Palmerlee, Huachuca Mountains, July 6, by H. A. Kaeber.

MICROCENTRUM[15] Scudder.

Microcentrum rhombifolia[16] (Saussure).

A single female of this species was taken at light at Nogales, August 13, 1906, by Calvert.

[14] Abnormally distended.

[15] Kirby (*Synon. Catal. Orth.*, II, pp. 455, 480) has transferred this generic name to the genus usually known as *Stilpnochlora* Stål, and in its place for *Microcentrum* of authors uses *Orophus* Saussure, 1859. For the type of the latter he selects *retinervis* Burmeister (*salicifolia* Saussure), disregarding the fact that Rehn (*Proc. Acad. Nat. Sci. Phila.*, 1905, p. 808, March, 1906) some months previously had selected *mexicanus* as the type of *Orophus*. In selecting a type

GRYLLIDÆ.

NEMOBIUS Serville.

Nemobius neomexicanus Scudder.

This species was taken at light at Tucson (July 23, 1 ♀) and Yuma (July 27 and 28, 3 ♀) and was decidedly scarce wherever it was encountered. The Tucson specimen is appreciably larger than the Yuma individuals.

GRYLLUS Linnæus.

Gryllus personatus Uhler.

At Tucson this species came to light in great numbers the evenings of July 23 and 26, a series of twenty males and eighteen females being collected.

Size as usual exhibits a considerable range of variation, while several males are of a strongly megacephalic type.

As the proportions of the caudal femora and ovipositors and the measurements of the tegmina may prove of use to future workers, they are tabled below.

Proportions of caudal femur and ovipositor in eighteen females from Tucson.

Ovipositor.

Caudal femur.	12 mm.	12.3 mm.	12.5 mm.	13 mm.	13.2 mm.	13.5 mm.	13.8 mm.	14 mm.	14.5 mm.	15 mm.
10.7 mm.	1	......	......	1	......	......	......	......	......	......
11 "	......	......	......	1	......	......	......	......	......	......
11.3 "	......	1	1	1	......	......	......	......	......	......
11.5 "	......	......	......	......	......	......	......	......	......	......
11.7 "	......	......	......	1	......	1	......	......	......	......
12 "	......	......	1	1	1	......	......	......	......	......
12.2 "	......	......	......	......	......	1	1	1	1	......
12.5 "	......	......	......	......	......	......	1	......	......	......
13 "	......	......	......	......	......	......	......	......	......	2

for *Microcentrum* Scudder, Kirby has been confused by the synonymy of the species and selected *Steirodon thoracicus* Serville as the type, which was not included in *Microcentrum* by Scudder; the latter's *Microcentrum thoracicum* having been proposed independently, not being the same as *thoracicus* Serville or *thoracica* Burmeister. This is shown by Kirby in his arrangement of the synonymy; but in selecting his type he has overlooked it. In consequence it is necessary to select as the type of *Microcentrum* a species originally included in the genus and *affiliatum* Scudder (= *rhombifolia* Saussure) is so selected. This is in accordance with Article 30 of the Revised International Code of Nomenclature.

[16] This name must be used in place of *laurifolium* of authors; *laurifolium* of Linnæus, as shown by Kirby (*Synon. Catal. Orth.*, II, p. 456), being a *Stilpnochlora*.

Measurements of caudal femur, tegmen and ovipositor.

Females (eighteen specimens).

Caudal femur.	*Tegmen.*	*Ovipositor.*
10.7 mm. (2)	13 mm. (8)	12 mm. (1)
11 “ (1)	13.2 “ (2)	12.3 “ (1)
11.3 “ (3)	13.5 “ (1)	12.5 “ (2)
11.5 “ (1)	14 “ (3)	13 “ (5)
11.7 “ (1)	14.2 “ (2)	13.2 “ (1)
12 “ (3)	14.5 “ (1)	13.5 “ (2)
12.2 “ (4)	14.8 “ (1)	13.8 “ (2)
12.5 “ (1)		14 “ (1)
13 “ (2)		14.5 “ (1)
		15 “ (2)

Males (twenty specimens).

Caudal femur.	*Tegmen.*
10.5 mm. (1)	12 mm. (1)
11 “ (1)	12.3 “ (2)
11.2 “ (2)	12.5 “ (1)
11.5 “ (1)	12.8 “ (1)
11.7 “ (6)	13 “ (2)
12 “ (3)	13.2 “ (1)
12.2 “ (1)	13.5 “ (4)
12.5 “ (2)	13.8 “ (5)
12.7 “ (1)	14 “ (1)
13.8 “ (2)	15 “ (1)
	15.3 “ (1)

The entire series of thirty-eight specimens is macropterous.

There is considerable variation in the depth of the coloration, some individuals having the head so much suffused with blackish that the usual pale occipital lines are not visible.

Gryllus armatus Scudder.

This species came to light abundantly at Yuma on the evenings of July 27 and 28, a series of nine males and forty-five females being collected. A pair were also taken at Tucson, July 26, under the same conditions. All the specimens collected are macropterous.

To assist future workers in this difficult genus measurements taken from the Yuma series are here given.

Length of tegmen.	*Length of caudal femur.*	*Length of ovipositor.*
10 mm. (1)	9.6 mm. (1)	11.6 mm. (1)
11.2 " (1)	10 " (2)	11.8 " (1)
11.6 " (2)	10.2 " (3)	12 " (4)
11.8 " (3)	10.4 " (2)	12.2 " (3)
12 " (5)	10.6 " (7)	12.6 " (3)
12.2 " (3)	10.8 " (2)	12.8 " (7)
12.4 " (5)	11 " (15)	13 " (6)
12.6 " (6)	11.2 " (8)	13.2 " (6)
12.8 " (5)	11.4 " (5)	13.4 " (3)
13 " (7)	11.6 " (3)	13.6 " (4)
13.2 " (3)	11.8 " (4)	13.8 " (2)
13.4 " (4)	12 " (3)	14 " (3)
13.6 " (6)	12.2 " (1)	14.4 " (2)
13.8 " (3)		Broken in one specimen.
14 " (1)		

Proportions of caudal femur and ovipositor in forty-five Yuma females.

Ovipositor.

Caudal femur.	11.6 mm.	11.8 mm.	12 mm.	12.2 mm.	12.4 mm.	12.6 mm.	12.8 mm.	13 mm.	13.2 mm.	13.4 mm.	13.6 mm.	13.8 mm.	14 mm.	14.2 mm.	14.4 mm.
10 mm.			1	1											
10.2 "	1	1					1								
10.4 "			2			1									
10.6 "						1	1	1		1					
10.8 "				1											
11 "			1	1			5	3	1			1	1		
11.2 "								1	2		3				1
11.4 "								1	1		1		1		
11.6 "									1		1				
11.8 "						1			1			1			
12 "											1		1		1

While the head is blackish in all the specimens, the pronotum is frequently quite reddish, in some individuals entirely so, which latter type is connected with that having the pronotum solid blackish by a considerable number of intermediates.

It was astonishing to note the numbers in which this species came to the arc lights, hundreds of them running about on the ground beneath the lights or flying swiftly around in circles.

MIOGRYLLUS Saussure.

Miogryllus pictus Scudder.

At Yuma on the evenings of July 27 and 28 this species frequented the vicinity of the electric lights in considerable numbers. A series of fourteen males and sixteen adult and one immature female was taken. There is an appreciable but not very great variation in the size of individuals of this species, while the coloration varies only in the suffusion of the pronotal markings; some specimens having them distinct and others having them clouded with a wash of the darker color. The males without exception have the pronotum dark and the pattern not apparent.

This species was more agile than *Gryllus armatus*, with which it was associated.

ŒCANTHUS Serville.

Œcanthus niveus (DeGeer).

A single male of this species was taken near Bright Angel Trail, Grand Canyon, at an elevation of about 4,900 feet, September 12. It was taken from a weed resembling rabbit-weed in the piñon zone.

Œcanthus nigricornis Walker.

A single male from the rim of the Grand Canyon at Bright Angel, September 11, is referred tentatively to this species. The antennal markings are not as complex as usual in the species, but the proportions and general coloration are nearly typical. The individual was captured stridulating at night on the species of weed referred to under *Œ. niveus.*

Œcanthus quadripunctatus Beutenmüller.

Four specimens taken at Tucson, July 23–26, are referred to this species, one male, a female, attracted to light, and two immature individuals.

NOTES ON THE DISTRIBUTION OF COLORADO MAMMALS, WITH A DESCRIPTION OF A NEW SPECIES OF BAT (EPTESICUS PALLIDUS) FROM BOULDER.

BY ROBERT T. YOUNG.

In the following article I propose (1) to discuss briefly the distribution of the mammals of the mountains of northern central Colorado in their relation to the life zones of that region;[1] (2) to point out the apparent movement of some species relative to their centers of dispersal and to give a few facts regarding the little known distribution of certain forms in this State, and (3) to describe a new species of bat from Boulder.

(1) Distribution of mammals relative to the life zones of northern central Colorado.

In two recent papers by Ramaley[2] and myself[3] the life zones of the Rocky Mountains in this region, as determined by the flora, have been mapped out. Does the mammalian fauna of the mountains show the same zonation as does the flora?

The zones as outlined by Ramaley are as follows:

1. Plains Zone, below 5,800 feet.
2. Foothill Zone, from 5,800 to 8,000 feet.
3. Montane Zone, from 8,000 to 10,000 feet.
4. Sub-alpine Zone, from 10,000 to 11,500 feet.
5. Alpine Zone, from 11,500 to 14,000 feet.

The first of these not being a mountain zone may be omitted from our discussion. The last four correspond to the zones which I, in accordance with the terminology of Merriam[4] and others, have specified as Transition 1,650–2,400 m., Canadian 2,400–2,850 m., Hudsonian 2,850–3,300 m. and Alpine[5] 3,300–3,450 m.[6]

---

[1] Where the records for any species number very few, I have usually omitted such species from this part of my discussion.

[2] Plant Zones in the Rocky Mountains of Colorado, *Science*, N. S., Vol. XXVI, pp. 642–3.

[3] Forest Formations of Boulder County, Colorado, *Bot. Gaz.*, Vol. XLIV, pp. 321–52.

[4] Life Zones and Crop Zones of the United States, Bull. 10, U. S. Biological Survey.

[5] Merriam applies the term Arctic-Alpine to this zone.

[6] Ramaley's terminology, as applied to this particular region, is perhaps more desirable than that of Merriam; but for purposes of comparison with other regions, and for the sake of uniformity, I much prefer the latter.

While it is well known that an absolute delimitation of zonal areas in mountain regions is impossible, whether plants or animals are chosen as characteristics, still the zones as outlined above are fairly well defined by their plant inhabitants.

Of the mountain mammals of northern Colorado many range widely from timber line to the plains, and, with a few exceptions, there are none whose range is closely coincident with any one of the zones mentioned above. These exceptions are the following: *Sciurus aberti concolor, Citellus variegatus grammurus, Citellus elegans, Cynomys leucurus, Peromyscus truei nasutus, Neotoma fallax,* and *Spilogale tenuis* in the Transition zone; and *Lepus americanus bairdi, Ochotona saxatilis* and *Phenacomys preblei* in the Hudsonian zone.

The Canadian zone possesses no characteristic mammals. Species ranging through both Hudsonian and Canadian zones, but mainly restricted to them, are the following: *Evotomys gapperi galei, Microtus nanus, Gulo luscus, Mustela americana, Putorius streatori leptus* and *Putorius arizonensis.*

Boreal species which include the Transition zone within their range are as follows: *Cervus canadensis, Ovis canadensis, Sciurus fremonti, Eutamias amœnus operarius, Eutamias minimus consobrinus,*[7] *Callospermophilus lateralis, Marmota flaviventer, Neotoma orolestes, Microtus mordax, Thomomys fossor, Thomomys clusius fuscus, Zapus princeps, Erethizon epixanthus, Sylvilagus pinetis,*[8] *Felis hippolestes, Lynx uinta, Ursus americanus, Sorex obscurus, Sorex personatus,* and *Neosorex palustris navigator. Vulpes macrourus* should probably be included in this list, but as to its altitudinal limits I have no definite information. Sonoran species extending into the Transition zone are the following: *Odocoileus macrourus, Antilocapra americana, Mephitis mesomelas varians* and *Putorius longicauda.*

Of general distribution through both Sonoran and Boreal regions may be mentioned the following species: *Odocoileus hemionus, Bison bison,*[9] *Eutamias quadrivittatus, Citellus tridecemlineatus pallidus, Castor canadensis fondator, Peromyscus nebracensis, Peromyscus rufinus, Microtus pennsylvanicus modestus, Lepus campestris, Lepus townsendi, Canis* sp.,[10] *Taxidea taxus, Lutreola lutreocephala energumenos* and *Putorius nigripes.* Both the wild cat and timber wolf ought probably to be included under

[7] Extends into the Sonoran.

[8] Also Sonoran to some extent. I have taken it 12 km. east of Boulder on the hot barren plains.

[9] Now practically extinct.

[10] The distribution of the different forms of coyotes through the mountains is not yet known.

this last heading. I have omitted them, however, because I have no information as to the species of each, and but little as to their distribution.

Thus we find the Alpine zone with no characteristic mammals, the Hudsonian with three, the Canadian with none and the Transition with seven, while there are six Boreal species (*Cervus occidentalis, Eutamais m. consobrinus, Thomomys clusius fuscus, Thomomys fossor, Sylvilagus pinetis* and *Neosorex palustris navigator*) and one Sonoran-Boreal form (*Eutamias quadrivittatus*) which probably do not extend much above the Canadian zone, and six which seldom if ever extend below it. In addition to the seven species characteristic of the Transition zone, we find this zone forming the lower limit of eighteen Boreal species and the upper limit of four Sonoran forms.

While the Alpine zone possesses many characteristic plants, on the mammalian side it is characterized chiefly by the paucity of its fauna, possessing not a single characteristic species. The Hudsonian and Canadian zones have most of their mammals in common, while of the three species characteristic of the former zone, *Ochotona saxatilis*[11] invades the latter to some extent, while on the other hand it occurs in the Alpine zone in suitable places.

These facts bring out very clearly, I believe, the distinctness of Boreal and Sonoran regions in northern Colorado, as based on the distribution of the mammals in this territory. The Transition zone is, as its name implies, a meeting ground of these two great regions, common to, and yet distinct from each. They show further the intimate relation between Hudsonian and Canadian zones. Using the mammals only as a criterion, I hardly believe we should be justified in separating these zones from each other; their characteristics are relatively much fewer than among the plants.

(2) The movement of some species relative to their centers of dispersal and notes on the little known distribution of certain forms.

The occurrence of a species outside its proper habitat does not necessarily prove a migration on the part of that species from such habitat. It may, on the contrary, mean that the species formerly had a more widespread distribution than at present, becoming secondarily restricted to its present habitat, with the exception of a few stragglers remaining in the territory formerly occupied by it. This is a question which cannot, in most cases, be settled with our present lack

[11] Warren, E. R.: The Mammals of Colorado, *Colorado College Publications*, Science Series, No. 46, p. 254, mentions the coney as occurring as low as 2,834 m. near Crested Butte.

of data regarding the former abundance of the species in the region in question. Where, however, a typical plains form, as *Putorius nigripes* or *Citellus tridecemlineatus pallidus*, is found in the higher mountains, I believe we are justified in concluding that they have migrated outside of their proper habitat.

Sciurus ludovicianus.

This species is now quite common in the neighborhood of Greeley, where I understand it has been introduced from Omaha. It is also present in Denver.

Citellus tridecemlineatus pallidus.

The presence of this spermophile at Divide,[12] altitude 3,000 m., and elsewhere in the mountains,[13] indicates a westward and upward movement of this species from its center in the Great Plains, probably dependent upon the presence of its physical habitat, the grass-sage-brush plains in some parts of the mountains, rather than upon temperature.

Peromyscus nebracensis.

This is another plains form of Upper Sonoran and Transition zones which appears to be invading the mountains, judging by its occurrence at an altitude of 3,508 m.[14] and elsewhere through the mountains.

Phenacomys preblei.

The only record hitherto of this species is that given by Merriam[15] from Long's Peak. I have taken a single specimen on North Boulder Creek at about 2,900 m. altitude. This is the only specimen I have secured in spite of careful trapping in several places.

Spilogale tenuis.

I have taken a few of this species at Boulder, hitherto known only from Arkins and Estes Park.

Putorius nigripes.

The occurrence of the black-footed ferret at an altitude of 3,124 m.[16] indicates a probable migration on its part from its habitat on the plains into the mountains.

---

[12] *Fide* Warren (*op. cit.*, p. 242).

[13] Bailey, V: The Prairie Ground Squirrels of the Mississippi Valley, Bull. 4, *U. S. Biol. Survey*, gives its western limits as approximately Twin Lakes.

[14] *Fide* Warren (*op. cit.*, p. 245).

[15] Merriam, C. H.: *Phenacomys preblei*, a New Vole from the Mountains of Colorado, *Proc. Biol. Soc. Wash.*, Vol. XI, p. 45.

[16] *Fide* Warren (*op. cit.*, p. 264).

Putorius longicauda.

This weasel invades the mountains also to some extent, as I have observed it in Boulder Canyon several miles above its mouth.

Sorex personatus.

The occurrence of this shrew in the Rocky Mountains as far south as Colorado extends considerably southward in these mountains the range of this northern and eastern form. Its presence in the meadows about Boulder brings this Boreal species down to the edge of the Upper Sonoran zone.

Sorex personatus haydeni.

Warren[17] records a specimen of this shrew taken by him at Lake Moraine and identified by Merriam. Inasmuch as *haydeni* is a North Dakota plains form its occurrence in the Hudsonian zone on Pike's Peak is certainly interesting. Have we here a marked case of migration, a case of polygenesis, or is *haydeni*, as Elliott[18] believes, a synonym for *personatus*?

Sorex vagrans dobsoni.

This is another interesting record given by Warren[19] and based on an identification by Merriam. In *N. A. Fauna*, No. 10, p. 68, the latter gives the distribution of this shrew as parts of Idaho, Montana, Wyoming and Utah. He says further in the same place: "The interrelations of *dobsoni* and *obscurus* are intricate and perplexing. The two animals resemble one another very closely, but no intergrades have been found, and each has, so far as known, an independent distribution." This record extends the range of *dobsoni* considerably southward, making it coincident, at this point at least, with that of *obscurus*.

Sorex obscurus.

Merriam[20] gives the distribution of this species as "Restricted to Boreal Zone." Specimens collected by me at Boulder extend its range through the Transition zone.

Corynorhinus macrotis pallescens.

I have a specimen taken in Boulder Canyon at an approximate altitude of 2,300 m., which shows an occasional invasion of the Transition zone by this supposedly Sonoran species.

---

[17] *Op. cit.*, p. 265.
[18] Elliott, D. G.: A Synopsis of the Mammals of North America and the Adjacent Seas, *Field Columbian Museum*, Zool. Ser., II, 1901, p. 367.
[19] *Op. cit.*, p. 266.
[20] *Op. cit.*, p. 72.

Myotis lucifugus longicrus.

The only Colorado record of this bat which I have found is one by Miller[21] for Grand Junction. I have taken it at Steamboat Springs, and have a badly mutilated skin from Eldora which is probably one of this species.

Myotis evotis.

The only Colorado record I have seen is one by Miller[22] from Loveland. I have a specimen taken in the Yellow Jacket Mountains 21 km. east of Steamboat Springs at an approximate altitude of 2,140 m.

(3) Description of a new species of bat from Boulder.

Eptesicus pallidus sp. n.

Type No. 142,526 ♀ ad., collection of U. S. Nat. Mus. Collected by R. T. Young at Boulder, Colorado, July 22, 1903.

Distribution.—Known from type locality only.

Diagnosis.—Skull identical with that of *Eptesicus fuscus.* Size largest of American species of the genus. (Average total length of four specimens, all females, 124.)[23]

Color palest of American species of the genus, distinctly lighter than that of *E. fuscus.*

Color.—Above brownish ashy, the basal half of hairs fuscous; below pale silvery gray, the basal half of hairs fuscous, with a narrow transition zone of brownish ashy between the inner and outer parts. Dorsally and ventrally along the line of attachment, and on the surfaces of the membranes, the basal fuscous zone of the hairs disappears.

Measurements of Type.—Total length, 127; tail, 50; hind foot, 12. Skull, occipito-nasal length, 19; interorbital constriction, 4; zygomatic breadth, 13; upper tooth row, 8.5; palato-basi-occipital length, 15; mandible (from condyle to symphysis), 14; lower tooth row, 9.

Measurements (average of four females).—Total length, 124; tail, 49; hind foot, 12.[24] Average of two females in alcohol: Ear from crown, 13.5; tibia, 20.5; forearm, 49; thumb, 8; longest "finger," 80.5;[25] width of ear, 11.5; tragus (from posterior angle), 8. Skull (average of three specimens),[26] 18.5, 4, 12.5,[27] 8, 14.5, 13.5, 9.

Remarks.—While conclusions based on so small a number of specimens as I possess are necessarily uncertain, still I believe that, since

[21] Miller, G. S., Jr.: Revision of the North American Bats of the Family Vespertilionidæ, *N. A. Fauna*, 13, p. 65.

[22] *Op. cit.*, p. 80.

[23] All measurements in mm.

[24] Average of five specimens including one male.

[25] From tip to base of phalanges not including carpus.

[26] Measurements given in same order as those of the type.

[27] Average of two specimens.

specimens of *Eptesicus fuscus* from this region[28] have the color and size typical of the species, the new form must be considered as a distinct species and not merely a geographical race of *fuscus.*

The probable origin of this species is a matter of some interest. Occurring in the same territory and occupying the same habitat as its near relative *fuscus*, neither the geographic isolation nor selection theory seem to offer a satisfactory explanation. Neither the mutation nor orthogenesis theory finds any difficulty in these facts. Moreover we have here an apparent exception to Jordan's law of geminate species.

Further information as to the distribution of this species is very desirable.[29]

In conclusion I wish to thank the authorities of the Field Museum, the Academy of Natural Sciences of Philadelphia and the U. S. National Museum for the identification of much of my material; and the latter institution especially for its loan of valuable material.

---

[28] Loveland, *fide* Miller, *op. cit.*, p. 98. A single skin without skull in my own collection from Boulder Canyon, approximate altitude 2,300 m., has the typical brown color of *E. fuscus.*

[29] Miller, *op. cit.*, p. 99, says of *fuscus*: "Very pallid specimens are occasionally taken in the Southwestern United States, but the number of skins available for comparison is so small that it is impossible to determine the status of the form which these aberrant individuals represent." It is possible that these specimens are representatives of my new form, but not having seen them I cannot say.

SOME EFFECTS OF ENVIRONMENT ON THE GROWTH OF LYMNÆA COLUMELLA Say.[1]

BY HAROLD SELLERS COLTON.

Table of Contents.

I. Introduction.

It is a widely recognized fact that animals raised in confinement differ in various ways from those in the wild state. The differences

[1] The writer takes great pleasure in thanking Dr. J. Percy Moore and Dr. E. G. Conklin in particular for many helpful suggestions and criticisms in carrying out the work.

that are most easily observed are those of relative rate of growth and of relative fertility. Although naturalists for many years have recorded cases of this sort, few have undertaken an experimental study of the factors concerned.

External conditions modifying one structure of an organism have usually been found to be correlated with similar modifications in other organs, yet few correlations between dissimilar physiological processes have ever been observed, although most naturalists hold them to be present.

In studying the effect of confinement on organisms, nearly all investigators have chosen the Pond Snail as an animal admirably adapted to their purpose. Perhaps it is largely due to the abundance, to the hardiness, to the rapidity of growth and above all to the extreme sensibility of Pond Snails to any slight change in environment that they have been so universally chosen.

II. Historical.

Jebez Hogg ('54) discovered that *Lymnæa* confined in small aquaria were much smaller than their brothers of the same egg case raised in a large one. The latter were full grown and had produced young which were as large as the former at the end of six months. Hogg attempted to explain this phenomenon by saying that the snail had the power of "adapting itself to the necessities of its existence."

Carl Semper ('79) did not consider this as an explanation. He believed that there was a definite factor that would cause dwarfing. This led him to perform a series of experiments with various sized containers. The conclusion that he arrived at was as follows: that there was a chemical in the water (he had the water analyzed, but nothing was discovered) that stimulates growth without actually contributing to it, but yet is essential, "like oil to a steam engine."

The next investigator to enter this field was E. Yung ('78, '85). He proceeded to raise tadpoles from the egg in various sized and shaped containers. He found that those with the greatest area exposed to the air held the largest tadpoles after a certain length of time. The obvious conclusion was that the dwarfing was caused by lack of aeration.

Stimulated by the experiments of Semper and Yung, De Varigny ('94) made an attempt to solve the problem by returning to *Lymnæa*. After a hundred or more very careful experiments, he did not dare venture any very definite conclusion, but thought that the dwarfing of these Pond Snails was caused by lack of exercise.

Both Semper and De Varigny, on *à priori* grounds, assumed that the manner of respiration in the fresh water pulmonates was entirely performed by the so-called lung. This caused them to overlook the factor of the aeration of the water.

Willem ('96) called attention to this fact and conducted a series of experiments with this particular end in view. Various authors had already noticed that *Lymnæa* in deep lakes never came to the surface, and that under certain conditions they could be made to visit the surface very seldom. Acting on these suggestions, he performed his experiments by running a stream of air bubbles through the water, using De Varigny's experiments as a basis. By this means he was able to explain all of De Varigny's results as due to the simple factor of aeration of the water.

Parallel to the experiments of De Varigny ('94) and Willem ('96), Vernon ('95) experimented at Naples on the growth of Echinoderm larvæ. His conclusions were that dwarfing in confined spaces was due to the concentration of excretory secretions in the medium. Aeration seemed not to be a factor in the growth of Echinoderm larvæ, except for the fact that æration would tend to oxidize the waste products of metabolism.

Warren ('00), as a result of experiments with *Daphnia* in confined spaces, reported that the individuals were dwarfed by the accumulation of their own excretory secretions. This was specific and did not affect the growth and abundance of other crustaceans.

It will be seen that five factors have been advanced to explain dwarfing in confined spaces. These are lack of oxygen, presence of secretions, lack of exercise, presence of unknown chemical, and the adaption to the necessities of existence.

In commenting on these explanations Davenport ('99) writes, "There is, however, much reason for believing that Hogg's conclusion is the one which with our fuller knowledge we can hardly improve upon." In the mind of the author Hogg's explanation is not an explanation but a statement of the fact that confined spaces do affect growth. It does not help us to understand how and why animals adapt themselves to their surroundings.

III. Materials.

After a few preliminary experiments with *Lymnæa*, *Physa* and *Planorbis*, it was soon found that the former was by far the best form for experiments in the laboratory. There are several reasons for this. *Lymnæa* is abundant in the ponds and streams about Philadelphia. It is not quite as abundant, perhaps, as is *Physa*; yet, except when the ponds are frozen in the winter, is easily procured. A fact of the greatest importance is that eggs are laid throughout the winter, and that these eggs ordinarily develop with slight mortality. The *Lymnæa* on which the following experiments were performed was identified by Dr. H. A. Pilsbry as *Lymnæa columella* Say. This is the most common *Lymnæa* in the neighborhood of Philadelphia. The specimens were procured in certain ponds in Fairmount Park, in a stream near Bryn Mawr, and in the Vivarium of the University of Pennsylvania; the latter had come from an unknown source.

The number of eggs laid at one time by *Lymnæa columella* may vary between one egg and ninety. The egg is, as in the case of other Basiommatophora, imbedded in an albuminous food material, all of which is enclosed by a membrane. This membrane is in turn imbedded in a slimy jelly in which lie the other eggs, laid at the same time. This slimy jelly is again surrounded by an outer layer of jelly, which is quite tough when compared to that matrix which holds the eggs. This tough jelly is thick on the free side, but thin where it cements the eggs to the substratum. In the act of hatching the young snail, which crawls around inside of the membrane, finds its way into the soft jelly mass. After spending a day or two eating this substance, it finally ruptures the wall of tough jelly and escapes. In this jelly mass the eggs are usually placed in three rows. Although the number of eggs may vary greatly, yet in the winter time the average number is about twenty. When adult snails, as soon as the ice is off the ponds in the spring, are brought into the laboratory, they lay the largest number of eggs in a capsule. This fact will be discussed later.

To shed some light on the behavior of the snail after hatching, an egg case containing four young was placed in a dish of water and the positions of the snails after hatching plotted at intervals of five minutes for a period of forty-four hours. From the data gathered in this manner the following generalizations were made:—

1. Although on hatching the lung contained no air, yet 95 minutes, 50 minutes, 110 minutes and 60 minutes respectively were consumed by the different snails in reaching the surface of the water. One snail captured an air bubble before it left the egg case.

2. The movements of snails, previous to their reaching the surface, were more or less at random, and they paid very little attention to the direction of the diffused light in which the experiment was started. However, on first reaching the edge of the dish they, in every case, crawled up to the surface. The snail that captured the air bubble

wandered for 110 minutes after leaving the capsule and then reached the surface by a different method. Letting go from its substratum this snail floated up and proceeded to crawl on the surface film, precisely like an adult snail.

3. In this experiment the snails without exception rested at night. The lack of activity may be due to slightly cooler water, yet the dish was kept in a warm room all of the time. Although these snails had no experience of the oustide world, yet they acted, as far as this experiment indicates, exactly as adults.

Walter ('06) has given us the most complete account of the bionomics of *Lymnæa*. Using his work as a basis it is necessary to call to mind certain activities of the animal. *Lymnæa* has four methods of locomotion, which may be roughly described as gliding, hunching, dangling and dropping. The last two methods are rare and it is not necessary to consider them in this place. The first method is the most common. It consists in the cilia of the foot beating on a path of mucus secreted by the animal and attached to the substratum. When the snail is out of water, when its supply of mucus is inadequate and when certain stimuli are applied the snail resorts to the hunching method, which consists of muscular movements of the foot which bring the snail forward. This is something like the movements of a measuring worm. Whatever method the snail uses it is attached to some substratum, whether it be the sides of the aquarium or the surface film of the water, or suspended by a string of mucus from the surface film or anchored by a string of mucus from the bottom. In these ways the snail can browse on water plants, on the sides of the aquarium, and gather the algæ floating on the surface (Plankton fishing of Brockmeier, '98); but cannot gather any amount of food suspended in the water.

We have seen by the experiments of Hogg, Semper and De Varigny that certain external conditions will inhibit growth in *Lymnæa*. It is interesting to know just what structural differences exist between the full-grown snail, the dwarf and a normal growing snail the size of the dwarf. Hogg ('54) noticed that the dwarfed snail had many characteristics of the newly hatched individual.

A comparison of the structure of a dwarf with a young snail of equal size that was being raised under favorable conditions, and a comparison of the structure of a dwarf with a snail of the same age that had spent its growing period under favorable conditions and therefore much larger, will show certain relations. These relations are as follows:

1. Of snails the same size but not the same age the number of whorls of the shell are the same.

2. The same relation holds true with regard to the arrangement of the viscera, *i.e.*, lobes of the liver, stomach and intestines.

3. Cytologically, however, the tissues of the young snail are quite different from the older ones. As an instance of this the liver of the young snail contains large cells laden with yolk, all of which has been completely absorbed in the dwarf.

In a pond near Geneva Brot[2] found that *Lymnæa* had a malformation on the columella that seemed to be correlated with the presence of *Hydra viridis*. If a snail be long dwarfed and later be put under favorable conditions, the shell is often strangely distorted. The pond near Geneva may have nearly dried up and suddenly filled up again. All the snails in the pond would be under unfavorable conditions and dwarfed. The pond filling up would offer ideal conditions and the snails would grow.

Dr. Pilsbry informed the writer that he has noted cases of this sort.

A question of great interest is, will a dwarf put under favorable conditions "grow up"? In *Lymnæa* many experiments seem to show that a dwarf does not cease to grow, but rather ceases to grow fast. If, however, the snail is put under favorable conditions it starts at once to grow faster and may "grow up." However, they seem "delicate" and it is with difficulty that they are raised.

In this section the writer has attempted to outline some of the points that have certain bearings on the experiments to come.

IV. Methods.

In the brief review of the experiments of various authors that has been given, certain controllable factors were shown that would affect in certain ways the growth of animals. Every author on *a priori* grounds has assumed that (1) food supply will influence growth. It was found by Hogg ('54) and by Semper ('74) that (2) the volume of water affected growth. Semper showed that (3) temperature also was a factor that could not be neglected, and that (4) the number of individuals reacted in some manner on one another. Willem ('96) proved that (5) aeration of the water affected the growth of *Lymnæa*, even as Yung ('79) had previously observed for tadpoles. De Varigny considered that a large (6) area on which a snail could crawl was beneficial to growth. The effect of (7) light was recognized by Higgenbottom ('50) and by Yung ('80). Vernon ('95–'99) completed this list by adding to it a factor, (8) the chemical composition of the water.

[2] Cited from the *Camb. Nat. Hist.*, Mollusks, p. 88.

There are eight variable factors that have been considered to affect the growth processes of aquatic animals. Each factor, however, is not of equal weight, but should be held in mind and controlled, if possible, in an experimental study. Using the topics named above as a basis for study, the general plan of the experiments that follow in the subsequent section will be to keep every other factor constant and vary one alone.

Precautions.—The experiments were carried out principally in battery jars. The size used in the majority of the experiments was 4 inches in diameter by 5 inches high. Other vessels used were 5 x 6 battery jars, 8 x 10 battery jars and 12-inch dishes.

In order to save repetition we will consider here the methods employed in every case. Where this order has been deviated from, it will be mentioned in its place.

(1) Before each experiment the jars were washed out and wiped clean. In the later experiments the jars were washed with oxidizing solution (potassium bichromate in concentrated sulphuric acid) as an extra precaution.

(2) The water used in the experiments was taken from a large aquarium in the University Vivarium which contained fish. This was done to introduce algæ, etc., without the danger of adding young snails with it.

(3) In any one experiment the jars used were similar, the water was taken from the same source, and the same amount of water was used unless stated otherwise. These conditions being fulfilled, the composition of the water, the algæ for food, and the temperature must vary in the same way.

(4) In a given experiment the jars were placed near together and care was taken so that each received an equal amount of light.

(5) Over each was placed a glass plate to prevent evaporation and the escape of the snails. This latter apparently suicidal behavior, as described by Walter, was found often occurring. In many of the cases that have come under observation, this was caused by the vapor condensing on the glass sides of the jar above the water. Up this wet glass the snail crawls, until temperature changes occur that dry the glass. The snail is then dried and killed. Other cases are not so easy to explain.

(6) Just before an egg case was ready to hatch, with a section lifter it was carefully removed from its substratum and isolated in a jar of water. If the eggs are freshly laid it is usually fatal to the embryos to remove them. In some of the earlier experiments, after the young snail has broken through the egg membrane, the jelly mass was divided

up so that each piece contained an equal number of snails and placed at once under the conditions of the experiment. As there was less mortality by letting the young snails escape from the case normally, they were not placed under the conditions of the experiment until a day after they escaped from the egg case.

(7) In those jars in which I have placed water plant I have tried to add pieces of water plant of equal length and foliage.

(8) Where sediment was needed approximately the same amount was added to each jar.

Measurements.—To measure growth several methods have been used. It is possible to measure volume, weight, a lineal dimension of some part, or the number of successively arising homodynamous structures. In the case of the pond snail the lineal dimension of the length of the shell at once suggests itself. To measure this the following apparatus was arranged. A is a compound microscope with about a 7-inch working distance magnifying the object about three times (fig. 1). O is a snail on a thin glass slide that was placed over a piece of paper ruled in millimeters. The snail was placed with the aperture flat on the glass and the shell would be projected on the ruled lines. Millimeters were then read off on the paper and tenths estimated. This is sufficiently accurate where the work is purely qualitative. A Vernier caliper could not be used on account of the delicacy of the shell.

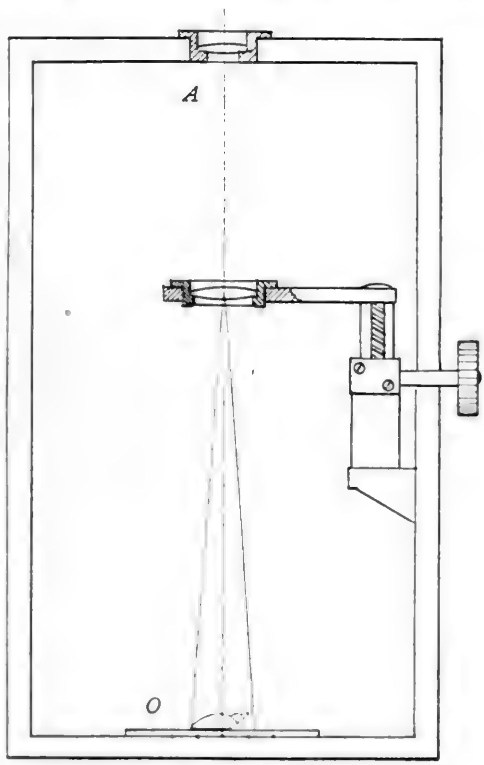


Fig. 1.

In some cases the weight is given. This is not always satisfactory. As growth is a three dimensional phenomenon weight more nearly represents growth. However, the writer found that the snails, large and small, are mathematically similar. That is, the weights are proportional to the cubes of the length.

In determining the average weight all the snails from a given experiment were placed on a microscopic slide of known weight and all excess water wiped away with a clean handkerchief or with lens paper. They were then let dry for three or four minutes and weighed. Dividing the weight found for the snails by the number gives the average.

Tables.—The results of experiments are placed in tabular form. Each experiment consists of two parts; the second member of the pair is in every case the control or the condition most nearly normal. The variable factor precedes it.

A detailed description of the vertical columns of the tables will now be considered. Cf. tables, pp. 421 *et seq.*

Column 1.—The serial number of the experiment.

Column 2.—The number of days the experiment was carried on.

Column 3.—The number of snails placed in a jar at the beginning of the experiment.

Column 4.—The number of snails alive at the time the measurements were taken.

Column 5.—The condition that varied in each pair of experiments.

Column 6.—Certain constant conditions. These constants are in some cases interesting to know. In this column certain abbreviations are used. W P equals Water Plant, *i.e.*, *Myriophyllum*, *Ceratophyllum*, *Elodea* or *Spirogyra*. N indicates no water plant. cc. equals cubic centimeters present in each jar.

Column 7.—Average size. If the number is expressed in ten thousandths, grams are to be implied; if expressed in units and tenths, millimeters.

Column 8.—The differences between pairs are placed opposite the largest number of the pair.

Column 9.—The quantity in this column is the per cent. of the difference to the largest average of the pair. To be able to compare the per cent. difference of the weights with those of lengths the following formula was used, being based on the fact that the snails are similar.

a and b are two members of a pair expressed in grams and $a > b$. Since the shells are similar mathematically, then

$$\frac{\sqrt[3]{a}}{\sqrt[3]{a} - \sqrt[3]{b}} = \frac{100}{\times \%} \text{ or } \times \% = 100 \frac{(\sqrt[3]{a} - \sqrt[3]{b})}{\sqrt[3]{a}}$$

Analysis of Experiments.—To bring the mass of experiments into a form in which they may be more easily considered, a subsidiary table has been compiled from the primary ones. This table consists of four columns (p. 420*a*).

Column 1 contains the number of the primary table for reference.

Column 2 gives the number of experiments in the primary tables that are favorable to the presence of a factor.

Column 3 gives the number of experiments in the primary tables that are favorable to the absence of a factor.

Column 4 shows the number of experiments that are indeterminate. To determine whether an experiment is indeterminate or not certain rules are followed:

1. If there has been a large mortality among the snails which were the larger at the end of the experiment the difference was considered indeterminate. The fact that they were the larger could be explained by the fact that they were the fewer. If, however, the opposite was true, *i.e.*, the mortality was among the smaller snails, then the probability is that they are fewer because the conditions have been the more severe.

2. An experiment has been considered indeterminate if there was a large mortality on both sides of the experiment, notwithstanding the fact that the remaining numbers are nearly equal. The reason for this is the probability that an uncontrolled factor has been acting.

3. When a known factor has acted on one portion of the experiment and not on the other, the difference has been considered indeterminate.

4. Those experiments where the difference is under 10 per cent. of the greatest average has been believed to be indeterminate. This purely arbitrary criterion has been devised to allow for two uncontrollable errors—individual variation and errors in measurement. The obvious way to correct these errors would be to make use of large numbers of individuals in single experiments. As the number of eggs in a case is small, and when the snails are crowded the mortality is large, it has been found impossible to deal with large numbers. A limi of error must be made that will be large enough to cover most unknown errors (see next page).

SECONDARY TABLE.

For description see page 419.

Table			Indeterminate.
I.	Elodea............ 2 exp.	Absence of....... 4 exp.	4 exp.
II.	Myriophyllum..... 6 "	" " ...... 4 "	7 "
III.	Sediment..........13 "	" " ...... 4 "	5 "
IV.	Fæces............. 2 "	" " ...... 0 "	1 "
V.	Flat dish .... 2 "	Jar and slides.... 2 "	4 "
VI.	" .... 1 "	Battery jar ...... 0 "	6 "
VII.	Air bubbles........ 5 "	Absence of...... 2 "	3 "
VIII.	(See Special Table, p. 431)		
IX.	Excretions conc. .. 1[3] "	" "....... 4 "	0 "
	" dilute.. 5 "	" "....... 0 "	0 "
X.	(See Special Table.)		
XI.	Numbers.......... 0 "	" "....... 5 "	0 "
XII.	Shell salts (see Special Table).		
XIII.	Temperature (see Special Table, p. 419).		
XIV.	Cold .... 0 exp.	Warm ....11 "	1 "
XV.	Dark.............. 0 "	Light............ 5 "	1 "
XVI.	Large area .... 2 "	Small area .... 8 "	9 "
XVII.	Large volume ..... 8 "	Small volume ... 0 "	3 "
XVIII.	Alternate heat and cold .... 4 "	Warm .... 7 "	4 "
XIX.	Alternate light and dark .... 0 "	Light............ 3 "	2 "
XX.	Alternate starving and feeding...... 0 "	With food........ 5 "	3 "

V. EXPERIMENTS.

1. *Effect of Food.*—Various authors (Semper, Ullyet,[4] Cockerall,[4] Walter, etc.) have shown that *Lymnæa* will eat animal as well as vegetable food. However, the latter furnishes the normal diet. This consists of diatomes, desmids, unicellular and filamentous algæ, the leaves of water plants, and dead leaves of trees. If a snail after hatching is placed in a clean battery jar with 500 cc. of clear pond water that snail will grow, the necessary amount of food being supplied by the microscopic algæ introduced with the water which will increase faster than the snail can eat up. If the temperature is favorable, in the course of two months the snail will reach 7 mm. or 8 mm. in altitude and become sexually mature. The fact that the supply of food keeps ahead of the demand is interesting and led to a series of experiments

[3] Boiled water from a jar in which a snail had been raised.
[4] Cited from Walter ('06).

with *Myriophyllum* and *Elodea*, to see the effect of these water plants and to discover whether or not their presence is beneficial. *A priori* one would consider that the effect of these larger water plants as *Elodea* or *Myriophyllum* would be beneficial. My experiments seemed in indicate that their effect was the opposite. I at once started a great number of experiments in this line. Some experiments, as can be seen in Table I and Table II, went decidedly one way and some went decidedly the other. The results were chaotic and no generalizations were possible.

A study of the gross anatomy of *Lymnæa* reveals the fact that the anterior portion of the stomach is highly muscular. This muscular sac was originally described by Martin Lister[5] and compared to the stomach of a mullet. Cuvier ('17) more happily compared it to the gizzard of a granivorous bird. It was compared much later by the geologist Whitfield ('82), independently of Cuvier, to the gizzard of a fowl. Whitfield showed that this organ like the gizzard is normally filled with sand in *Lymnæa megasoma*.

Table I—Effect of Elodea.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Size.	Dif.	Per cent.
2A	52	4	3	Elodea.	500 cc.	3.2	—	—
B		4	4	None.		4.0	.8	16%
3A	52	4	2	Elodea.	500 cc.	1.0	—	—
B		4	2	None.		1.6	.6	37%
4A	52	4	4	Elodea.	500 cc.	4.5	—	—
B		4	1	None.		5.0	.5	10%
5A	54	6	5	Elodea.	500 cc.	.0032	—	—
B		6	4	None.		.0220	.0188	50%
6A	54	6	4	Elodea.	500 cc.	.0005	—	—
B		6	4	None.		.0010	.0005	20%
7A	54	6	5	Elodea.	500 cc.	.0010	—	—
B		6	5	None.		.0012	.0002	5%
8A		6	6	Elodea.	500 cc.	.0010	—	—
B		6	5	None.		.0032	.0022	32%
9A		6	5	Elodea.	500 cc.	.0010	.0005	20%
B		6	2	None.		.0005	—	—
10A		6	3	Elodea.	500 cc.	.0016	.0008	23%
B		6	3	None.		.0008	—	—
11A	57	6	6	Elodea.	500 cc.	.0052	—	—
B		6	6	None.		.0077	.0025	12%
12A	57	6	5	Elodea.	500 cc.	.0039	—	—
B		6	6	None.		.0039	—	—

[5] Cited by Cuvier ('17).

TABLE II—EFFECT OF MYRIOPHYLLUM.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Av. Size.	Dif.	Per cent.
13A	28	2	2	Myrio.	200 cc.	5.0	—	—
B		2	2	None.		5.2	.2	3.8%
14A	50	2	2	Myrio.	400 cc.	9.0	—	—
B		2	2	None.		9.5	.5	5.1%
15A	27	1	1	Myrio.	500 cc.	4.4	.9	20%
B		1	1	None.		3.5	—	—
16A	27	1	1	Myrio.	500 cc.	6.5	1.5	23%
B		1	1	None.		5.0	—	—
17A	48	6	6	Myrio.	460 cc.	3.7	—	—
B		6	6	None.		4.3	.6	14%
18A	48	6	6	Myrio.	680 cc.	3.2	—	—
B		6	5	None.		3.3	.1	3%
19A	48	6	6	Myrio.		1.3	—	—
B		6	6	None.		2.2	.9	41%
20A	69	7	9	Myrio.	400 cc.	3.4	.6	18%
B		7	3	None.		2.8	—	—
21A	69	7	3	Myrio.	680 cc.	5.5	2.0	36%
B		7	4	None.		3.5	—	—
22A	28	2	2	Myrio.	466 cc.	4.4	1.2	27%
B		2	2	None.		3.2	—	—
23A	28	2	1	Myrio.	680 cc.	4.1	—	—
B		2	2	None.		5.1	1.0	20%
24A	29	2	1	Myrio.	2000 cc.	1.7	—	—
B		2	2	None.		2.4	.7	28%
25A	29	2	1	Myrio.	2000 cc.	6.5	—	—
B		2	1	None.		6.5	—	—
122A	37	3	2	Myrio.	500 cc.	4.9	3.2	67%
B		3	2	None.		1.7	—	—
193A	38	4	3	Myrio.	500 cc.	3.9	2.0	51%
B		4	4	Algæ.		1.9	—	—
194A	38	4	4	Myrio.	500 cc.	5.9	3.8	68%
B		4	4	Algæ.		2.1	—	—
195A	38	4	3	Myrio.	500 cc.	8.0	4.6	57%
B		4	4	Algæ.		3.4	—	—

Effect of Sediment.—The gizzard of *Lymnæa columella*, like the latter, is usually filled with fine sand. However, in dissecting a number of individuals of *Lymnæa columella* that had been raised in clean battery jars I found no sign of sand. In a few individuals I found some grains, when a diligent search of the jar failed to reveal any more. It seems that this individual had in its crop the only grains of sediment that the jar contained.

TABLE III—EFFECT OF SEDIMENT.

Ex.	Days.	No. Beg.	No. End.	Variable.	Constant.	Av. Size.	Dif.	Per cent.
85A		2	2	Sediment.	N. 500 cc.	5.1	1.9	37%
B		2	2	None.	"	3.2	—	—
86A		2	1	Sediment.	W. P. 500 cc.	4.1	—	—
B		2	2	None.	"	4.4	.3	6%
87A		2	2	Sediment.	W. P. 500 cc.	5.0	.5	10%
B		2	1	None.	"	4.5	—	—
88A		2	2	Sediment.	W. P. 500 cc.	3.6	—	—
B		2	2	None.	"	4.6	1.0	22%
89A		2	2	Sediment.	N. 200 cc.	6.5	4.1	63%
B		2	2	None.	"	2.4	—	—
90A		1	1	Sediment.	W. P. 200 cc.	6.5	4.4	67%
B		1	1	None.	"	1.7	—	—
118A	60	3	1	Sediment.	N. 500 cc.	8.0	4.4	55%
B		3	3	None.	"	3.6	—	—
119A	60	2	1	Sediment.	N. 500 cc.	7.9	5.7	72%
B		2	2	None.	"	2.2	—	—
120A	60	2	2	Sediment.	N. 500 cc.	7.4	2.0	27%
B		2	2	None.	"	5.4	—	—
121A	60	2	2	Sediment.	N. 500 cc.	8.1	3.1	38%
B		2	2	None.	"	5.0	—	—
124A	43	4	4	Sediment.	N. 500 cc.	1.8	—	—
B		4	4	None.	"	1.9	.1	5%
125A	43	4	4	Sediment.	N. 500 cc.	2.3	1.0	43%
B		4	4	None.	"	1.3	—	—
126A	51	4	4	Sand.	N. 500 cc.	3.4	.8	23%
B		4	4	None.	"	2.6	—	—
127A	51	4	4	Sediment.	N. 500 cc.	2.1	—	—
B		4	4	None.	"	2.6	.5	19%
128A	37	3	3	Myrio.	500 cc.	9.0	3.7	41%
B		3	3	Myrio (washed).	"	5.3	—	—
129A	47	4	4	Ignited sediment.	N. 500 cc.	2.	—	—
B		4	4	None.	"	2.9	.9	31%
130A	47	4	4	Sand.	N. 500 cc.	3.5	.6	17%
B		4	4	None.	"	2.9	—	—
131A	77	3	3	Sediment.	N. 500 cc.	1.7	—	—
B		3	3	None.	"	3.5	1.8	51%
132A	77	3	3	Sand.	N. 500 cc.	4.7	1.2	23%
B		3	3	None.	"	3.5	—	—
133A	77	3	2	Gravel.	N. 500 cc.	6.0	2.5	41%
B		3	3	None.	"	3.5	—	—
123A	38	4	4	Sediment.	N. 500 cc.	2.1	.3	14%
B		4	4	None.	"	1.8	—	—
196A	38	4	4	Sediment.	W. P. 500 cc.	5.9	2.0	34%
B		4	3	None.	"	3.9	—	—

Another point of importance in these experiments was the fact that in no cases was the water plant attacked when sediment was not present. On the other hand, in jars with sediment present the normal thing was to have the leaves of the water plant cut to pieces.

To determine whether the presence or absence of sediment would affect the growth processes of the snail a number of experiments were undertaken. The sediment used in Experiments 85, 86, 87 and 88, was mud from the pond in the Botanic Gardens. This was washed and that which settled in from 1 to 5 minutes kept for experimental purposes. Because this mud would probably introduce food into the jars, soil from the garden bed was taken, boiled and that which settled in from 1 to 5 minutes used in Experiments 89 and 90. In Experiments 118–121 the sediment was boiled in concentrated nitric acid, evaporated to dryness, and ignited. This would surely destroy all organic matter; yet the results of these experiments continued to show the benefit of the sediment. Quartz sand and quartz pebbles washed with nitric acid gave beneficial results also. If the *Myriophyllum* was washed in running water the snails did not grow as large as if it was used with the particles of sediment still clinging to the leaves.

In conclusion it seems probable that (1) the muscular gizzard filled with sand is necessary to break up the plant cells that have been torn off by the radula. (2) The absence of sand seems to have the effect of causing the snails not to rasp off cells from the tissues of water plant. (3) If there is enough small algæ present, *Myriophyllum* will have little or no effect on the growth. (4) An examination of the stomach of small snails under 5 mm. shows that such plant tissue as *Myriophyllum* is not eaten. With snails 5 to 12 mm., however, great gashes are torn in the leaves, and the stomach is filled with the crushed cells. (5) The discordant results of Tables I and II are no doubt due to the presence or absence of sediment.

Fæces.—The amount of fæces produced by *Lymnæa* is enormous and Walter ('06) reports that *Lymnæa elodes* forms cylinders of fæcal matter fourteen times its own length every twenty-four hours. This collects at the bottom of the aquaria in great tangled masses.

De Varigny ('94) investigated the effect of this material on the growing snail. The result of his experiments was the stunting of the snails in the jar with the fæcal masses. In repeating these experiments of De Varigny the writer gathered fæces from a jar in which a snail had been living for a month or two. This matter in some cases was washed in a filter and in others by decanting. This washed material was added to jars of snails. The result indicated in Table IV was the opposite from that found by De Varigny. However, the latter did not wash the fæcal material, and so introduced into the water a large amount of soluble excreted material that he himself found so harmful to the growing snail.

TABLE IV—EFFECT OF FÆCES.

Ex.	Days.	No. Beg.	No. End.	Variable.	Constant.	Av. Size.	Dif.	Per cent.
45A	40	1	1	Fæces.	N.	3.0	1.2	40%
B		1	1	None.		1.8	—	—
46A	60	8	8	Fæces.	N.	3.6	—	—
B		8	6	None.		4.0	.4	10%
47A	54	5	4	Fæces.	N.	7.0	4.0	59%
B		5	3	None.		3.0	—	—

Rathay's ('98) observations on *Helix hortensis* and Young's ('88) observations on *Helix pomatia* and on *Arion* show that these pulmonates eat a great mass of food, very little of which appears to be assimilated or even digested.

Observations of the fæcal matter of *Lymnæa* shows the same thing true for these pond snails. Although the writer did not perform any special tests on the cells found in fæces, as did Rathay ('98), yet the appearance of the *Pleurococcus* and desmids in those masses was so nearly normal that there is very little doubt that there was any change.

Other Effects of Water Plants.—Warren ('00) discovered that *Daphnia* in a vessel filled with *Vallisneria* became less and less productive. If, however, the bulk of the water plant was removed, the crustaceans soon regained their normal number. As green light was found to be unfavorable to the fertility of *Daphnia*, Warren concluded that the mass of green plant caused the light to be green and the *Daphnia* infertile in consequence.

It can be imagined from what has been said that the effect of water plant on the physiological processes of organisms is not simple and it is not easy at once to discover just how it acts.

2. *Aeration.*—This section should be treated under the head of the composition of the water, but as Semper, De Varigny, Willem and Walter have each considered it separately, it was thought best to follow them and make it an independent topic.

On *a priori* grounds Semper ('79) and De Varigny ('94) both decided that the only means of respiration in *Lymnæa* was by the specially differentiated so-called lung; therefore these mollusks must come to the surface for air. However, the observations of v. Siebold[6] ('59), Pauly[6] ('77), Forel ('69, '74, '04), Andre[6] ('01), Walker ('00) and the experiments of Willem ('96) show that the respiration of the animal is in a large part carried on by the outer surface of the body.

De Varigny's Experiment.—De Varigny noticed that dishes with the largest area contained the largest snails. This at once suggested aeration. To determine whether this was the true explanation, he half immersed a small glass cylinder with the bottom covered with muslin in a large vessel of water. To insure the mixture of the water in both vessels, he lifted the small vessel out of the large one daily and allowed it to empty and fill, when he replaced it again. In each vessel he introduced a snail of equal size and age; and at the end of the experiment the one that had a large place in which to roam was the larger. As the water in both compartments was in communication, the amount of oxygen in both vessels must be identical. Therefore, the snail having the greatest area to roam about, on his exercise theory, became the larger.

Willem's Experiment.—Semper ('79) found that to carry air bubbles through a vessel containing young snails created such a disturbance that the small snails were washed from their substratum. Willem ('96) devised an apparatus for conducting air bubbles through a liquid without disturbing the water. It consisted of a glass tube (fig. 2) (*a*) immersed in the jar to be experimented on. Below the surface was blown a hole (*o*). Tube (*c*), turned upon the end, conducted bubbles of air into tube (*a*). The bubbles escaped into the water and travelled up tube (*a*), the water carried up by the bubble escaping by the hole (*o*), and the air bubble continued up the tube and escaped.

Willem repeated the experiment of De Varigny, but introduced his aerating apparatus into the small jar (fig. 3). The water, kept constantly interchanging in the large and small vessel, caused the snails to be of equal size.

Vernon ('03) explained the results of this experiment not by lack of aeration, but by the increase of excretory products which did not pass freely through the muslin.

Surface Aeration.—The experiments undertaken by the writer are considered under two heads—surface aeration and artificial aeration. The effect of surface aeration was determined by the use of flat dishes and a battery jar for control. To make the inside area of the jar equal to the inside area of the dish, so as to have equal areas inside the jar

[6] Cited from Walter ('06).

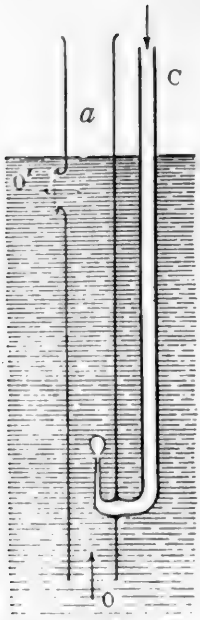


Fig. 2. (After Willem.)

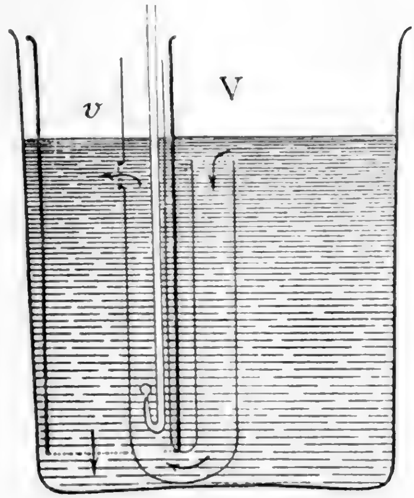


Fig. 3. (After Willem.)

for algæ to grow upon and for the snail to "exercise" upon, a structure of microscopic slides of calculated area was introduced. Table V gives the results of these experiments. These results are seen to have little

Table V—Flat Dish and Jar Area Increased by Slides.

Ex.	Days.	No. Beg.	No. End.	Variable.	Constant.	Av. Size.	Dif.	Per cent.
29A	48	6	6	Large sur. area.	N. 500 cc.	2.2	—	—
B		6	5	Small sur. area.		3.2	1.0	30%
30A	48	6	6	Large sur. area.	W. P. 500 cc.	1.3	—	—
B		6	6	Small sur. area.		3.9	1.6	40%
31A	28	2	2	Large sur. area.	W. P. 500 cc.	4.6	.1	2%
B		2	1	Small sur. area.		4.5	—	—
32A	28	2	2	Large sur. area.	W. P. 500 cc.	3.6	—	—
B		2	2	Small sur. area.		5.	1.4	28%
94A	58	2	2	Large sur. area.	N. 500 cc.	5.7	1.0	18%
B		2	2	Small sur. area.		4.7	—	—
95A	58	2	2	Large sur. area.	N. 500 cc.	6.5	2.1	32%
B		2	2	Small sur. area.		4.4	—	—
96A	51	3	3	Large sur. area.	N. 500 cc.	4.2	—	—
B		3	3	Small sur. area.		4.5	.3	6%
97A	35	2	1	Large sur. area.	N. 500 cc.	7.2	3.0	41%
B		2	2	Small sur. area.		4.2	—	—

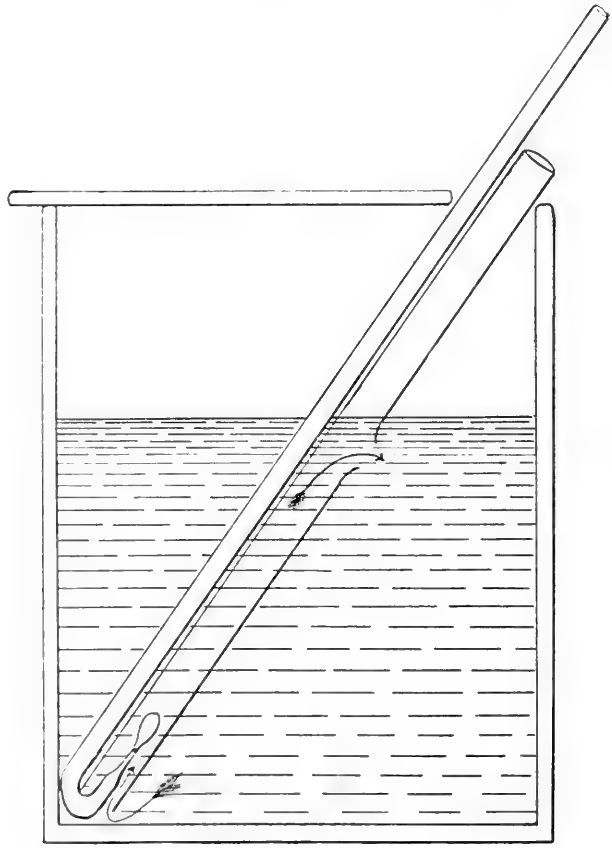


Fig. 4.

significance. In some, however, no slides were used (Table VI). Out of seven experiments but one difference was significant, and that one indicated that the larger surface was beneficial.

However, these experiments seem to indicate that the effect of surface aeration is not very striking, yet increased aeration by the surface of the water no doubt is of slight advantage to the growth of the snail.

Artificial Aeration.—In a number of experiments streams of air bubbles were conducted through jars of water. The apparatus used was a modification of that of Willem ('96) (see fig. 4). In Experiments 37–43 (Table VII) the air was passed through night and day, in the remaining experiments for but eight hours a day. The results confirm Willem's conclusion that cuticular respiration is a large factor in the growth of *Lymnæa*.

Table VI—Flat Dish and Battery Jar.

Ex.	Days.	No. Beg.	No. End.	Variable.	Constant.	Av. Size.	Dif.	Per cent.
33A	28	2	2	Large sur. area.	W. P. 500 cc.	4.6	.2	4%
B		2	2	Small sur. area.		4.4	—	—
34A	28	2	2	Large sur. area.	W. P. 500 cc.	3.6	—	—
B		2	1	Small sur. area.		4.1	.5	12%
98A	58	2	2	Large sur. area.	N. 500 cc.	5.7	1.2	21%
B		2	2	Small sur. area.		4.5	—	—
99A	58	2	2	Large sur. area.	N. 500 cc.	6.5	—	—
B		2	1	Small sur. area.		8.0	1.5	18%
100A	54	4	4	Large sur. area.	N. 500 cc.	3.9	—	—
B		4	3	Small sur. area.		4.2	.3	7%
101A	51	3	3	Large sur. area.	N. 500 cc.	4.2	.2	4%
B		3	3	Small sur. area.		4.0	—	—
102A	35	2	1	Large sur. area.	N. 500 cc.	7.2	2.5	34%
B		2	2	Small sur. area.		4.7	—	—

Table VII—Artificial Aeration.

Ex.	Days.	No. Beg.	No. End.	Variable.	Constant.	Av. Size.	Dif.	Per cent.
37A	27	1	1	Air bubbles.	N. 500 cc.	3.8	1.0	26%
B		1	1	None.	"	2.8	—	—
38A	42	1	1	Air bubbles.	W. P. 500 cc.	8.8	2.4	27%
B		1	1	None.	"	6.4	—	—
39A	42	1	1	Air bubbles.	W. P. 500 cc.	8.2	.2	2%
B		1	1	None.	"	8.0	—	—
40A	42	1	1	Air bubbles.	N. 500 cc.	7.0	2.5	36%
B		1	1	None.	"	4.5	—	—
41A	52	1	1	Air bubbles.	W. P. 750 cc.	6.2	2.2	36%
B		1	1	None.	"	4.	—	—
42A	52		15	Air bubbles.	W. P. 750 cc.	2.	—	—
B			14	None.	"	2.8	.8	29%
134A	26	4	4	Air bubbles.	W. P. 500 cc.	4.9	—	—
B		4	4	None.	"	5.9	1.0	17%
135A	26	4	3	Air bubbles.	W. P. 500 cc.	3.1	.2	6%
B		4	2	None.	"	2.9	—	—
197A		4	4	Air bubbles.	W. P. 500 cc.	5.8	—	—
B		4	4	None.	"	7.0	1.2	17%
198A		4	4	Air bubbles.	W. P. 500 cc.	6.8	3.	44%
B		4	4	None.	"	3.8	—	—

Walter's ('06) experiments show that *Lymnæa* will live in boiled water, but come to the surface more often. If imprisoned below the surface of aerated water they die.

In consideration of the above the writer believes the following statement of Willem not altogether supported by the facts. Willem ('96) writes, p. 567: "Ces expériences, ..., prouvent que chez les Basommatophores la respiration cutanée est plus importante que la respiration pulmonaire et qu'à elle seule, elle peut suffire à la vie de ces animaux."

3. *The Composition of the Water.*—The present study considers those conditions alone in which the composition of the water might affect the growth of pond snails under natural conditions.

Effect of Accumulation of Excreted Matter.—De Varigny ('94) grew snails in water in which a snail had been living for months, with the result that the snails were dwarfed. Vernon ('95) performed similar experiments with Echinoderm larvæ with the same result. The writer has conducted experiments of this sort on *Lymnæa.* Table IX expresses the results of eight experiments. These results are as follows: (1) That weak solutions of the waste products of metabolism are of benefit to the snail. (2) That concentrated solutions are harmful. (3) In Experiments 136 and 199 the water was aerated so the factor of the aeration of the water would be constant. In Experiment 143 the water was boiled, yet in these two cases the results were similar. Later the experiments of Table X were repeated with different dilutions of urea with similar results. As these were similar to those found by Vernon ('95), who used also uric acid on Echinoderm larvæ, it was not thought necessary to continue the experiments further.

Analyses of the water. A year before Vernon's ('99) paper was called to the attention of the writer, a series of analyses were made of the water in a number of jars. Although not nearly so extensive as those of Vernon, yet the results were nearly parallel.

By the methods of water analysis (Clowes and Coleman, '03), the water in the jars of several experiments was analyzed for chlorides, nitrates and particularly for free and for albuminoid ammonia. The free ammonia consists largely of the inorganic salts of ammonia. Albuminoid ammonia on the other hand is made up of organic compounds from which the ammonia radicle is not detached by boiling with sodium carbonate.

Experiments 200 and 201, Table VIII, were conducted in the following manner: Six jars with 500 cc. of water, which was analyzed before the experiment, were taken. Two were used without water plant or snail as control. The other jars contained snails and water plant as follows: one without water plant but with one full-grown snail, one without water plant but with five snails, one with water

TABLE VIII.

Experiment 200.

Analysis for	Water beginning of experiment. Grams in 1000 cc.	Water at end of experiment. Grams in 1000 cc.	Water at end of experiment. Grams in 1000 cc. 1 snail.	Water at end of experiment. Grams in 1000 cc. 5 snails.
Free NH_3...	.0003	.0012	.0120	.0300
Alb. NH_3...	.0020	.0010	.0012	.0080
Calcium.....	.0100	.0090	.0090	.0100
Chloride	.0080	.0018	.0018	.0020

Experiment 201.

Analysis for	Water beginning of experiment. Grams in 1000 cc.	Water at end of experiment. Grams in 1000 cc.	Water at end of experiment. Grams in 1000 cc. Myriophyllum.	Water at end of experiment. Grams in 1000 cc. Myriophyllum. 2 snails.
Free NH_3...	.0008	.0012	.00025	No trace.
Alb. NH_3...	.0020	.0010	.00018	.0080
Calcium.....	.0100	.0080	.01000	.0100
Chloride	.0080	.0016	.00160	.0020

Experiment 202.

Size of Snail.	Free NH_3. Grms. per 1000 cc.	Alb. NH_3. Grms. per 1000 cc.
Control, no snail present.	.025	.018
2.8 mm.	.015	.025
10 mm.	.075	.030
11.5 mm.	.075	.025
15.5 mm.	.155	.030

plant and no snail, and one with water plant together with two snails. After ten days the water was analyzed. The following facts seem to be illustrated by these experiments: (1) Calcium and chlorides in the water do not seem to be affected by the excretions of the snail. (2) In the jar that contained no snails yet contained *Myriophyllum* nearly all the free ammonia was taken up by the water plant. This is a phenomenon well known to botanists (Sachs, '75; Bessy, '92). Vernon ('99) found that the presence of *Ulva* decreased the free ammonia, but increased the albuminoid ammonia.

TABLE IX—EFFECT OF EXCRETIONS.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Av. Size.	Dif.	Per cent.
				Tap. water. Old water.				
142A	40	1	1	300 cc.	N. 100 cc. pond w.	1.8	—	—
B		1	1	200 cc. + 100 cc.		2.7	—	—
C		1	1	100 cc. + 200 cc.		2.4	—	—
D		1	1	300 cc.		1.5	—	—
				Boiled pond wat. Boiled old wat.				
143A		9	6	500 cc. + 0 cc.	+ 100 cc. pond w.	2.6	—	—
B		9	8	450 cc. + 50 cc.	"	3.4	—	—
C		9	9	400 cc. + 100 cc.	"	3.1	—	—
D		9	7	200 cc. + 300 cc.	"	3.3	—	—
E		9	9	0 + 500 cc.	"	3.3	—	—
144A	44	4	3	Dilute old water.	300 cc.	3.4	1.3	40%
B		4	3	Control.	300 cc.	2.1	—	—
145A	44	4	2	Dilute old water.	300 cc.	3.6	1.6	44%
B		4	2	Control.	300cc.	2.0	—	—
146A	26	4	2	Old water.	500 cc.	2.9	—	—
B		4	4	Control.	500 cc.	5.9	3.0	50%
200A		4	4	Old water.	500 cc. W. P.	3.8	—	—
B		4	4	Control.	500 cc.	7.0	3.2	46%
136A	26	4	3	Old water.	W. P. 500 cc.	3.1	—	—
B		4	4	Control.	Aerated.	4.9	1.8	36%
199A	26	4	4	Dilute old water.	W. P. 500 cc.	6.8	1.0	14%
B		4	4	Control.	Aerated.	5.8	—	—

TABLE X—EFFECT OF UREA.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Av. size.
137A	22	1	D	No. urea.	500 cc.	Dead.
B		1	1	$\frac{1}{5000}$ N. urea.	"	2.0
C		1	1	$\frac{1}{2500}$ N. urea.	"	2.6
D		1	1	$\frac{1}{1000}$ N. urea.	"	2.5
E		1	1	$\frac{1}{500}$ N. urea.	"	2.8
F		1	D	$\frac{1}{250}$ N. urea.	"	Dead.
138A	27	1	1	$\frac{1}{100}$ N. urea.	500 cc.	2.8
B		1	1	Control.		3.5
139A	27	1	1	$\frac{1}{10}$ N. urea.	500 cc.	3.8
B		1	1	Control.		5.0
140A	37	4	3	Control.	500 cc.	1.7
B		4	4	$\frac{1}{1000}$ N. urea.	"	1.9
C		4	3	$\frac{1}{500}$ N. urea.	"	1.5
D		4	0	$\frac{1}{100}$ N. urea.	"	Dead.

TABLE XI—EFFECT OF NUMBERS.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Av. Size.	Dif.	Per cent.
60A	52	1	1	The number.	W. P.	4.	1.2	30%
B		17	15	"		2.8	—	—
61A	52	1	1	The number.	W. P.	3.2	.5	16%
B		17	5	"		2.7	—	—
62A	52	1	1	The number.	W. P.	6.2	4.2	70%
B		17	14	"		2.	—	—
203A		40	32	1 in a jar.	W. P. 500 cc.	7.9	—	—
B		40	26	2 in a jar.	"	7.2	—	—
C		40	38	3 in a jar.	"	6.1	—	—
D		40	16	4 in a jar.	"	5.2	—	—
E		20	14	20 in a jar.	"	3.2	—	—
F		20	17	20 in a jar.	"	2.7	—	—

Experiment 202 shows but one fact, *i.e.*, that the amount of excretion is roughly proportional to the size of the snail.

TABLE XII—EFFECT OF SHELL SALTS.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Av. size.
55A	48	6	7	Control.	W. P. 500 cc.	3.3
B		6	5	Powdered $CaCO_3$.		3.9
C		6	5	Powdered $CaSO_4$.		4.2
D		6	5	Powdered $Ca_3(PO_4)_2$.		3.0
56A	86	7	5	Control.		6.0
B		7	5	$CaCO_3$.		5.7
C		7	6	$CaSO_4$.		6.8
D		7	7	$Ca_3(PO_4)_2$.		6.5
201A	43	4	4	Control.	N. clean jar.	1.9
B		4	3	Sediment.		1.8
C		4	4	$CaSO_4$.		2.0
D		4	2	$CaCO_3$.		1.6
202A	43	4	4	Control.	N. clean jar.	1.3
B		4	4	Sediment.		2.3
C		4	4	$CaCO_4$.		2.2
D		4	4	$CaCO_3$.		2.
203A	38	4	4	Control.	N. Started	1.9
B		4	4	Sediment.	with 3 weeks	2.1
C		4	4	Crushed shells.	growth of algæ.	3.4
204A	38	4	2	Control.	W. P.	3.9
B		4	4	Sediment.		5.9
C		4	3	Crushed shells.		8.0

Effect of Shell Salts.—If it were possible to measure some other physiological process of the snail than growth, another method might be instituted to attack the study of the effect of environment. As it is possible to measure the activity of a certain tissue in the pond snail by the amount of its secretions, a series of experiments were conducted. The tissue referred to is the mantle which secretes the shell. With this in mind a few experiments with calcium carbonate, calcium sulphate, and calcium phosphate. Snails that had been raised in saturated solutions of these salts, which are but slightly soluble in water, were measured; the results are expressed in Table XII. The salts were supplied as the pure chemical or as ground-up *Lymnæa* shell. The results show that calcium sulphate is most beneficial and that the presence of shell salts are favorable to snail growth. Experiments 55–56 did not consider that the sediment of the ground mineral might introduce another factor. Experiments 201–204 consider this factor. The fact that each chemical seems to favor a separate flora introduces another factor which makes these experiments most unsatisfactory.

Number of Individuals.—Semper ('74) and De Varigny ('94) both reported that in two similar jars, one containing one snail and one containing many, the single one grew the larger in every case. This fact was one of Semper's strongest arguments in favor of the presence of an unknown chemical. De Varigny could not explain this result on his exercise theory, so he advanced a psychological theory based on the fact that two snails might annoy each other. He writes: "Mais que peut être cette influence morale dans le monde des Lymnées? Le problème est embarrassant, et je n'ose décide si la présence de deux Lymnées gêne ou ne gêne pas le pérégrinations de la troisième, etc." (p. 187).

The result of the experiments reported in Table VI of the present work confirm the results of the authors who have investigated this factor. Discarding both Semper's and De Varigny's explanation, we must turn to a consideration of those of the later authors. Willem ('96) explained the result as due to aeration, but it seems rather that Vernon's ('03) explanation is more nearly true. Vernon considers that the toxic influence of accumulations of the waste products of metabolism is the cause of the dwarfing, yet increased aeration will insure more rapid oxidation of those waste products and so remove their harmfulness.

From what has been said it will be seen that the chemical composition of the water is a very important factor in the rate of growth of *Lymnæa*. The composition of the water may exert a toxic or a beneficial effect on the growing snail. This has been explained in the case of effect of numbers in various ways, but most reasonably by lack of aeration and of composition of the water. It is probable that those two factors work together.

4. *Temperature.*—Semper ('79) reported that snails chilled were retarded in growth and that growth ceased at 13° C. Walter ('06) found that they became more active in warm water than in cold water. The experiments of Walter ('06) were repeated in the following way: Four large snails 9 mm. and four small snails 1.5 mm. were placed in a glass dish with about 20 cc. of water. Under the dish a piece of cross-section paper was laid, and on another piece of cross-section paper the position of each snail was plotted every five minutes for a period of three hours.

For the first hour the dish was in a cold room and the temperature fell from 12½° to 6½° C. The dish was then packed around with ice for half an hour until the temperature fell from 6½° to 3½° C. The dish was then placed in a warm room for one hour, the temperature rising from 3½° to 17° C. For the next twenty minutes it was placed near a radiator, and the last ten minutes the dish was placed above the radiator, the temperature rising from 17° to 26° C. Fig. 5 shows how the snails were affected. tt represents the temperature curve; the heavy black line the distance in millimeters that the small snails travelled in periods of five minutes; the dotted line indicates the same thing for the large snails.

TABLE XIII.

Temperature.	Speed.		Remarks.
	Large Snails.	Small Snails	
12½°– 8½°	Increase.	Increase.	In cold room.
8½°– 6½°	Decrease.	Decrease.	" " "
6½°– 3½°	Increase.	Constant.	Packed with snow.
3½°–10°	Decrease.	Sl. decrease.	In warm rooms.
10° –17°	Increase.	Increase.	" " "
17° –22°	"	"	Near radiator.
22° –23°	Decrease.	Decrease.	" "
23° –25°	Increase.	Increase.	On radiator.

The average speed for the small snails closely follows that for the large ones. The table shows several things: (1) that cold applied rather suddenly stimulates the snail to become active so as to escape from the cold. The same reaction is noticed when heat above the optimum is applied. (2) When the water continued cold the activities decreased.

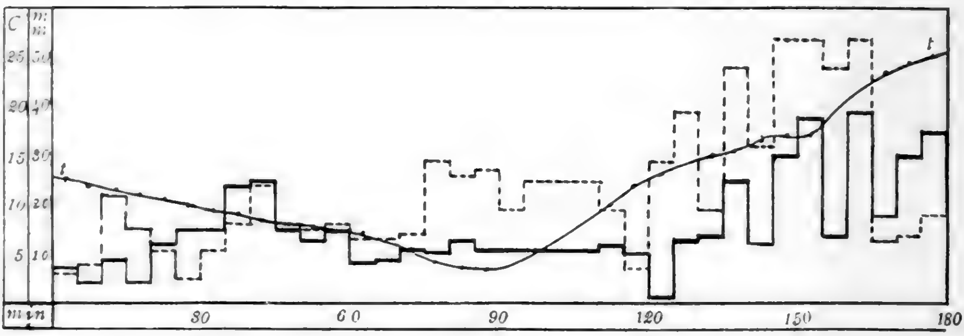


FIG. 5.—Temperature and velocity curve of large and small Lymnæa. [Line t t represents temperature in centigrade during three hours. Dotted line represents distance traveled in m.m. in five-minute intervals by the large snails. The solid line shows the same thing for the small ones.]

The experiments on growth conducted by Semper did not take into account the effect of cold on the water plant. To eliminate this factor the writer alternated the jars with the water plant from the warm to the cold at stated intervals, but transferred the snails from one jar to the other, so that certain snails remained in the warm and certain snails remained in the cold all the time, yet the jars that contained them were the same, and therefore the amount and condition of the food was similar.

The manner that cold acts on the growth of *Lymnæa* may be twofold. Cold, as is so well known, retards the rate of chemical combinations and so retards physiological processes. As growth is a physiological process it is retarded, and as the activities of the animal are physiological processes they are also retarded. Growth depends largely on the presence of food, yet the food of *Lymnæa* is acquired only through constant motion, so it might easily become dwarfed, with abundance of food about it, if conditions should make the snail sluggish. In *Lymnæa* we have seen that both these factors may be at work, reduced physiological processes acting directly on growth, or reduced activities may actually cause dwarfing by lack of food.

TABLE XIV—EFFECT OF HEAT AND COLD.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Size.	Dif.	Per cent.
26A	52	4	4	Warm.	N. 500 cc.	.0055	.0047	49%
B		4	2	Cold.		.0008	—	—
27A	52	4	3	Warm.	W. P. 500 cc.	.0035	.0030	45%
B		4	2	Cold.		.0005	—	—
28A	61	10	8	Warm.	W. P. 500 cc.	.0079	—	—
B		10	10	Cold.		.0080	.0001	0%
91A	52	2	2	Warm.	N. 500 cc.	4.5	2.9	64%
B		2	2	Refrigerator.		1.6	—	—
92A	52	2	2	Warm.	N. 500 cc.	5.6	3.9	70%
B		2	2	Refrigerator.		1.7	—	—
93A	45	1	1	Warm.	N. 500 cc.	8.2	6.0	73%
B		1	1	Refrigerator.		2.2	—	—
147A	48	2	2	Warm.	N. 500 cc.	6.5	3.5	54%
B		2	2	Cold.		3.0	—	—
148A	48	2	2	Warm.	N. 500 cc.	5.2	2.6	50%
B		2	2	Cold.		2.6	—	—
205A	42	3	2	Warm.	W. P. 750 cc.	4.8	1.2	25%
B		3	2	Cold.		3.6	—	—
206A	42	4	4	Warm.	W. P. 750 cc.	7.2	4.9	68%
B		4	3	Cold.		2.3	—	—
207A	44	5	4	Warm.	W. P. 750 cc.	7.6	4.6	60%
B		5	3	Cold.		3.0	—	—
208A	44	5	4	Warm.	W. P. 750 cc.	8.0	5.4	67%
B		5	3	Cold.		2.6	—	—

5. *Light.*—Beginning with Higgenbottom ('50), various writers have conducted experiments on the effect of light on the growth of animals. The work of these authors, including Yung ('78, '80 and '92), Vernon ('95), Warren ('00) and Beclard ('58), deals largely with the effect of colored light on the development of different animals. The present work considers the effect of light and darkness alone. Although experiments were attempted with colored lights, yet the many difficulties in the shape of uncontrollable factors made the results so unreliable that space will not be taken in discussing them. Even in the experiments on light and darkness the factor of food was with difficulty controlled. It was only by resorting to similar means as in the experiments on temperature that this factor was controlled at all. However, this did not remove all the uncontrolled factors present. There was also the chance of there being a different temperature of the water between the two jars; this difference at times amounting to 2° C.

Although the experiments of Walter ('06) and some of the writers seem to indicate that *Lymnæa* is slightly negatively phototactic, yet darkness is prejudicial to growth (Table XV).

TABLE XV—EFFECT OF LIGHT AND DARK.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Size.	Dif.	Per cent.
57A	54	6	4	Light.	N. 500 cc.	4.9	3.2	65%
B		6	4	Dark.	"	1.7	—	—
58A	54	6	5	Light.	W. P. 500 cc.	3.0	1.8	60%
B		6	4	Dark.	"	1.2	—	—
59A	42	5	5	Light.	W. P. 500 cc.	8.5	2.1	25%
B		5	5	Dark.	"	6.4	—	—
103A	47	4	3	Light.	N. 750 cc.	3.0	1.8	60%
B		4	1	Dark.	"	1.2	—	—
104A	45	5	3	Light.	N. 750 cc.	2.5	1.0	40%
B		5	1	Dark.	"	1.5	—	—
105A	45	5	3	Light.	N. 750 cc.	2.5	.8	32%
B		5	5	Dark.	"	1.7	—	—

This factor of light is of less importance than the other external conditions affecting growth, and is one that the snail can directly control to some extent through its behavior, and is also one that can be easily regulated in the laboratory. It is almost impossible to devise experiments on the effect of light on animals whose food consists of green plants, and experiments so conducted can have little significance.

6. *Area.*—According to De Varigny's exercise theory, dwarfing of *Lymnæa* was caused by too little area for the snail to crawl upon. To test the truth of this hypothesis, structures of various shapes were constructed out of microscopic slides and introduced into one of two similar jars containing snails. As some of the structures were cemented with sealing wax, sealing wax was added to the other jar of the experiment, so that there was no difference between the jars, except the fact that one had a larger surface exposed on which the snail could crawl than did the other. The results (Table XVI) were contrary to what might have been expected from De Varigny's hypothesis. It can hardly be that the slides hindered the snails from wandering around; on the contrary the great area exposed would form a surface on which much more algæ would grow.

TABLE XVI.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Size.	Dif.	Per cent.
65A	28	1	1	Area = 125 sq. c.	N. 200 cc.	2.	—	—
B		1	1	Area = 40 sq. c.		4.3	2.3	53%
66A	28	1	1	Area = 125 sq. c.	N. 200 cc.	4.	—	—
B		1	1	Area = 40 sq. c.		6.	2.0	33%
67A	48	1	1	Area = 165 sq. c.	N. 400 cc.	9.	—	—
B		1	1	Area = 80 sq. c.		9.5	.5	5%
68A	48	1	1	Area = 165 sq. c.	N. 400 cc.	9.	—	—
B		1	1	Area = 80 sq. c.		9.5	.5	5%
69A	48	6	5	Area = 455 sq. c.	N. 500 cc.	3.2	—	—
B		6	6	Area = 285 sq. c.		4.3	1.1	25%
70A	48	6	6	Area = 455 sq. c.	W. P. 500 cc.	3.9	.2	5%
B		6	6	Area = 285 sq. c.		3.7	—	—
71A	28	2	1	Area = 455 sq. c.	W. P. 500 cc.	4.5	.1	2%
B		2	2	Area = 285 sq. c.		4.4	—	—
72A	28	2	2	Area = 455 sq. c.	W. P. 500 cc.	5.	.9	18%
B		2	1	Arta = 285 sq. c.		4.1	—	—
73A	69	7	7	Area = large.	N.	3.3	—	—
B		7	7	Area = small.		4.6	1.3	30%
74A	69	7	7	Area = large.	W. P.	2.8	—	—
B		7	6	Area = small.		4.1	1.3	31%
75A	29	2	1	Area = large.	W. P.	4.	—	—
B		2	1	Area = small.		4.7	.7	15%
106A	58	2	2	Area = 314 sq. c.	N. 500 cc.	4.7	.2	4%
B		2	2	Area = 42 sq. c.		4.5	—	—
107A	58	2	2	Area = 144 sq. c.	N. 500 cc.	4.4	—	—
B		2	1	Area = 42 sq. c.		8.	3.6	45%
108A	51	3	3	Area = 144 sq. c.	N. 500 cc.	4.5	.4	8%
B		3	3	Area = 42 sq. c.		4.1	—	—
109A	50	2	2	Area large.	N. 500 cc.	2.0	—	—
B		2	2	Area small.		4.6	2.6	56%
110A	50	3	3	Area large.	N. 500 cc.	2.8	—	—
B		3	1	Area small.		5.0	2.2	44%
111A	35	2	2	Area large.	N. 500 cc.	4.2	—	—
B		2	2	Area small.		4.7	.5	10%
112A	35	2	2	Area large.	N. 500 cc.	1.7	—	—
B		2	2	Area small.		2.9	1.2	41%

This experiment suggests some results reported by Dandino ('04) on the effect of toxic solutions on germinating peas and corn. In toxic solutions (dilute acids) the addition of quartz sand (washed in HCl and distilled water) was 32 times as toxic as that without the sand. The author explains this fact as the result of surface action. In the present work experiments with quartz sand and even with pebbles caused an increase in the rate of growth. This is an effect opposite to that found by Dandino, yet it throws very little light on the bad effects caused by the presence of microscopic slides.

As De Varigny used flat dishes in contrast to spherical flasks, his cases of dwarfing by rearing in a small area can be referred with very little doubt to lack of aeration.

7. *Volume.*—Before the preceding series of experiments were completed, so before the bad effect of the presence of microscopic slides was known in experiments with volume, the inside area of the two similar jars was made equal by a structure of slides of calculated area. The amount of water in the two jars was not the same, the smaller volume of water containing the structure of slides. Experiments without the structure were later tried, but all the experiments led to the same result (Table XVII): the snails in the smaller volume were the smaller.

Table XVII—Effect of Volume.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Size.	Dif.	Per cent.
76A	57	6	6	Volume small.	N.	3.2	—	—
B		6	6	Volume large.		4.3	1.1	28%
77A	57	6	5	Volume small.	W. P.	3.3	—	—
B		6	6	Volume large.		3.7	.4	17%
78A	53	1	1	Volume small.		5.0	—	—
B		1	1	Volume large.		6.5	1.5	23%
79A	42	1	1	Volume small.		5.2	—	—
B		1	1	Volume large.		7.0	1.8	26%
80A	42	1	1	Volume small.		6.0	—	—
B		1	1	Volume large.		6.0	—	—
81A	69	7	3	Volume small.	N.	2.8	—	—
B		7	4	Volume large.		3.5	.7	20%
82A	69	7	9	Volume small.	W. P.	3.4	—	—
B		7	3	Volume large.		5.5	2.1	38%
113A	58	2	2	220 cc.	N.	3.0	—	—
B		2	2	500 cc.		4.5	1.5	33%
114A	58	2	1	220 cc.	N.	3.8	—	—
B		2	1	500 cc.		8.0	4.2	52%
115A	51	3	3	220 cc.	N.	3.2	—	—
B		3	3	500 cc.		4.1	.9	22%
116A	50	3	3	220 cc.	N.	2.8	—	—
B		3	2	500 cc.		4.6	1.8	40%
117A	35	2	2	220 cc.		1.7	—	—
B		2	2	500 cc.		4.7	3.0	63%

Dandino, referred to above, found that in toxic solutions, *i.e.*, weak acids, the radicles of peas and corn grew longer in a small volume than in a larger volume. This could be explained by assuming that there is but a definite amount of toxin present to act on the seed. With the snail, however, the case is reversed. The toxin, which we have shown in the preceding sections to be present, is ever being increased in quantity by the secretions of the animal. In the case of the seedling the solution becomes weaker and weaker.

Pearl and Dunbar ('05) found that *Paramecium* in small vessels were dwarfed. This is due most likely to the accumulation of excreted matter. In fact almost every case of this kind among aquatic animals can be so explained.

8. *Alternation of Conditions.*—In connection with some of the experiments on heat and cold, a jar was moved from the warm to the cold, and *vice versa,* at two weekly intervals for a period of two months, with the very striking result that the alternated snails were larger at the end of that time than those kept in the warm all of the time. This result was accomplished notwithstanding the fact that, when in the cold, the water in the alternate jars was sometimes frozen. This experiment led to a series of experiments in the same line, and although many were as striking as the first, yet the larger snails were those, as a general rule, that had been in the warm room all the time. This control in the warm room was every two weeks transferred to a jar from the cold conditions, while at the same time the jar in which they had been living was placed in the cold and snails that had lived in the cold all the time added. This process of changing the snails was performed every two weeks or every week. The interval of alternation is given in the tables. See Tables VIII–XX. Not only were alternate conditions of heat and cold considered, but also alternating conditions of starving and feeding and light and dark. The latter experiments are not of particular interest, as the alternated snails are purely intermediate in size between those under favorable and those under unfavorable conditions. The starving and feeding experiments, however, closely approximated those of heat and cold. Some were larger and some were smaller than the control. These results must mean that the change from an unfavorable to a favorable condition causes the snail to grow faster than if it were continually in the favorable condition.

9. *Experiments on Tadpoles.*—As Yung ('85) performed some experiments on the effect of external conditions on tadpoles, arriving at the same conclusion as did Willem ('96), *i.e.*, that dwarfing was caused by lack of aeration, the writer, using the methods described in the preceding pages, repeated these experiments with tadpoles of *Rana* in the spring of 1907.

TABLE XVIII—ALTERNATE HEAT AND COLD.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Size.	Dif.	Per cent.
149A	52	4	1	Alt. 2 weeks.	N. 500 cc.	.0110	.0055	23%
B		4	4	Warm.		.0055	—	—
150A	52	4	4	Alt. 2 weeks.	W. P. 500 cc.	.0078	.0043	23%
B		4	3	Warm.		.0035	—	—
151A	61	10	10	Alt. 2 weeks.	W. P. 500 cc.	.0086	.0024	10%
B		10	7	Warm.		.0062	—	
152A	52	2	2	Alt. 1 week.	N. 500 cc.	4.4	—	—
B		2	2	Warm.		4.5	.1	.02%
153A	52	2	2	Alt. 1 week.	N. 500 cc.	4.9	—	—
B		2	2	Warm.		5.6	.7	12%
154A	45	1	1	Alt. 1 week.	N. 500 cc.	6.0	—	—
B		1	1	Warm.		8.5	2.5	29%
155A	42	8	5	Alt. 1 week.	W. P. 750 cc.	5.0	—	—
B		8	7	Warm.		5.9	.9	15%
156A	42	8	4	Alt. 2 weeks.	W. P. 750 cc.	5.6	—	—
B		8	4	Warm.		6.5	.9	14%
157A	42	9	8	Alt. 2 weeks.	W. P. 750 cc.	3.5	.4	11%
B		9	8	Warm.		3.1	—	—
158A	48	2	2	Alt. 1 week.	N. 500 cc.	3.0	—	—
B		2	2	Warm.		6.5	3.5	54%
159A	48	2	2	Alt. 1 week.	N. 500 cc.	3.1	—	—
B		2	2	Warm.		5.2	2.1	40%
209A	42	3	3	Alt. 1 week.	W. P. 750 cc.	10.2	5.8	57%
B		3	2	Warm.		4.4	—	—
210A	42	4	4	Alt. 2 weeks.	W. P. 750 cc.	6.3	—	—
B		4	4	Warm.		7.2	.9	12%
211A	44	5	5	Alt. 2 weeks.	W. P. 750 cc.	6.1	—	—
B		5	5	Alt. 2 weeks.		4.2	—	—
C		5	4	Heat.		7.6	2.5	34%
212A	44	5	5	Alt. 1 week.	W. P. 750 cc.	6.6	—	—
B		5	5	Alt 1 week.		6.7	—	—
C		5	4	Heat.		8.0	1.4	18%

TABLE XIX—ALTERNATE LIGHT AND DARK.

Ex.	Days.	No. beg.	No. end.	Variable.	Constant.	Size.	Dif.	Per cent.
182A	54	6	5	Alternate.	N. 500 cc.	1.7	—	—
B		6	4	Light.		4.9	3.2	65%
183A	54	6	5	Alternate.	W. P. 500 cc.	1.7	—	—
B		6	5	Light.		3.0	1.3	43%
184A	47	4	2	Alternate.	N. 750 cc.	1.4	—	—
B		4	3	Light.		3.0	1.6	53%
185A	45	5	2	Alternate.	N. 750 cc.	1.9	—	—
B		5	3	Light.		2.5	.6	24%
186A	45	5	5	Alternate.	N. 750 cc.	1.8	—	—
B		5	3	Light.		2.5	.7	28%

TABLE XX—ALTERNATE STARVING AND FEEDING.

Ex.	Days.	No beg.	No. end.	Variable.	Constant.	Size.	Dif.	Per cent.
160A	52	2	2	Alt. 1 week.	N. 500 cc.	4.7	.2	4%
B		2	2	Control.		4.5	—	—
161A	59	2	2	Alt. 1 week.	N. 500 cc.	5.8	.1	2%
B		2	2	Control.		5.7	—	—
187A	38	5	4	Alt. 2 weeks.	N. 500 cc.	2.6	—	—
B		5	4	Control.		3.3	.7	21%
188A	38	2	1	Alt. 2 weeks.	N. 500 cc.	3.8	—	—
B		2	1	Control.		4.0	.2	5%
189A	34	3	2	Alt 2 weeks.	N. 500 cc.	2.7	—	—
B		3	3	Control.		5.0	2.3	46%
190A	34	3	3	Alt. 2 weeks.	N. 500 cc.	2.8	—	—
B		3	3	Control.		4.3	1.5	35%
191A	31	4	3	Alt. 2 weeks.	W. P. 500 cc.	3.3	—	—
B		4	4	Control.		4.2	.9	21%
192A	31	4	4	Alt. 2 weeks.	W. P. 500 cc.	2.9	—	—
B		4	4	Control.		6.4	3.5	55%

The results—which may be classed as follows: effect of artificial aeration, of surface aeration, of volume, of number of individuals—were exactly the same as those found for *Lymnæa*.

VI. Effect of External Conditions on the Number of Eggs Laid.

To supplement the experiments on the effect of external conditions on growth, and to observe the effect of external conditions on some physiological process rather different from growth, the following series of experiments was arranged. When adult *Lymnæa* is brought into the warm laboratory in the late winter or early spring it lays an immense number of fertile eggs. This fact was made the basis of some experiments. Snails gathered at such a time were placed under various conditions and the number of eggs laid during a given time recorded. Conditions that one would not consider to have any effect whatever on fertility were quite effective in their results.

1. *Sediment.*—As we have seen on p. 424, the presence of sediment is beneficial to snail growth, yet the presence of sediment is also of advantage in increasing the fertility of the snail.

Four adult snails were isolated in four jars with a small amount of sediment, and four jars were similarly treated without the sediment. At the end of some days the eggs in each jar were counted. See Table XXI.

TABLE XXI.

Ex.	No begin.	No. end.	Variable.	No. of eggs laid.	
A..........	1	1	Sediment.	39	
B..........	1	1	"	48	
C..........	1	1	"	13	
D..........	1	1	"	62	
				——	162
E..........	1	1	None.	10	
F..........	1	1	"	15	
G..........	1	1	"	15	
H..........	1	1	"	18	
				——	58

The total of 162 in favor of the sediment is quite striking, against the total of 58 eggs without sediment, yet the small number of snails in the experiment must not be overlooked. As the writer did not have a chance to repeat this experiment its value is only suggestive.

2. *Number of Individuals.*—In each of seven jars with *Ceratophyllum* was placed a single snail. In seven other jars similarly arranged were placed two snails each. In ten days the seven snails in seven jars laid 1,149 eggs. The fourteen snails in seven jars laid 1,277 eggs.

The result of this experiment is similar to the growth experiment. In other words two snails in a jar together do not lay twice as many eggs as a single individual, but each snail lays only half as many eggs as when it is alone in the jar. Thus again is illustrated the bad effect of the presence of the waste products of metabolism in the water.

3. *Effect of Light.*—In each of twelve similar jars one snail was placed and *Ceratophyllum* was added to each jar. Six jars were placed

TABLE XXII.

In Light.			In Dark.		
Size of snail	No. of egg cases.	No. of eggs laid in 8 days.	Size of snail.	No. of egg capsules.	No. of eggs laid in 8 days.
	7	117		4	61
	6	173		8	114
	7	184		4	59
	5	190		2	56
	6	136		4	155
	—	——		—	——
	31	800		22	415

in diffused daylight and six in the dark. During the daytime the jar in the light had the temperature about two degrees higher than those in the dark. As the snails were of slightly different sizes, all the jars were placed in a row with the snails in series from the largest to the smallest. Every other jar was then put in the dark. The experiment ran 8 days. In the following table the number of egg capsules laid and the total number of eggs per individual is indicated. One snail died in the dark and one died in the light. Both are left out of account in the table.

It will be seen that those in the light laid nearly twice as many eggs as in the dark.

5. *Other Effects and Observations.*—Snails brought into the laboratory from the ponds lay at first a great number of eggs in a single egg case, and the masses laid subsequently contain fewer and fewer eggs. (See Table XXIII.) Placing two individuals together does not have an effect of revivifying the fertility of the snail, but has the opposite effect.

TABLE XXIII.

Experiment.	No. snails.	Days rm.	Egg Case.													
			1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
A	1	10	36	28	20	29	31	16	25	19						
B			83	38	16	25	33	9	1							
C			85	38	20											
D			43	39	15	5										
E			89	38	25	25	13	12	10	7	23					
F			48	34	28	26	16	17								
G			37	36	19	3	17									
A	1	11	40	16	12	8	5									
B			52	36	16	15	13	19	20	12	14	17	8			
C			40	16	8	4	3	6								
D			52	29	19	11	9									
E			29	27	19	18	13	9	5	5						
F			88	37	21	22	13	12	9	9	9	14	7	15	8	16
G			52	13	11	8	16	14	9	5	10					
H			35	19	15	9	12									

Table showing the number of eggs in successively laid egg cases after the snail is brought into a warm room from out of doors in the winter time.

The last eggs laid by these snails are sometimes quite abnormal. Sometimes the eggs are fused, sometimes there is a capsule or a number of small capsules without a single egg.

Some snails prefer to lay their eggs on the water plant, others always lay their eggs on the glass jar, while still others show no preference at all.

VII. Summary of the Conclusions.

1. The effect of *Myriophyllum* and of *Elodea* on the growth of *Lymnæa* is quite complex. That it is not a simple factor that is being dealt with is indicated by the inconstancy of the results of the experiments. Notwithstanding the fact that one factor has been isolated, yet it is probable that there are other factors besides. This determined factor is the presence or absence of sand in the so-called "gizzard." In the latter case plant tissue, although ingested cannot be assimilated, so that the snail is smaller because it actually lacks food. On the other hand it is possible that the products of plant metabolism may have a harmful effect on the growing snail.

2. The accumulations of fæcal matter of *Lymnæa*, instead of having the harmful effect on growth as described by De Varigny ('94), when washed and filtered, have a beneficial effect. These tangled masses of unassimilated food form a great harbor for algæ, and so increase the food supply of the snail.

3. The "original planting" of the aquarium, *i.e.*, algæ accidentally introduced with the water, causes great variation in the size of the snails.

4. Experiments on artificial aeration confirm the conclusions of Yung and Willem; yet experiments on surface aeration do not seem so clear.

5. Vernon reported that Echinoderm larvæ raised in solutions in which other larvæ had been raised were dwarfed. De Varigny found the same thing true for *Lymnæa*. Experiments on *Lymnæa columella* confirm the results of the two authors referred to. Weak solutions were found beneficial and concentrated solutions harmful. Experiments using urea gave the same result. Why dilute solutions of excreted matter and urea are beneficial and concentrated solutions are harmful may be explained in the following way. The presence of the excretions which contain plant food may cause more algæ, snail food, to grow; on the other hand the solutions are harmful to snail growth. In dilute solutions, however, the quantity of toxic substance may be so little harmful that an increase of food will overbalance the harmful effect. However, this explanation is not very satisfactory as the Echinoderm larva experimented on by Vernon had no mouth and so did not eat.

6. As Semper and De Varigny showed, the number of individuals in

a jar affect the rate of growth. The cause is probably due to increased secretions and perhaps to diminished aeration.

7. Calcium salts in the water seem on the whole beneficial to growth —calcium sulphate particularly so.

8. Growth of *Lymnæa* is inhibited by cold, as Semper reported. This factor may act in two ways—directly on the physiological processes of the animal and indirectly through the inability to procure food, the snail becoming too sluggish to search for it.

9. Area. The cause that De Varigny advanced to explain dwarfing was lack of exercise on the part of the snail. The greater the place to crawl, the greater the snail. However, when aeration was kept constant, which De Varigny failed to do, the results were not significant.

10. Volume. That the volume of the medium affects the growth of *Lymnæa* is certain. Willem explains the fact on the ground of aeration. The author accepts this view, but considers that the more concentrated excretions in smaller volumes must play an equal part.

11. Alternate Conditions. Snails under unfavorable conditions when placed under favorable ones grow faster than if they were continuously in favorable conditions. It would seem that the change from unfavorable to favorable conditions of life acts as a stimulant for growth. However, this does not always mean that it surpasses the control size. It rarely does that.

12. Not only does the environment affect growth, but it affects the number of eggs laid in a given time. This fact is very important, because it shows that the environment probably affects all the physiological processes and not one alone.

13. This study reveals the fact that confinement influences the growth of aquatic animals in three ways—through the amount of food, through the amount of oxygen and through the accumulations of the waste products of metabolism. The phenomenon is not a simple one and each factor plays its own part.

Literature Referred to.

Bessey, C. E. 1892. Botany, 7th edition.

Brockmeier, H. 1898. Süsswasserschnecken als Planktonfischer. Forch-Ber. Biol. Sta. Plon., Th. VI, p. 165.

Clowes, F., and Coleman, J. B. 1903. Quantitative Chemical Analysis, p. 323.

Cooke, A. H. 1895. Cambridge Natural History, Mollusks, pp. 94–95.

Cuvier. 1817. Mémoire sur le Limnée et le Planorbe.

Dandino, J. B. 1904. Relation of Mass Action and Physical Affinity to Toxicity, with Incidental Discussions as to how far Electrolytic Dissociation may be Involved. Am. Jour. Sci., Vol. XVII, 4th series, p. 437.

Davenport, C. B. 1899. Experimental Morphology, Vol. II, pp. 173–178.

FOREL. 1874. Materiaux pour servir à l'étude de la faune profonde du lac Léman. Bull. Soc. Vaud. Sci. Nat., t. XII, p. 72.

———. 1904. La Léman, p. 103.

HYATT, A. 1880. Changes in the Shell of Lymnæa megasoma produced by Confinement. Am. Nat., Vol. XIV, p. 51.

HOGG, J. 1854. Observations on the Development and Growth of the Water Snail Lymnæus stagnalis. Quar. Jour. Mic. Sci., Vol. II, p. 91.

MOQUIN-TANDON. 1855. Histoire Naturelle des Mollusques terrestres et fluviatiles de France, Paris, t. I, p. 81.

PEARL, R., and DUNBAR, F. J. Some Results of a Study of Variation in Paramecium. Mich. Acad. of Sci., 7th Ann. Rep.

RATHAY, E. 1898. Ueber den Frass von Helix hortensis auf Baumrinden. Zeit f. Pfanzenkr., Bd. VIII, p. 129.

SACHS, J. 1875. A Text-book of Botany, Oxford, Eng. trans., p. 621.

SEMPER, C. 1874. Ueber die Wachsthums-Bedingungen des Lymnæus stagnalis. Arb. Zool.-Zoot. Inst., Wurzburg, Bd. I, pp. 138–167.

———. 1879. Animal Life. International Scientific Series, pp. 160–167.

STERKI, V. 1895. Food of the Limnæidæ. Nautilus, Vol. V, p. 94.

DE VARIGNY, H. 1892. Experimental Evolution. Nature Series, pp. 79–88.

———. 1894. Recherches sur le nanisme expérimental. Contribution a l'étude de l'influence du milieu sur les organismes. Jour. Anat. et Phys., Paris, t. XXX, pp. 147–188.

———. 1895. Note sur le period de croissance chez Lymnæa stagnalis. Bull. Mus. Hist. Nat., Paris, t. I, pp. 131–132.

VERNON, H. M. 1895. Effects of Environment on the Development of Echinoderm Larvæ. Phil. Trans. Roy. Soc. London, Vol. CLXXXVI, pp. 577–632.

———. 1899. The Relations between Animal and Vegetable Life. Mitth. aus der Zool. Sta. zu Neapel, Bd. XIII, p. 334.

———. 1903. Variation in Animals and Plants. Int. Nat. Sci. Series.

WALTER, H. E. 1906. Behavior of the Pond Snail Lymnæus elodes. Cold Spring Harbor Monographs, VI.

WARREN. 1900. Changes in Environment of Daphnia. Quar. Jour. of Mic. Sci., Vol. XLIII, p. 212.

WHITFIELD. 1882. Description of Lymnæa megasoma Say, with an Account of Changes produced in the Offspring by Unfavorable Conditions of Life. Bull. Am. Mus. Nat. Hist., Vol I, p. 29.

WILLEM, V. 1896. Observations sur la respiration cutanée des Lymnées et son influence sur leur croissance. Bull. de l'Acad. Roy. des Sci. Brussels, t. XXXII, p. 566.

YUNG, E. 1878. Contributions à l'histoire de l'influence des milieux physiques sur les êtres vivants. Arch. Zool. Exper. et Gen., t. VII, pp. 251–282.

———. 1880. De l'influence des lumieres colorées sur le developpement des animaux. Mitth. a. d. Zool. Stat. zu Neapel, Bd. II, pp. 233–237.

———. 1885. De l'influence des variations du milieu physico-chemique sur le developpement des animaux. Arch. des Sci. Phys. et Nat., t. XIV, pp. 502–522.

———. 1888. Contributions à l'histoire physiologique de l'escargot (Helix pomatia). Mem. Cour., t. XLIX, p. 119.

———. 1892. Comp. Rend., CXV, pp. 620, 621, October 24.

THE DIRECTIVE INFLUENCE OF LIGHT ON THE GROWTH OF FOREST PLANTS.

BY JOHN W. HARSHBERGER, PH.D.

It is a well-known fact that light exercises a directive influence upon plants. This directive influence is called heliotropism, or phototropism. When a plant is grown in the window of a room, so that it is unequally illuminated, that is, more powerfully through the window, its leaves and even its stem are turned toward the incident rays of light. This is known as positive heliotropism. If the common English ivy, *Hedera helix,* be grown in pots by a north window, so as to emphasize better the difference in light intensities, in about four weeks it will be apparent that the growing sprouts are bending toward the inner part of the room, away from the stronger light. This reaction is negative heliotropism.

The growth of forest plants is largely a question of light relationship. Foresters recognize this fact and group trees into those intolerant of the shade and those that are tolerant. The herbaceous plants, likewise, are influenced by the light which filters through the crown of leaves above. The herbaceous spring flora of the forest requires more light than the relatively few plants which flower in the autumn require, when the trees are covered with foliage. These facts, although they can be proved experimentally, are not always demonstrable to the uninitiated. One of the best illustrations that the writer has seen is the directive influence of light upon the leaves, or fronds, of the hay-scented fern, *Dicksonia pilosiuscula* (= *Dennstædtia punctilobula*), which is widely distributed on open hillsides from New Brunswick and Ontario to Indiana and Minnesota, south to Alabama and Tennessee, ascending to 1680 m. in Virginia. The stipes of this fern are pale green and chaffless, covered with fine hairs, and the leaves (10 dm. long, 12–20 cm. wide) are ovate-lanceolate, acute or acuminate, frequently long attenuate, usually tri-pinnatifid, thin and delicate in the woods, tougher, more inrolled and more erect in the sun; rachis and under surface of blades glandular pubescent. The observations which the writer wishes to record on the directive influence of light upon the position of the fronds were made at Pocono Pines, Monroe County, Pennsylvania, where this fern is one of the most abundant species. As the photograph will show (Pl. XXIV), the upper surfaces of the leaves are turned toward the light, if the illumination is one-sided. If the illumination is from all sides of the fern clump, then there is no particular direction in which the leaf-blades face. The one-sided illumination is obtained when the ferns grow along the edge of the woods, composed in the Pocono region of white pines, white birches, black spruces, beeches and maples, which on account of their dense crown cut off much of the light from behind and above, so that such woods can be called appropriately dark woods. The photograph shows how all the leaves of a single patch are turned outward toward the open field adjoining the woods, in obedience to the directive influence of the light, so that the leaves stand, row after row, all facing in one direction.

The second and more striking example of the directive influence of light is illustrated by the hobble-hush, *Viburnum lantanoides* (= *V. alnifolium*), a shrub which ranges from New Brunswick to North Carolina, western New York and Michigan, but which does not occur in the woods near the City of Philadelphia. In the dark pine woods on the Pocono plateau this shrub is extremely abundant, and where the woods are the densest, not only are all of the branches and the leaves directed by the incident rays of light, but they show permanent structural changes which are induced by the directive light influence. It is known that light has a most notable influence in the determination of the external form of a large number of plants. The development of certain tissues or organs on one side of the axis of a shoot, and their suppression on other parts of the plant body, may be regulated experimentally by means of the character of the illumination. This development of tissues on one side of the axis is illustrated finely in the branches of adult forest-grown specimens of the hobble-bush. If we examine young shrubs of this plant, illustrated in Pl. XXV, fig. 7, we see that the branching system follows the method of a dichasium. The leaves in such young bushes stand perfectly horizontal, so as to receive the incident rays of light on the upper surface of the blade, and so as to present their profile to the observer standing in front of the plant. As fig. 6 shows, they arrange themselves, when viewed from above, in the pattern of a leaf mosaic, so that none of the leaves overshadow the others. Such plants merely show the directive influence of the light on the leaves, without showing any characteristic growth differences. The same influence of light is manifested in the stoloniferous branches which strike root, and which give the common names hobble-bush or trip-toe to the plant (fig. 8). These plagiotropous shoots are only formed in the shade. The diminished light can be better used by such branches, to which the moist soil offers at the same time an opportuntity to root. Such plagiotropous stolons with elongated internodes show, however, orthotropous branches, and we, therefore, have on the same shrub branches which react differently to the light, some that are stoloniferous and plagiotropic, others that are leaf-bearing and orthotropic. After a time, however, the bushes assume a different habit by a suppression of parts, so that the older stems show two horizontally directed branches (plagiotropic), which separate from the common stem in a dichotomous manner. Now if we examine figs. 1 and 2 of Pl. XXV, we see that all of the lateral spurs that are formed from such a plagiotropic branch are placed on the upper side (orthotropous), where their leaves receive to the best advantage the light which filters down through the leafy canopy above. Each segment of such a branch represents a sympodium, where there are a series of phytons placed one after the other in serial order. By this method of sympodial branching, each new branch with the suppression of a bud on the other side and torsion of the axis, terminates in a leafy extremity, and the elongation of the branch according to this arrangement depends on a lateral bud (fig. 3). In this case clearly, as all of the leaves are directed dorsiventrally by light relationship, the permanent branching system is determined largely by the influence which the light has had in producing a one-sided growth of the lateral dichotomous branches of the adult plants. The fruit stands vertically above the broad, cordate leaves, as shown in figs. 4 and 5. Attention might be directed in closing to the color change which takes place in the leaves with the approach of autumn. The leaves become bronzed to a greater or less extent. Sometimes the bronze is in the form of blotches. In other leaves one side is bronzed, the other side is green, and in many examples the whole leaf rapidly bronzes. What induces the bronzing of one side of the leaf first, while the other side remains of a bright green color? Is it a light reaction? The photograph in Pl. XXIV was taken by Mrs. Harshberger; the drawings reproduced in Pl. XXV were made from rough drawings and data furnished Mr. Louis Schmidt by the writer.

A COMPARISON OF THE LAND-SNAIL FAUNA OF KOREA WITH THE FAUNAS OF JAPAN AND CHINA.

BY HENRY A. PILSBRY.

The compilation of a list of Korean land mollusks gives occasion for a comparison of that fauna with the faunas of China and Japan. In the list of Korean land snails published by Dr. O. von Moellendorff in 1887,[1] some 26 species are catalogued; of this number, 7 are stated to be common to Japan, 3 to China, and 2 (omitting the doubtful *Helix ciliosa*) to both countries.

The fruitful researches conducted by Mr. Y. Hirase have increased the roll of known Korean forms to 58. This number is no doubt a mere fragment of the total fauna; yet it is enough to show the dominance of Japanese over Chinese forms in Korea. This preponderance can only be explained by the theory that the submergence of the straits between Kyushu and Korea is a geologically recent event. From the large proportion of Japanese species existing in Korea, this submergence may probably have taken place not earlier than the Pliocene.

Twenty-one Japanese species occur in Korea and Quelpart. Seven Chinese species occur in Korea and Quelpart. Four of these species are common to Japan and China. The great preponderance of characteristically Japanese over Chinese species is thus evident. Thirty-two species and subspecies, out of a total of fifty-eight, are peculiar to Korea including Quelpart.

So much for the numerical relations of the species. The faunas may also be compared qualitatively. All of the genera and subgenera of the Korean fauna occur in Japan. In the *Clausiliidæ* all the species of Quelpart and Korea belong to *Euphædusa*, a group of minor importance in Japan, but extending farther north on the Asiatic mainland than any other group of Clausiliæ. The genus *Ganesella*, well represented in Japan, seems to be absent in Korea, unless the species described as *Helix* (*Satsuma*) *gradata* proves to belong to *Ganesella*, which seems improbable. The absence of *Ganesella* and of *Clausiliidæ*, other than *Euphædusa*, are the most conspicuous discrepancies between

[1] *Jahrbucher d. Deutschen Malakozoologischen Gesellschaft*, XIV, 1887, pp. 9-22.

the faunæ of Quelpart and Tsushima. By the prevalence of *Hemiphædusa, Ganesella* and *Plectotropis*, Tsushima is wholly Japanese in its snail fauna, while Quelpart is as unequivocally Korean. The political boundaries of Japan and Korea coincide therefore with the faunal limits. The largely deforested condition of Quelpart and Korea is probably responsible for its rather poor land shell fauna.

In the following table, the "Korea" column is compiled from Dr. von Moellendorff's paper and the collections of Mr. Hirase, determined by the author. The column "Korean Archipelago" contains a few species reported with that indefinite locality by Pfeiffer and A. Adams. The "Quelpart" column contains species collected by Mr. Kuroda, part of them identified by the writer, the others quoted from Mr. Kuroda's list.[2] The "Matsushima" (Dagelet Island) species were recorded by Arthur Adams, who visited that island when surgeon on board H. M. S. "Actæon." In the column of "Remarks" sundry notes on the affinities of the species find place.

---

[2] *The Conchological Magazine*, II, June, 1908, pp. 25–29.

Species of Korea, including Quelpart and Matsushima.	China.	Korea.	Korean Archipelago.	Quelpart.	Matsushima.	Japan.	Remarks.
Cyclophorus herklotsi Marts.	—	—	—	*	—	*	
Spiropoma j. chejuense Pilsbry and Hirase	—	—	—	*	—	—	A subspecies of the Japanese *S. japonicum*.
Cyclotus campanulatus Marts.	—	*	—	*	—	*	
" *m. quelpartensis* P. and H.	—	—	—	*	—	—	A subspecies of *Cyclotus minutus* of Formosa.
Alycæus kurodai P. and H.	—	—	—	*	—	—	
" *cyclophoroides* P. and H.	—	*	—	—	—	—	
Diplommatina paxillus Gredl.	*	*	—	*	—	—	
" *p. ultima* P. and H.	—	*	—	—	—	*	Tsushima is the only Japanese locality.
Pupinella rufa Sow.	—	*	—	*	—	*	
Cyathopoma micron Pils.	—	—	—	*	—	*	
Omphalotropis japonica Pils	—	*	—	—	—	*	
Eulota sieboldiana Pfr.	—	*	—	*	—	*	
" *coreanica* A. and R.	—	—	*	—	—	—	
" *koreana* Pfr.	—	*	—	—	—	—	
" *purpurascens* Pfr.	—	*	—	—	—	—	
" *orientalis* A. and R.	—	—	—	*	—	*?	Close to the Chinese *E. cecillei*.
" *luhuana* Sow.	—	—	—	*	*	*	
" *tenuissima* P. and H.	—	*	—	—	—	—	
" *gottschei* Mlldff.	—	*	—	—	—	—	
" *chejuensis* P. and H.	—	—	—	*	—	—	Close to *E. mimula* of Japan.
" *proxima* P. and H.	—	*	—	—	—	—	
" *m. peninsularis* P. and H.	—	*	—	—	—	—	A subspecies of the Japanese *E. mimula*.
" *verrucosa* Reinh.	—	*	—	—	—	*	
" *pumilio* P. and H.	—	*	—	—	—	—	
" *lasia* P. and H.	—	*	—	—	—	—	
" *vulgivaga quelpartensis* P. and H.	—	—	—	*	—	—	
" *ciliosa*[3] Pfr.	*	—	*?	—	—	—	Evidently allied to the Japanese *E. horrida*.

[3] *Eulota* (*Plectotropis*) *ciliosa* was described from China, but has not been rediscovered there. A. Adams reported it from Port Hamilton, but his identifications are not wholly trustworthy.

Trishoplita dacostæ awajiensis P. and H.	—	*	—	*	—	*	
Ganesella? gradata Mlldff.	—	*	—	—	—	—	
Opeas javanicum Rve.	*	*	—	—	—	*	
" *c. kyotoense* Pils.	—	—	—	*	—	*	A form of the widely spread *Opeas clavulinum*.
" *heudei*(?) Pils.	*	*	—	*	—	—	Not positively identified in Korea.
Clausilia aculus coreana Mlldff.	—	*	—	—	—	—	A subspecies of the common Chinese *C. aculus*.
" *a. mokpoensis* P. and H.	—	*	—	—	—	—	Variety of the Chinese *C. aculus*.
" *fusaniana* P. and H.	—	*	—	*	—	—	
" *tau* Bttg.	*	*	—	—	—	*	
" *belcheri* Pfr.	—	—	*	—	—	—	
" *claviformis* Pfr.	—	—	*	—	—	—	
Ennea cava P. and H.	—	—	—	*	—	—	Close to the Japanese *E. iwakawa*.
Petalochlamys subrejecta P. and H.	—	*	—	—	—	*	Tsushima is the only Japanese locality.
" *quelpartensis* P. and H.	—	—	—	*	—	—	
Macrochlamys hypostilbe P. and H.	—	*	—	—	—	—	
Microcystina lampra P. and H.	—	—	—	*	—	*	Also the Loochoo Islands and Tsushima.
Kaliella crenulata Gude.	—	—	—	*	—	*	
" *obesiconus* P. and H.	—	*	—	—	—	—	
" *fusaniana* P. and H.	—	*	—	—	—	—	
" *coreana* P. and H.	—	*	—	—	—	—	
" *multivolvis* Pils.	—	—	—	*	—	*	
Pyramidula costulata A. Ad.	—	*	—	—	—	—	
" *elatior* A. Ad.	—	—	—	—	*	—	
Punctum a. conoideum Mlldff.	—	*	—	—	—	—	Subspecies of the Japanese *P. amblygona*.
Vallonia tenera Reinh.	*	*	—	—	—	*	
Ena coreana P. and H.	—	*	—	*	—	—	
Pupilla cryptodon Hde.	*	*	—	—	—	*	
Bifidaria armigerella Reinh.	*	*	—	—	—	*	
Vertigo japonica Pils.	—	*	—	*	—	*	
Strobilops hirasei Pils.	—	—	—	*	—	—	Related to the Chinese *S. diodontina*.
Carychium noduliferum Reinh.	—	—	—	*	—	*	

October 6.

Mr. Frank J. Keeley in the Chair.

Twelve persons present.

The Secretaries, Librarian and Curators reported on the work accomplished during the summer vacation.

The Publication Committee reported that papers under the following titles had been presented for publication since the last meeting:

"Description of Trachypterus seleniris, a New Species of Ribbon Fish from Monterey Bay, California," by John Otterbein Snyder (May 30).

"Some Polychætous Annelids from the Northern Pacific Coast of North America," by J. Percy Moore (June 16).

"An Orthopterological Reconnaissance of the Southwestern United States: Part II, Arizona," by James A. G. Rehn and Morgan Hebard (June 26).

"Notes on the Distribution of Colorado Mammals, with a Description of a New Species of Bat (Eptesicus pallidus)," by Robert T. Young (July 16).

"Some Effects of Environment on the Growth of Lymnæa columella Say," by Harold Sellers Colton (July 25).

"The Directive Influence of Light on the Growth of Forest Plants," by John W. Harshberger, Ph.D. (August 9).

"A Comparison of the Land-Snail Fauna of Korea with the Faunas of Japan and China," by Henry A. Pilsbry (September 5).

"The Composition and Ecological Relations of the Odonate Fauna of Mexico and Central America," by Philip P. Calvert (September 17).

The deaths of the following members were announced: Samuel G. Rosengarten, May 15, 1908; Stephen Greene, May 21, 1908; Benjamin Bullock, March 4, 1908; Elizabeth S. Bladen, August 19, 1908; Jacob F. Holt, August 3, 1908, and William G. Freedly, October 3, 1908.

In announcing the death of William S. Vaux, Jr., which occurred July 23, 1908, the Secretary remarked that it inflicted a loss of which the Academy is immediately conscious. He was born April 1, 1872, and continued the traditions of his family by manifesting an active interest in the work and well-being of the Academy. He contributed to the *Proceedings*, in conjunction with his brother, important reports on glacier movements in the Canadian Rockies. He served as Curator since January, 1905, and gave special attention, valuable because of his ability as an architect, to the plans for the alteration and extension of the premises made possible by the recent appropriation of $150,000 by the Legislature of Pennsylvania. His singularly engaging personality and amiable disposition endeared him to his associates, and the Academy deeply sympathizes with the loss his family has sustained in his untimely death.

The deaths of the following Correspondents were also announced: Spiridione Brusina, May 21, 1908, and Gustav Mayer, July 14, 1908.

OCTOBER 20.

ARTHUR ERWIN BROWN, Sc.D., Vice-President, in the Chair.

Eighteen persons present.

The Publication Committee reported the reception of a paper entitled "A Review of the Genus Piaya Lesson," by Witmer Stone (October 14).

Recent Additions to Our Knowledge of the Flora of Southern New Jersey.—MR. WITMER STONE based his remarks on the work of the Philadelphia Botanical Club, especially during the past few years.

Taking Dr. Britton's *Catalogue of the Flora of New Jersey*, published in 1889, he stated that twenty-six phænerogams and pteridophytes had been added by the Club since that date, exclusive of the numerous subdivisions that have been made of older species or closely allied species not recognized as distinct by Dr. Britton. Of the latter he had listed fifty-five not in Dr. Britton's Catalogue and doubtless there are others. Introduced or naturalized plants were not considered in either enumeration. The twenty-six species were as follows, the nomenclature following Britton's Manual:

Ophioglossum arenarium.—Originally discovered by Mrs. E. G. Britton, July 3, 1897, at Holly Beach, and later exterminated by a building operation. This species was rediscovered during the present year by Mr. Joseph Crawford at Longport, and by Mr. Bayard Long at Spray Beach.

Dryopteris simulata.—Discovered several years ago at Clementon by Mr. Stewardson Brown; later found at Sicklerville, Cedar Brook, Double Trouble, and Forked River.

Isoetes dodgei.—Collected at Fish House, on the Delaware, by Mr. W. A. Poyser.

Alisma tenellum.—Discovered in August, 1907, on the border of a pond a short distance above Delanco by Messrs. Brown, Van Pelt and Stone. In the same pond grew *Scirpus torreyi*, new to the State, and *Eleocharis robbinsii*, which had not before been found out of the pine barrens, while on the swampy margin occurred *Eleocharis melanocarpa*, a species not before detected by the Club. It was found to be rooting at the tips of the leaves like *E. rostellata*. The occurrence of so many new or rare species in one spot was remarkable.

Manisuris rugosa.—Discovered in southwestern Cape May County, by Mr. O. H. Brown, August, 1908.

Paspalum glabratum.—Found in September, 1891, at Cape May by several members of the Club; since discovered at Cold Spring.

Panicum condensum Nash.—Collected at Piermont, September 1, 1902, by the speaker, and by Mr. S. S. Van Pelt at Holly Beach; since found at Cold Spring (='*Brachiaria digitarioides*' Stone, *Torreya*, 1907, p. 39).

Chætochloa magna.—Collected near Cape May Point in August, 1891, by the speaker.

Saccolepis gibba.—Found on the shores of Lily Lake, Cape May Point, by Mr. C. S. Williamson, September, 1905.

Aristida lanosa.—Found at Medford, N. J., by Messrs. W. Stone and S. Brown, September 15, 1901.

Sporobolus longifolius.—Discovered September, 1908, at Cape May by Mr. O. H. Brown.

Gymnopogon brevifolius.—Found by Mr. C. D. Lippincott at Swedesboro, September 2, 1894, and later at Cape May, by Mr. O. H. Brown.

Agrostis coarctata.—Discovered by the late U. C. Smith at Anglesea, July 4, 1907.

Cyperus pseudovegetus.—Found by Mr. C. D. Lippincott at Riddleton, September 16, 1894, and still plentiful at the same spot.

Eleocharis interstincta.—Discovered by the late Dr. J. B. Brinton at Repaupo, July 15, 1892.

Eleocharis ochreata.—Found at Cape May Point, September, 1905, by Mr. S. S. Van Pelt.

Scirpus torreyi.—Detected by the speaker at Delanco as stated above.

Rynchospora oligantha.—Found at Speedwell, in the heart of the pine barrens, by Mr. S. S. Van Pelt, July, 1906.

Rynchospora rariflora.—Discovered by the speaker west of Bennett, Cape May County, August 4, 1907.

Juncus setaceus.—First collected by Mr. Joseph Crawford in Cape May County, July 15, 1892, and later found to be rather plentiful in that section.

Gymnandeniopsis nivea.—Found by Mr. Bayard Long near Bennett, Cape May County, July 24, 1907. It was later found to be plentiful over a limited area.

Quercus michauxi.—Found by Messrs. Stewardson Brown and Edward Harris at Moorestown, October, 1902.

Rumex hastatulus.—Discovered at Longport by Messrs. Joseph Crawford and Stewardson Brown, June 23, 1907.

Bradburya virginica.—Discovered by the late J. B. Brinton, M.D., at Holly Beach, July 24, 1892.

Boltonia asteroides.—Found by Mr. Long growing with *Gymnandeniopsis nivea*; known before from New Jersey only as an introduced species.

Senecio crawfordii.—Originally discovered at Tullytown, Pa., this species has recently been found at several points on the New Jersey side of the river.

Among rare species marked in Dr. Britton's Catalogue as not recently collected several have been rediscovered:

Triglochin maritima was found at Point Pleasant by Mr. Stewardson Brown, July 22, 1902.

Tofieldia racemosa, collected by Mr. C. F. Saunders between Atsion and Tuckerton on July 4, 1899, and later found in abundance at several places near Speedwell and at High Bridge by the speaker.

Lilæopsis lineata.—Perhaps the most interesting discovery of the present year was the finding by Mr. Van Pelt and the speaker of this obscure little plant about a mile below Palermo, where a fresh spring bubbles up out of the salt marsh, making a hard sandy bottom which was literally covered with *Lilæopsis.* The plant has been unknown from the State since its discovery by Thomas Nuttall, nearly one hundred years ago, "in a salt marsh near Egg Harbor." As the present spot is only a few miles from the shore of Egg Harbor it is quite possible that it is Nuttall's original locality

The following was ordered to be printed:

THE COMPOSITION AND ECOLOGICAL RELATIONS OF THE ODONATE FAUNA OF MEXICO AND CENTRAL AMERICA.

BY PHILIP P. CALVERT.

CONTENTS.

The preparation of an extended account[1] of the Odonata of Mexico and Central America has induced me to study the relations of these insects to various factors of their environment, with the results here set forth. The facts on which this study is based, in so far as the Odonata are concerned, are contained in the *Biologia* volume, to which reference must be made for further details. Since the completion of that work, I have received, through the kindness of Mr. H. T. Van Ostrand, specimens of *Enallagma prævarum*, *Oplonæschna armata* and *Sympetrum illotum virgulum,* taken at or near Real del Monte, Hidalgo, Mexico, which add to our knowledge of the distribution of these three species as given in the *Biologia.* The first and third are labelled as having been captured at 9,000 feet elevation, or the highest altitude yet recorded for Odonata in Mexico or Central America. These additional data are included in the following pages.

GENERAL CONDITIONS DETERMINING ODONATE DISTRIBUTION.

The actual distribution of the Odonata is determined by the conditions under which their aquatic larvæ are able to exist. The distribution of the larvæ, so far as the present region is concerned, is almost entirely unknown. Our present information refers to the appearance of the imagos in certain localities, and the summary herewith presented

[1] Odonata, by P. P. Calvert, forming pp. 17–420 and Introduction, pp. v–xxx of volume *Neuroptera* of the *Biologia Centrali Americana,* edited by F. D. Godman. London, 1901–1908. 4to. 9 plates, 1 map.

rests on the unproven assumption that the adults do not wander far from the waters in which they have passed their earlier stages or in which their offspring are capable of surviving. This assumption is one of the weaknesses in the following attempted generalizations; another is the real scantiness of our knowledge of the distribution of even the winged individuals. How scanty this is may be seen by a glance over the list of localities in Honduras, Nicaragua, etc., in Table A and in the columns for these countries in Table B of the Introduction to the *Biologia* volume quoted and a study of Tables 6–8 of the present paper.

It must be distinctly understood, therefore, that all which follows is subject to future correction in these two important particulars. In spite of these disadvantages, however, some generalization has been deliberately attempted, in the belief that by so doing progress in investigation will be hastened much more than if no such summary were ventured.

The Chief Odonatological Features of Mexico and Central America.

These are: the practical absence of the subfamily Cordulinæ,[2] some species of which have been recorded from corresponding latitudes in the Old World.

Absence of the following genera, conspicuous or well developed in other parts of America: (*a*) in Northern America,[3] *Ophiogomphus, Gomphus, Dromogomphus, Octogomphus, Celithemis, Leucorhinia*; (*b*) in South America, *Lais, Thore, Euthore, Microstigma, Telagrion, Leptagrion, Diastatops, Potamothemis*; (*c*) in the West Indies, *Scapanea*.

The small number of genera, seven out of seventy-one, which are restricted to this area. They are *Pseudostigma, Thaumatoneura, Paraphlebia, Hesperagrion, Anisagrion, Oplonæschna* and *Pseudoleon*. Three of these (*Hesperagrion, Oplonæschna, Pseudoleon*) embrace only one species each. *Oplonæschna* and *Pseudoleon* should be good fliers and, therefore, one would not expect their limited distribution.

The unity of the district, in that only one genus (*Hesperagrion*) is restricted to Mexico north of the Isthmus of Tehuantepec, none to the

[2] Already pointed out by Carpenter, *Scient. Proc. Roy. Dublin Soc.* (n. s.), VIII, p. 450 (1897).

[3] Throughout this memoir, as in the *Biologia* volume on Odonata, by "Northern America" is meant all north of central California, Arizona, New Mexico, Texas and (east of this last) of the 30th parallel of north latitude.

area between the latter and the Isthmus of Nicaragua and only one (*Thaumatoneura*) to the Costa Rican-Panaman section.

The predominant Calopterygine genus is *Hetærina* with 17 species out of 23 for the subfamily. Several species (*H. americana, tricolor, titia, macropus, capitalis*) show a marked tendency to reduction in size of the pterostigma in some of the western portions of their ranges, but the geographical areas in which this reduction is strongly marked for one species (*e.g., macropus* in Guatemala) are not necessarily those in which it is displayed by another (*e.g., americana*). *Amphipteryx* is interesting as presenting some features intermediate between those of this subfamily and the Agrioninæ. Only one Old World genus (*Calopteryx*) is represented and its existence here rests on a single specimen.

Lestinæ. Six of the 7 species belong to the cosmopolitan *Lestes.*

Agrioninæ. Of 24 genera, 3 only (*Argia, Enallagma, Ischnura*) have been recorded from the Old World. Five of the 7 endemic Odonate genera belong here. Of the 112 species, 48 belong to *Argia*; next follow *Protoneura* with 7 species and *Telebasis* with 6. Six species (of 3 genera) are of the exclusively Neotropical Pseudostigmatina, including some of the linearly largest known Odonata of the world.

Gomphinæ. None of the genera are extra-American. *Erpetogomphus* is the predominant genus of the subfamily in the northern part of our district, *Epigomphus* in the southern.

Cordulegasterinæ. The single genus of our area, *Cordulegaster*, is Holarctic.

Æshninæ. Three (*Anax, Æshna, Gynacantha*) of the six genera are also found in the Old World, but none of the species extends thither. One of the seven endemic genera belongs here (*Oplonæschna*). *Æshna* has the largest number of species.

Cordulinæ. The single record for this subfamily, from near the northern limit of our district, is of the Holarctic and Palæotropical *Macromia.*

Libellulinæ. Of 28 genera, one (*Pseudoleon*) is endemic, five (*Libellula, Tholymis, Tramea, Pantala, Sympetrum*) are regarded as also occurring in the Old World. The only Odonate species common to our area and to the Old World—*Pantala flavescens* (and *Sympetrum corruptum?*)—are of this subfamily. Predominant genera are *Libellula, Micrathyria, Orthemis, Erythrodiplax, Brechmorhoga, Tramea, Perithemis* and *Erythemis.*

Relations of the Mexican-Central American Odonate Fauna to those of other Areas.

The study of the species of Odonata found over large parts of Mexico has shown that, to the northward, many of them occupy also considerable portions of Texas, New Mexico, Arizona, and California (in the last named possibly to San Francisco), although their northern boundary line has not been determined in any of these States.[4] Therefore, all species, subspecies or varieties found in Mexico and Central America and which may extend also into these four States of the United States, but not beyond them, nor into the West Indies nor South America, have been considered as *endemic*. With this explanation, which applies to all the tables in this paper, the general relations of the Odonate fauna may be learned from an inspection of Table 1.

A further analysis of the relations of the fauna is given in Table 2, wherein, passing from north to south and, in Mexico, from plateau to lowlands, the decrease in the northern element and the increase in the southern element is clearly shown. Even on the Mexican plateau, excluding its highest portion,[5] as the most northern and most elevated section of the present faunal district, the southern element, measured by the number of the "exclusively South American" species, is almost as strong as the northern, represented by the "exclusively Northern American" species[6]—a striking fact when the narrow land connection with South America is contrasted with the very much wider union with the United States, and the geological history of the plateau is borne in mind. It is of further interest to note that while 15 exclusively Northern American species are found on the plateau, 14 Northern American species are found in Mexico exclusive of the plateau, the corresponding figures for the exclusively South American species being 14 and 50. These differences are in agreement with Gadow's

[4] The existing data for about 40 Mexican species would seem to show that their northern boundary line *may* correspond with the upper limit of the *Upper* Sonoran of Merriam (Map in Bull. 10, U. S. Dept. Agric., Div. Biol. Surv., 1898) in California, Arizona and New Mexico; but not east of the last named, as in Texas these species are not yet known as far north as the upper limit of Merriam's *Lower* Sonoran.

[5] The Distrito Federal embraces much of the highest portion of the Mexican plateau, having an elevation of 7200–8000 ft. or 2200–2450 m., and has been fairly well examined as regards its Odonate fauna, which numbers 21 species, etc. Outside of Mexico and Central America, 6 of the 21 occur exclusively in Northern America and 2 of the 21 exclusively in South America, so that here the southern element is weak.

[6] Contrast on this feature Bates, *Biol. Centr. Amer. Coleop.*, I, pt. 1, p. vi, and W. Horn, *Deut. ent. Zeitschr.*, 1897, pp. 161–2.

TABLE 1.—DISTRIBUTION BY SUBFAMILIES OF THE ODONATA OF MEXICO AND CENTRAL AMERICA.

("Spp." includes species, subspecies and varieties.)

Subfamilies.	Totals.		Endemic.		Distribution in America elsewhere than Mexico and Cent. Amer.													
					Exclusively Northern Am.		Exclusively Northern and W. Ind.		Exclusively Northern and S. Amer.		Northern S. Amer. and West Indies.		Exclusively West Indies.		Exclusively West Ind. and S. Amer.		Exclusively South Amer.	
	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.
Calopteryginæ	4	23	0	11	1	2	0	0	0	1	1	0	0	1	0	1	2	7
Lestinæ	2	7	0	3	0	0	0	0	1	1	1	0	0	0	0	2	0	1
Agrioninæ	24	112	5	80	0	4	0	0	0	2	4	2	2	4	5	2	8	18
Gomphinæ	5	28?	0	25	1?	2	0	0	0	0	1	0	0	0	1	0	2	1
Cordulegasterinæ	1	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Æshninæ	6	23	1	3	1	3	0	1	0	0	2	1	0	1	1	6	1	8
Corduliinæ	1	1	0	1?	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Libellulinæ	28	97	1	16	2	10	0	3	1	1	6	4	0	6	13	22	5	35
Totals	71	293	7	141?	7	21	0	4	2	5	15	7	2	12	20	33	18	70
Equivalent percentages of the Totals	100	100	9.8	48.1[7]	9.8	7.2	0	1.4	2.8	1.7	21.1	2.4	2.8	4.0	28.2	11.3	25.4	23.9

[7] The endemic species of birds of this region are equivalent to 45% of the whole number (Godman, *Biol. Cent.-Amer.*, Aves, I, p. vi). This percentage is of some interest in comparison with that of actively flying insects like the Odonata.

TABLE 2.—DISTRIBUTION OF THE ODONATA OF CERTAIN PARTS OF MEXICO AND CENTRAL AMERICA.

("Spp." = as in Table 1.)

Area.	Totals.		Endemic in the area named.		Exclusively other parts of the Mex.-C. Amer. district.		Distribution in America elsewhere than Mexico and Cent. Amer.													
							Exclusively Northern Am.		Exclusively Northern and W. Ind.		Exclusively Northern and S. Amer.		Northern, S. Amer. and West Indies.		Exclusively West Indies.		Exclusively West Ind. and S. Amer.		Exclusively South Amer.	
	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.
Mexican plateau (as shown on map)	35	81	0	1	1	25	4	15	0	3	2	3	15	4	0	3	11	13?	1	14
Mexico exclusive of plateau	61	212 (215)	1	51	5	44	5	14	0	4	2	5	15	6	1	8 (9)	20	30 (31)	12	50
Mexico (as in Table 5)	62	219 (221)	1	51?	5	45	6	19 (20)	0	4	2	5	15	6	1	8 (9)	20	31	12	50
Guatemala	62 (63)	161 (186)	0	14	5	48 (50)	3?	5?	0	0 (2)	2	4 (5)	15	5 (6)	2	10	20	26 (32)	15 (16)	49 (61)
Costa Rica	41 (61)	101 (165)	0	15	3	26 (33)	2	1	0	1 (2)	2	3 (5)	11 (15)	1 (6)	0 (1)	3 (5)	14 (20)	14 (32)	9 (18)	37 (65)

The parentheses ( ) in this and the following tables enclose the probable numbers of genera and species, etc., in the areas in question, obtained by adding to those actually found there those which have been taken both north and south.

results for Reptiles and Batrachia: "The plateau seems to be a much more effective barrier to the southerners than is the descent into the hot lowlands to the northern creatures."[8]

The West Indies lie within the same parallels of latitude as do Mexico and Central America. The total number of species of Odonata found in those islands is about 91;[9] 56 of these, or 61.5%, also occur in our present district. The number of species common to both is likely to be increased by future explorations, especially as the Odonate fauna of Yucatan and British Honduras, the continental areas lying nearest to the West Indies, is very imperfectly known. But, making use of the present figures, it is rather surprising that only 61.5% of the West Indian Odonata are found in Mexico and Central America, seeing that the prevalent winds on the east coast of the mainland are easterly (*i.e.*, northeast, east and southeast).[10] With such insects as the Odonata one might expect the winds to play an important part as means of dispersal.[11] The West Indian species not yet found in Mexico or Central America include a number of fair-sized and probably fair-flying species, *e.g.*, *Aphylla producta*, *Progomphus integer* and *serenus*, *Dythemis rufinervis*, *Scapanea frontalis*, *Macrothemis celæno*, *Celithemis eponina*, etc.

The extent to which species common to the West Indies are found in some parts of Mexico and Central America is shown in Table 3.

The *Endemic Genera and Species* are summarized in Table 4, p. 468.

Of the genera listed in Table 4 as occurring in both Northern and South America, *Hetærina*, *Argia*, *Progomphus*, *Erythrodiplax*, and perhaps *Dythemis*, are represented by a greater number of species in South America than in Northern America, and these genera are entirely,

---

[8] *Proc. Zool. Soc. London*, 1905, II, p. 239.

[9] Hagen, *Proc. Bost. Soc. Nat. Hist.*, XI, pp. 289–291 (1867); XVIII, pp. 20–96 (1875). Uhler, *l.c.*, XI, pp. 295–298 (1867). Kolbe, *Archiv f. Naturges.*, LIV, I, pp. 153–178 (1888). Kirby, *Ann. and Mag. Nat. Hist.*, (6) XIV, pp. 261–269 (1894). Carpenter, *Journ. Inst. Jamaica*, II, pp. 259–263 (1896). Calvert, *Biol. Cent. Amer. Neurop. Introd.*, Table B (1908).

[10] See the charts of prevailing winds accompanying Buchan's *Challenger Report* on Atmospheric Circulation, and the data given in Table VII of the Appendix thereto, pp. 169, 170, for Matamoras and Cordova, Mex., and Belize; also the data for Merida, Campeche and Jalapa by Moreno y Anda and Gomez in *El Clima de la Republica Mexicana*, Año I (for 1895) and II (for 1896), Mexico City, Secretaría de Fomento, 1899 and 1900. Cf. also Sapper, *Mittelamerikanische Reisen und Studien*, Braunschweig, 1902, p. 297. The Challenger data for Blewfields, Nicar., *l.c.*, p. 171, represent the prevailing wind as northwest, which has little bearing on the question of the relations of the continental and West Indian Odonata.

[11] On the other hand Chapman states that of the 550 species and subspecies of birds recorded from the West Indies, 303, or 55%, are endemic. *Bull. Amer. Mus. Nat. Hist.*, IV, p. 318, 1892.

TABLE 3.—THE RELATIVE STRENGTH OF THE WEST INDIAN AND SOUTH AMERICAN ELEMENTS IN DIFFERENT PARTS OF THE ODONATE FAUNA OF MEXICO AND CENTRAL AMERICA.

Area.	Total number of species, etc.	Number of species, etc., found also in the West Indies, and their percentage equivalents.		Number of species, etc., found also (outside of Mexico and Cent. Amer.) exclusively in S. Amer., and their percentage equivalents.	
Mexican plateau	81	23	= 28.4%	14	= 17.3%
Mexico (as in Table 5)	219 (221)	49 (50)	= 22.4 (22.6)	50	= 22.8 (22.6)
Yucatan and British Honduras	35?	18?	= 51.4	8	= 22.8
Guatemala and Honduras	161 (186)	41 (50)	= 25.5 (26.9)	49 (61)	= 30.4 (32.8)
Costa Rica	101 (165)	19 (45)	= 18.8 (27.3)	37 (65)	= 36.6 (39.4)

(The parentheses have the same meaning as in Table 2, *q. v.*)

or almost entirely (*Argia*), confined to the Americas. *Lestes, Enallagma, Ischnura, Æshna, Libellula* and *Sympetrum* are almost or quite cosmopolitan, but are more abundant in the northern than in the southern hemisphere.

Of the seven endemic genera, *Pseudostigma, Thaumatoneura* and *Paraphlebia* are South American in their affinities; the other four are not so clear.

Adding together the 9 species of these three genera, the 56 endemic species of genera also occurring in South America but not in Northern America (Table 4), and the 70 non-endemic species found elsewhere exclusively in South America (Table 1), we have a total of 135 species, or 46% of the fauna, as being of distinctly southern relationships. Similarly, adding the 12 endemic species of genera also occurring in Northern America, but not in South America (Table 4), to the 21 non-endemic species found elsewhere exclusively in Northern America (Table 1) we have a total of 33 species, or 11% of the fauna, as being of distinctly northern affiliations.

In the endemic as well as in the non-endemic species, therefore, the South American element[12] is much the strongest in Mexico and Central America as a whole.

[12] While the expression "South American element" has been used in these pages to designate those species found at the present time in South America also, there seems to be no evidence to decide whether such Odonata, or their ancestors, entered Mexico and Central America from the south, or whether South America received them from the former countries. Probably only further discoveries of fossil Odonata will settle this question.

TABLE 4.—DISTRIBUTION OF THE ENDEMIC SPECIES, ETC., BY GENERA.

Subfamily and number of endemic species, etc.	Distribution of genera to which the endemic species, etc., belong, with the numbers of endemic species, etc., in each genus. Endemic.	Northern, but not South, America.	Both Northern and South America.	West Indies.	South, but not Northern, America.
Calopteryginæ 11			Hetærina 7	Hetærina.	Cora 4
Lestinæ 3			Lestes 3	Lestes.	
Agrioninæ 80	Pseudostigma 2		Argia 36	Mecistogaster.	Mecistogaster 1
	Thaumatoneura 2		Enallagma 1	Argia.	Philogenia 3
	Paraphlebia 5		Ischnura 1	Enallagma.	Heteragrion 3
	Hesperagrion 1			Ischnura.	Hyponeura 1
	Anisagrion 4			Telebasis.	Telebasis 5
				Leptobasis.	Leptobasis 1
					Metaleptobasis 1
					Palæmnema 4
				Neoneura.	Neoneura 2
				Protoneura.	Protoneura 7
Gomphinæ 25		Erpetogomphus 9	Progomphus 2	Gomphoides.	Gomphoides 8
					Cyanogomphus 1
					Epigomphus 5
Cordulegasterinæ 2		Cordulegaster 2			
Æshninæ 3	Oplonæschna 1		Æshna 2		
Corduliinæ 1?		Macromia 1			
Libellulinæ 16	Pseudoleon 1		Libellula 1	Micrathyria.	Micrathyria 1
			Erythrodiplax 2	Orthemis.	Orthemis 1
			Dythemis 1	Brechmorhoga.	Brechmorhoga 5
			Sympetrum 1	Tauriphila.	Tauriphila 1
					Rhodopygia 1
					Platyplax 1
Totals, 141 spp.	7 gen., 16 spp.	3 gen., 12 spp.	11 gen., 57 spp.	15 gen.	20 gen., 56 spp.

Arranging the subfamilies in the order of their percentages of endemic species, the series obtained is Cordulegasterinæ (*two* species only) 100%, Gomphinæ 85.7%, Agrioninæ 72.2%, Calopteryginæ 47.8%, Lestinæ 42.8%, Libellulinæ 16%, Æshninæ 13%. The Cordulegasterinæ, many Gomphinæ, most Libellulinæ and Æshninæ have well-developed powers of flight. Perhaps the great majority of the other three subfamilies are feebly-flying insects, yet some of their species appearing in the present faunal district are very widely distributed, *e.g.*, *Enallagma civile*, *Ischnura ramburi*, *Anomalagrion hastatum*. It is consequently impossible to account for the relative endemicity of the subfamilies by such general considerations.

If the relative endemicity of these groups is not always inversely proportional to the powers of flight, as these figures seem to indicate, and if nearly 40% of the West Indian Odonata are not to be found in Mexico and Central America in spite of favoring winds, the explanation of the present distribution of this group of insects may perhaps be found in the past distribution of land and water[13] in these regions.

Distribution of the Odonata within Limited Portions of Mexico and Central America.

Table 2 and the remarks on the fauna of the Mexican plateau (page 463) have already illustrated this topic to some degree. Table 5 gives the number of endemic species and of those common to the three countries whose Odonate fauna is best known.

Accepting the areas of Mexico (exclusive of Campeche, Yucatan and Baja California), of Guatemala and of Costa Rica as approximately 655,000,[14] 63,000,[15] and 21,000 square miles (1,700,000, 164,000 and 54,000 square kilometres) respectively, it follows that, in proportion to its area, Costa Rica is much the richest country of the three, both in its total number of species and its number of endemic species.

Tables 6–8 give the number of species and the number of localities at which they were collected in each of the States or Departments of

[13] Compare the geological data embodied in the sketch maps of Gadow (*Proc. Zool. Soc. London*, 1905, II, pp. 235–6); also the discussions in the papers of Chapman (*Bull. Amer. Mus. Nat. Hist.*, IV, pp. 318, 326–9, 1892) on birds, Simpson (*Proc. U. S. Nat. Mus.*, XVII, pp. 428, 438, 447, 1894) on land and fresh-water mollusks, and Ortman (*Proc. Amer. Philos. Soc.*, XLI, pp. 309, 341, 347) on fresh-water decapods, of the West Indies.

[14] Romero, *Geographical and Statistical Notes on Mexico*, p. 91, New York, 1898.

[15] *Century Dictionary*, Vol. IX, New York, 1906. Dr. Sapper gives the approximate area of Guatemala as only 110,000 square kilometres, *Mittelamerikanische Reisen u. Studien*, p. 424.

TABLE 5.—DISTRIBUTION OF THE ODONATA BY SUBFAMILIES IN (*a*) MEXICO, EXCLUSIVE OF CAMPECHE, YUCATAN AND LOWER CALIFORNIA; (*b*) GUATEMALA AND EXTREME NORTHWESTERN HONDURAS, AND (*c*) COSTA RICA.

Subfamilies.	Totals in Mexico and Cent. Amer.		Restricted to						Common to						Totals in					
			Mex.		Guat.		C. R.		Mex. and Guat.		Mex. and C. R.		Guat. and C.R.		Mex.		Guat.		C. R.	
	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.	gen.	spp.
Calopteryginæ	4	23	0	1	0	1	0	3	3	10	2 (3)	4	2 (3)	5	3	13	4?	14(16?)	2 (3)	10 (15)
Lestinæ	2	7	0	2	0	0	0	0	2	2 (4)	2	2 (3)	2	1 (3)	2	6	2	2 (4)	2	3 (4)
Agrioninæ	24	112	1	27	0	12	0	9	18	43 (44)	10 (17)	21(30?)	10 (18)	23 (32)	19	74	20	61 (62)	13 (21)	38 (49)
Gomphinæ	5	28	0	13	0	0	0	3	4 (5)	4 (6)	3 (5)	3 (4)	3 (5)	2 (4)	5	21	4 (5)	7?(9)	3 (5)	6 (9)
Cordulegasterinæ	1	2	0	1	0	0	0	0	1	1	1	1	1	1	1	2	1	1	1	1
Æshninæ	6	23	0	2	0	0	0	0	4	11 (17)	3	7 (15)	3 (4)	6 (16)	5	19 (20)	5	13 (18)	3 (4)	7 (16)
Corduliinæ	1	1	0	?1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Libellulinæ	28	97	0	4	0	1	0	0	24	53 (63)	17 (23)	34 (62)	17 (25)	34 (70)	26	83 (84)	26	63 (76)	17 (25)	36 (72)
Totals	71	293	1	51?	0	14	0	15	56(57)	124(145)	38(54)	72(119)	38 (58)	72(131)	62	219(221)	62(63)	161(186)	41 (61)	101(165)

"Spp." and the parentheses have the same meaning here as in Table 2.

Table 6.—Number of Species, etc., Recorded from the States, etc., of Mexico, and of the Localities at which they were Collected.

(See explanation in the text.)

Pacific (Western) Slope.			Central Plateau.						Atlantic (Eastern) Slope.		
State.	Localities.	Species.	State.	Localities.	Species.	State.	Localities.	Species.	State.	Localities.	Species.
Sonora	4	7	Chihuahua	6	25	Coahuila	5	22	Nuevo Leon	6	26
Sinaloa	3	25	Durango	4	15	Zacatecas	0	0	Tamaulipas	5	53
Tepic	7	52	Aguascalientes	1	9	S. Luis Potosi	4	15			
Jalisco	8	62	Guanajuato	2	11	Queretaro	1	4			
Colima	1	1	Michoacan	4	22	Hidalgo	1	6			
			Mexico	3	4	Tlaxcala	0	0			
Guerrero	20	71	Distrito Federal	14	21	Puebla	4	9	Vera Cruz	23	118
Morelos	6	50							Tabasco	3	71
Oaxaca	6	44							Campeche	1	3
Chiapas	2	13							Yucatan	7	12
Totals (after deducting duplications)	57	120	Totals for Central Plateau States, after deducting duplications				49	81	Totals (after deducting duplications)	45	167

(Common to Atlantic and Pacific slopes of Mexico, 83 spp., subspp. et varr.)

Mexico, Guatemala and Costa Rica, respectively. In each table the States or Departments are arranged in vertical columns corresponding to their position on the Atlantic or Pacific slopes, and in the case of Mexico also on the Central Plateau. In each vertical column the names stand in order from north to south, and the States or Departments whose names are on the same horizontal line, in reading across these tables, are, in part at least, in the same latitude. These three tables exhibit the scantiness of our knowledge, however, rather than actual differences in the faunas.[16]

Table 7.—Number of Species, etc., of Odonata Recorded from the Departments of Guatemala, and of the Localities at which they were Collected.

(See explanation in the text.)

Pacific (Western) Slope.			Atlantic (Eastern) Slope.		
Department.	Localities.	Species, etc.	Department.	Localities.	Species, etc.
			Alta Vera Paz	14	46
			Izabal	9	64
San Marcos	1	1	Baja Vera Paz	6	51
Quezaltenango	3	14	Zacapa	2	40
Retalhuleu	3	22	Guatemala	3	16
Suchitepequez	1	16	Jalapa	1	13
Solola	1	2			
Sacatepequez	1	9			
Amatitlan	2	15			
Escuintla	7	47			
Santa Rosa	1	2			
Totals (after deducting duplications)	20	68	Totals (after deducting duplications)	35	139

Common to Atlantic and Pacific slopes 56 species, etc. Subtracting 56 from 68 + 139 gives 151 species from definite localities in Guatemala, or 10 less than the total (161) credited to that country in Tables 2 and 5. For these ten species definite localities are not known and hence they could not be included in Table 7. A similar difference exists between Tables 8, 5 and 2.

[16] The State of Vera Cruz, lying exclusively on the Atlantic slope, extending through 5½ degrees (17° 22°) of latitude and 18,000 ft. (5,487 m.) of altitude, and having an area of 29,210 square miles (75,654 square kilometres), has 118 species of Odonata. The State of New Jersey, U. S. A., also bordering the Atlantic, reaching from 39° to 41° 15′ N. and to 1800 ft. (550 m.) in elevation, and with an area of 7,815 square miles (20,241 square kilometres) possesses 111 species of Odonata. Both areas have been examined by a number of collectors of these insects, and the results do not seem to favor the general belief in the richness of tropical countries in Odonata. At least 9 species are common to the two areas: *Hetærina americana*, *Argia translata*, *Ischnura ramburi*, *Anomalagrion hastatum*, *Anax junius*, *A. longipes*, *Libellula auripennis* (probably), *Pantala flavescens*, *Sympetrum corruptum*. As far as I am aware no data have been published showing a richer Odonate fauna in a limited period of time than that of the vicinity of Kent, Ohio, where Messrs. Osburn and Hine took 57 species between June 17 and 24 (*Ohio State University Naturalist*, I, pp. 13–15, 1900).

TABLE 8.—NUMBER OF SPECIES, ETC., OF ODONATA RECORDED FROM THE DEPARTMENTS OF COSTA RICA, AND OF THE LOCALITIES AT WHICH THEY WERE COLLECTED.
(See the explanation in the text.)

Department.	Localities.		Species, etc.
	Pacific slope	Atlantic slope	
Guanacaste	1	....	9
Alajuela	3	1	33
San José	8	3	46
Cartago	....	6	46
Puntarenas	9	....	29
Totals (after deducting duplications)	21	10	101

Total number of species, etc., Pacific slope	67
Total number of species, etc., Atlantic slope	59
Total number of species, etc., common to Pacific and Atlantic slopes	28

Although writers on other groups in the *Biologia* have distinguished between a "North" and a "South Mexico," the division line being near the Tropic of Cancer, the data at hand for the Odonata do not seem to indicate any such distinction.

RELATIONS OF THE ODONATE FAUNA TO TEMPERATURE.[17]

In Plate XXVI we have given a map of the distribution of mean annual temperatures in Mexico and Central America.[18] The topography, presenting a high paramesial axis running northwest and southeast through the greater part of the district, has brought about the existence of parallel zones of temperature, decreasing in mean annual intensity from each coast line to the axis. As a result the temperatures are not distributed latitudinally, but a high cool tract extends far

[17] It is not intended that the remarks here made on the relations of Odonate distribution to temperature, rainfall and other environmental factors are to be interpreted as showing the limits which these factors set to the distribution of the insects in question. Our knowledge of the areas occupied by the latter is still too imperfect to permit this. We may be said to know where many species occur, but not where they do not occur.

[18] Mr. C. H. T. Townsend, in his papers "On the Biogeography of Mexico, Texas," etc. (*Trans. Texas Acad. Sci.*, Vols. I and II, 1895 and 1897), has laid great emphasis on the difference between apparent and sensible temperatures, as obtained from dry and wet bulb thermometers respectively, holding that only sensible temperatures can be used in biogeographical work (*l.c.*, I, pp. 89–90; II, pp. 65–67). As very few wet bulb readings exist for our district, our data are those of his "apparent" temperatures only. I am indebted to Dr. C. C. Adams for calling my attention to these two papers, which seem to have been omitted from the "Zoological Record."

to the south of Mexico, thence continued as a chain of "islands" in the midst of lower and hotter lands. Considering the zones of mean annual temperature in order, from the hottest to the coldest:

Zone I (more than 30° C. = 86° F.) is doubtful, as stated in the explanation of the map; no species of Odonata are known to be restricted to the area supposed to constitute it.

Zone II (30°–25° C., 86°–77° F.) is continuous on the Atlantic, and also on the Pacific slope, for the entire length of its extent, from about 20° north latitude on the eastern, or 25° north on the western, coast of Mexico to South America. The Atlantic and Pacific belts of this zone are connected at the Nicaraguan lakes and at the Isthmus of Panama. This zone therefore offers a pathway for the extension, northward or southward, of species which find in it temperature conditions similar to those which prevail over large areas of South America.[19] It actually possesses a larger number (91) of species also found in South America than any other zone, although Zone III has 90 such species. Zones II and III have respectively 48 and 47 species also found in the West Indies, larger numbers than for the other zones. Peculiarities of Zone II are *Perilestes* (Costa Rica), *Argiallagma* (Guatemala), *Telebasis* 4 species, *Metaleptobasis, Neoneura, Protoneura* 5 species, *Nephepeltia* and *Rhodopygia*, all genera found in South America and the West Indies. Yucatan, Campeche and most of British Honduras lie within this zone, and these three have no endemic species.

Zone III (25°–20° C., 77°–68° F.), the Mexican Tierra Caliente of Hann,[20] extends continuously southward from the Gulf States on the east, and from Arizona and California on the west, to southern Nicaragua, where it is interrupted by Zone II. The Atlantic and Pacific belts are confluent from the southern part of the State of Puebla to the western part of Chiapas, and again for the southern part of Honduras and most of Nicaragua. After its interruption in southern Nicaragua, this zone reappears in northwestern Costa Rica and extends almost to the Isthmus of Panama. Zones III and IV possess an equal number (27) of species also found in Northern America, a larger number than for the other zones. Characteristic for this zone are *Philogenia* (not north of Costa Rica), *Palæmnema, Progomphus* 3 species, *Epigomphus* 4 species, genera chiefly South American in their distribution.

[19] The distribution of the Odonata by temperature zones in South America should also be considered here, but even the first steps in investigating the South American Odonata from this point of view have yet to be taken.

[20] *Handbuch der Klimatologie*, 2te Aufgabe, Bd. II, p. 285, Stuttgart, 1897.

Zone IV (20°–15° C., 68°–59° F.), the Mexican Tierra Templada of Hann, embracing a large part of the United States, nowhere touches the coasts in Mexico or Central America, as Zones II and III do, but occupies a central position. It consists in these countries of a Mexican portion, of rather greater area than that of the central plateau, and reaching to southern Puebla; a mostly elongated and narrow strip in Guerrero and Oaxaca, some of the western parts of Chiapas, Guatemala and Honduras, with an arm into western Salvador; a number of small scattered areas in Honduras and a larger one in northern Nicaragua; finally, an elongated strip in Costa Rica and Panama. Representatives of Zone IV are *Cordulegaster godmani*, *Æshna dugesi*, *Plathemis subornata*, *Libellula comanche*, *foliata*, *nodisticta* and *luctuosa*, members of chiefly northern, or (*Æshna*) cosmopolitan, genera.

Zone V (15°–10° C., 59°–50° F.), the Mexican Tierra Fria of Hann, occurs in scattered areas in Sonora, Chihuahua, Durango, Zacatecas, and one of greater extent in the States of Hidalgo, Puebla, Tlascala and Mexico; in western Guatemala and on some of the peaks of Costa Rica. No Odonata are peculiar to this zone.

Zone VI (less than 10° C. = 50° F.) occurs only on the higher peaks of Mexico, Guatemala and Costa Rica; no Odonata have been reported as yet at or above the elevations corresponding to its lower limit in these countries.

Zones III, IV, V and VI may be compared to continents or islands, lying within a sea of Zone II, and each enclosed by a girdle of zones of lower numbers than itself.

Table 9 gives the distribution of the Odonata within these zones.

From Table 9 it results that the number of species confined to one zone only is 104, extending through two zones 99, extending through three zones 71, and through four zones 8. Of all the zones, III contains the greatest number of species, subspecies and varieties, viz.: 222 as compared with 165 in II, 143 in IV, and 10 in V; it is also the richest in zonal endemic species, viz.: 46, as compared with 40 in II and 18 in IV; and the richest in endemic Mexican and Central American forms, viz.: 106, as compared with 60 in IV, 56 in II, 4 in V, and 3 in I.

The species, etc., which, outside of Mexico and Central America, are found exclusively in Northern America appear in the temperature zones of our district in the following numbers: IV 15, III 13, II 5, V 4. As our map (Plate XXVI) shows, zones IV and III are continuous from the United States into Mexico, so that they offer a pathway for the extension of species whose living conditions are

TABLE 9.—DISTRIBUTION OF THE ODONATA OF MEXICO AND CENTRAL AMERICA BY TEMPERATURE ZONES (cf. Map, Pl. XXVI).
(The Arabic numerals are those of species, subspecies and varieties.)

Subfamilies.	Restricted to Zone					Common to Zones										Zone unknown.	Totals.
	I	II	III	IV	V	I–II	I–III	I–IV	I–V	II–III	II–IV	II–V	III–IV	III–V	IV–V		
Calopteryginæ		3	3	3						5	3		5			1	23
Lestinæ				1						3	1		1	1			7
Agrioninæ		18	23	4		1	2	2		14	20	3	20	1		4	112
Gomphinæ		4	10	1						1	3		7			2	28
Cordulegasterinæ				1									1				2
Æshninæ		3	3	2						5	2		2	2		4	23
Corduliinæ			1														1
Libellulinæ		12	6	6				2		22	35	1	11	1	1		97
Total		40	46	18		1	2	4		50	64	4	47	5	1	11	293
Endemic		20	37	10		1	2			17	16		30	4		4	141
Distribution elsewhere in America. Also found in North'rn Am.		1	3	5						3	11	3	6	1	1	3	37
Also found in South Amer.		18	6	4				4		28	40	1	11			3	115
Also found in West Ind		5	2	2						15	26	2	2			2	56
Exclusively in North'rn Am.			2	4						1	2	2	5	1	1	3	21
Exclusively in Northern Am. and W. Ind.										1	2		1				4
Exclusively in Northern and So'h Amer.			1							1	3						5
Exclusively in N'th'n and S. Amer. and W. I.		1		1							4	1					7
Exclusively in West Indies		2	1							3	4	1				1	12
Exclusively in West Ind. and So'h Amer.		2	1	1						11	16		1			1	33
Exclusively in South Amer.		15	4	2				4		16	17		10			2	70

those of these zones. The Northern American species found in zones II and V are, in all cases, also found in III or IV, and hence can conceivably have descended or ascended from one or the other of the latter two.

Considering all the Mexican and Central American species, etc., occurring also (*a*) in South America, or (*b*) exclusively in South America and the West Indies, or (*c*) exclusively in South America, the order (according to the number of species) of the temperature zones in which they appear is always the same, viz.: II, III, IV, I, V, the numbers of species being respectively: (*a*) 91, 90, 60, 4, 1; (*b*) 29, 29, 18, 0, 0; (*c*) 52, 51, 33, 4, 0. Zone II as a pathway for the extension of the "South American element" has already been considered on page 474.

Some Anomalies in the Zonal Distribution.—Since Zone II is the only zone continuously extending northward from South America, it is of importance to notice, as Table 9 shows, that of the 70 Mexican and Central American forms occurring elsewhere exclusively in South America, 16, or 23%, have not been detected in zone II in our faunal region.

Of the 131 species, etc., common to Mexico, Guatemala and Costa Rica, the great majority have been found in zone II at some point (and hence presumably occur in it at other points), although they may also inhabit other zones, but there are 28 exceptions.

Sixteen of the species, etc., of zones III and IV of Costa Rica are not found farther north, but 17 other species of the same zones and country do so extend, although the Costa Rican areas of these zones are discontinuous.

In spite of the isolation of zone IV in Guatemala, no species of Odonata are known to be restricted thereto, and species found there and not known to occur in any other zone than IV, such as *Cordulegaster godmani* and *Libellula foliata*, are also found in Mexico and in Costa Rica.

Sixty-two and 27 species, etc., of zones higher than II found in Mexico and Guatemala are not and are, respectively, found farther south, a discontinuity of zones III–V existing south of Guatemala.

Nine and 4 species, etc., of zones IV–V (but not lower) found in Mexico are not and are, respectively, found farther south.

Some conceivable explanations of these anomalies (suggested for future investigation) are: incompleteness of data on the present distribution; that temperature does not limit the inhabitable area of the species concerned, or that, limiting it, the species found in discontinuous parts of the same zone may at times, past or present, have made their way from one separated area to another by their own powers of flight, perhaps aided by favorable winds; that zones III and IV may have been more continuous throughout the length of Mexico and Central America in Tertiary times, when higher elevations with consequent cooler temperatures prevailed over areas now low and hot, as a result of previous greater volcanic activity or orogenic revolution,[21] some of which latter causes have been invoked by botanists[22] to account for the distribution of the plants of this district.

That temperature is not the only factor in determining the distribution of the Odonata is shown by the fact that each of the zones II–IV, even when continuous over large areas, contains species of quite limited habitat within that zone. Such are *Perilestes fragilis, Argia wilsoni, gaumeri, popoluca,* and *cupraurea, Argiallagma minutum* and species of *Protoneura* in zone II; *Hetærina rudis, Argia percellulata, calida, barretti, rhoadsi* and *pocomana* and *Palæmnema desiderata* in zone III; *Hetærina tolteca* and *Argia herberti* in zone IV.

Relations of the Odonate Fauna to Rainfall.

The existence of pools, lakes, or watercourses of sufficient constancy for the development of the aquatic larvæ of the Odonata is dependent on the water supply (ultimately traceable to the precipitation) and on the factors which tend to prevent its loss by evaporation or by sinking into the soil. These latter factors probably include frequency of winds and of clouds, sheltering vegetation and the relative porosity of the soil and underlying rocks. The supply and conservation of the water of a given area have not only the direct effects of furnishing the necessary living medium for the Odonate larvæ, but also, in a more indirect manner, must influence the supply of food for both larvæ and adults through the existence of vegetation and through it of herbivorous insects and other animals.

The influence of these environmental conditions on the Odonate fauna has not yet been thoroughly investigated even in those parts of the earth for which the physical data have been accumulated. For Mexico and Central America, where the collection of these data has been very limited (except at a few well-known localities), it is hardly possible at this time to attempt to correlate the facts of Odonate distribution even with those of precipitation. The existing measure-

[21] Hill, *Bull. Mus. Comp. Zool.*, XXXIV, pp. 205–207, etc., 1899.

[22] Most recently by Bray, *Science* for Nov. 9, 1900, pp. 709–716, and *Botan. Gazette*, XXVI, pp. 121–152, 1898, with citations from previous writers.

ments of rainfall show a much greater annual variation[23] than in the case of temperature, and a much longer series of observations is, therefore, needed to determine the approximate average rainfall than to ascertain the approximate mean annual temperature. Since such series exist for very few places[24] and the rainfall differs so much at nearby localities (as the data gathered by the authors quoted show), the endeavor to correlate the occurrence of certain species of Odonata with rainfall differences appears to be premature,[25] although it may be that precipitation has a more important influence on the distribution of these insects than has temperature.[26] The annual variation in rainfall, however, may bring about an annual variation in the local Odonate fauna—a possibility which suggests that a proper understanding of the insect fauna may be obtainable only from the same methods of accumulation of data as are practised by the meteorologists.

Mr. E. B. Williamson, as a result of his observations made while collecting in Guatemala, has suggested in correspondence that "The species [of Odonata] occurring at any location during the dry season are those species of widest distribution, or, in other words, local species are to be found in the height of the season." In testing this suggestion, the difficulty at once arises that we have no complete records of the Odonata occurring both in the wet and dry seasons at the same locality. An absolute essential for the study of this and other problems connected with the seasonal distribution of these insects in our district is a series of continuous observations for at least twelve consecutive months in the same limited area. Under the present conditions the best that can be done is to compare wet season captures at one point with dry season collections at the nearest similar station. Thus both Santa Lucia and Zapote lie on the Pacific slope of Guatemala,

[23] Escobar, *Memor. Soc. Cien.* "Antonio Alzate," XX, 1903 (see his figures for Mazatlan, *e.g.*, *l.c.*, p. 29). Harrington, *Bull. Philos. Soc. Washington*, XIII, pp. 6, 19, 1895. Sapper, *Meteorol. Zeitschr.*, 1892–1906. A still more recent review of the distribution of rainfall in Central America is contained in Dr. Alfred Merz's "Beiträge zur Klimatologie und Hydrographie Mittelamerikas" (*Mittheil. Vereins für Erdkunde zu Leipzig*, 1906; 96 pp., 4 Beilagen; 1907, especially pp. 9–23). An extended discussion of Dr. Merz's work is given in *Meteorol. Zeitschr.*, XXV, pp. 326 *et seq.*, July, 1908.

[24] These localities are mostly at the higher elevations, in the larger centres of human population, while the majority of the species of Odonata are found at lower levels.

[25] See a note by Mr. Champion (*Biol. Cent.-Amer. Neur.*, p. 53) and one by Mr. C. H. T. Townsend (*Ann. Mag. Nat. Hist.*, 6, XX, p. 289, 1897) on the seasonal appearance of certain Odonata and Diptera, respectively, in our district.

[26] Mr. F. M. Chapman has some interesting remarks on the influence of temperature, independent of humidity, on the distribution of birds at Las Vigas and Jalapa, Vera Cruz, Mexico (*Bull. Amer. Mus. Nat. Hist.*, X, pp. 17 and 36).

have a mean annual temperature of 25°–20° C. and a yearly rainfall of more than 3000 mm.,[27] the former, however, at an altitude of 335 metres as against 720 for Zapote. They have yielded respectively 26 dry season species and 17 wet season species; each has 6 endemic species (*i.e.*, restricted to Mexico and Central America), one of which, with 7 non-endemic species, is found at both localities.

The single locality in all Mexico and Central America which has furnished the greatest number of species of Odonata is Atoyac, in Vera Cruz—68. At least 59 of these were taken in April and May (the specimens of the other 9 are undated), and of these 59, 17 are endemic in Mexico and Central America. If we may judge from the rainfall figures published for the nearest point, Cordoba,[28] April and May, while not a part of the wet season in its stricter sense, may have a precipitation of 29–101 mm. and 77–233 mm. respectively, the total for the year being 2600–3200 mm. On investigating the seasonal records for the 17 endemic species at other localities, it appears that they are by no means always confined to one limited portion of the year.

Gualan, Guatemala, lies in the rainfall zone of less than 1000 m.[29] The only rainfall records from anywhere in the vicinity appear to be those of Teculutan, Department of Zacapa, the monthly figures for 1902, from January to December respectively, being 1, 0, 1, 95, 70, 361, ?, 38, 83, 164, 17 and 2 mm.[30] Mr. Williamson collected 39 species at Gualan in January, 1905, 7 of which are restricted to Mexico and Central America. At Los Amates, lying in the rainfall zone of 1000–2000 mm., in the same month and the following February, 35 species were obtained, 6 being endemic in our district. At Puerto Barrios, whose measured precipitation for three years, 1894–6, is 3096 mm., with no month below 50 mm.,[31] 33 species were procured in December, 1904, and February and March, 1905, 7 of these being confined to Mexico and Central America. Gualan has a well-marked dry season, which is much less distinct at Los Amates and absolutely, but not relatively, absent at Puerto Barrios. Of the endemic species, three taken at Gualan (*Argia tezpi, A. pipila, Pseudoleon superbus*), three at Los Amates (*Neoneura amelia, Protoneura remissa, Orthemis biolleyi*), and four at Puerto Barrios (*Hetærina miniata, Argia gaumeri, Neoneura paya, Protoneura amatoria*) were not taken at either of the other

[27] Sapper, Petermann's *Mittheil.*, XLIII, map, 1897.
[28] For 1861–3, Nieto, *Bolet. Soc. Geog. Estadist. Mex.* (1), X, pp. 484 *et seq.*, 1864.
[29] Sapper, *l.c.*, 1897.
[30] Lottermoser, *Meteorol. Zeitschr.*, XXIII, pp. 237, etc., 1906.
[31] Sapper, Petermann's *Mittheil.*, XLIII, pp. 117 *et seq.*, 1897; *Meteorol. Zeitschr.*, XIV, p. 235, 1897.

two localities. Of the remaining endemic species taken at Gualan, two (*Argia frequentula, Telebasis digiticollis*) were taken also at both the other places, one (*Telebasis salva*) also at Los Amates, one (*Argia indicatrix*) also at Puerto Barrios.

Some other data are presented in Table 10 (see pp. 482, 483).

To illustrate the seasonal distribution more fully, the following lists of the species taken at three different localities are appended: the number before each specific name is the same as that employed in the list of species, Table B, of the Introduction, *Biol. Cent.-Amer. Neurop.;* names printed in heavy face type in this and other lists are those of species endemic in Mexico and Central America.

Distrito Federal, Mexico. No. 3. *Hetærina vulnerata*, 25. **Lestes alacer**, 53. *Hyponeura funcki*, 101. **Argia agrioides nahuana**, 108. *Enallagma civile*, 109. *E. prævarum*, 123. *Ischnura ramburi* and 124. var. *credula*, 125. **I. denticollis**, 126. *I. demorsa*, 160. **Erpetogomphus crotalinus**, 171. **Cordulegaster diadema**, 175. *Anax junius*, 179. *Æshna multicolor*, 204. *Libellula nodisticta*, 221. *Orthemis ferruginea*, 267. *Tramea cophysa*, 280. **Sympetrum illotum virgulum**, 281. *S. corruptum*, 286. *Erythemis simplicicollis collocata*, 293. *Pachydiplax longipennis*.

April, 179; May, 25, 109, 125, 175, 179, 221, 280, 281, 286, 293; June, 53, 108, 109, 123, 124, 125, 126, 160, 179, 280, 281, 286, 293; July, 25, 101, 109, 123, 124, 125, 204, 267, 280, 281, 286, 293; August, 281, 286, 293; September, 3, 25, 101, 108, 109, 125, 126, 179, 280, 281, 293; October, 3, 25, 109, 124, 125, 171, 280; November, 280; December, 281.

Cuernavaca, Morelos, Mexico. 3. *Hetærina vulnerata*, 4. *H. americana*, 24. *Archilestes grandis*, 25. **Lestes alacer**, 43. **Paraphlebia hyalina**, 52. **Hyponeura lugens**, 53. *H. funcki*, 78. *Argia ænea*, 84. **A. lacrymans**, 85. **A. tonto**, 86. *A. fissa*, 88. **A. tarascana**, 92. *A. extranea*, 93. *A. vivida*, 94. **A. vivida plana**, 103. **Hesperagrion heterodoxum**, 107. **Anisagrion lais**, 119. **Telebasis salva**, 125. **Ischnura denticollis**, 127. *Anomalagrion hastatum*, 157. **Erpetogomphus elaps**, 159. **E. cophias**, 160. **E. crotalinus**, 162. **E. sipedon**, 171. **Cordulegaster diadema**, 178. *Æshna cornigera*, 179. *Æ. multicolor*, 181. **Æ. williamsoniana**, 183. *Æ. luteipennis*, 194. **Oplonæschna armata**, 202. *Libellula saturata*, 203. *L. s. croceipennis*. 206. **Pseudoleon superbus**, 221. *Orthemis ferruginea*, 239. *Erythrodiplax connata* var. *b′* and 241. var. *d′*; 251. **Brechmorhoga tepeaca**, 253. **B. pertinax**, 261. *Paltothemis lineatipes*, 272. *Tramea onusta*, 275. *Perithemis domitia intensa*, 280. **Sympetrum illotum virgulum**, 281. *S. corruptum*.

January: Nos. 4, 24, 92, 93; May: 3, 4, 52, 78, 86 92 94, 107, 119, 202; June: 3, 24, 84, 92, 94, 103, 107, 159, 160, 178, 183, 202, 206, 221, 239, 261; July: 3, 24, 53, 92, 93, 127, 157, 159, 162, 181, 202, 203, 221, 253; August: 4, 24, 85, 88, 157; September: 3, 24, 103, 107, 119, 127, 160, 179, 275, 281; October: 3, 4, 24, 25, 84, 86, 88, 92, 93, 103, 107, 119, 127, 160, 171, 194, 202, 221, 239, 241, 251, 272, 280; November: 171.

San José, Costa Rica. No. 2. *Hetærina cruentata*, 24. *Archilestes grandis*, 67. *Argia oculata*, 86. *A. fissa*, 92. *A. extranea*, 104. **Anisagrion allopterum** and 105. var.? **rubicundum**, 113. *Acanthagrion gracile*, 157. **Erpetogomphus elaps**, 183. *Æshna luteipennis*, 203. *Libellula saturata croceipennis*, 221. *Orthemis ferruginea*, 237. *Erythrodiplax connata* var. *c*, 248. **Brechmorhoga vivax**, 254. *B. rapax*, 261. *Paltothemis lineatipes*, 273. *Pantala flavescens*, 280. **Sympetrum illotum virgulum**.

March: 203, 221, 248, 254, 273; May: 2, 67, 86, 92, 104, 105, 113, 157, 280; July: 24, 104; August: 24, 92, 183, 203, 221, 237, 261; September: 2; October: 2, 248.

From Table 10 and these three lists it is evident that the observations for different months in the same locality are quite unequal

Table 10. Number of Species, Subspecies and Varieties of Odonata taken in each Month at some Localities in which they have been Collected for more than Three Consecutive Months, with Temperatures and Rainfalls added for Comparison.

Period of Time.	Teapa, Tabasco, Mexico.				Tepic, Tepic, Mexico.				Cuernavaca, Morelos, Mexico.				Jalapa, Vera Cruz, Mexico.			
	Total number of species, etc.	Number of preceding species, etc., restricted to Mex. and Cent. Amer.	Mean temperature, Ixtacomitan, 1 year, 1884.	Mean precipitation, Ixtacomitan, 1 year, 1884.	Total number of species, etc.	Number of preceding species, etc., restricted to Mex. and Cent. Amer.	Mean temperature.	Mean precipitation 29 years, 1844–59, 1866–68, 1885–94.	Total number of species, etc.	Number of preceding species, etc., restricted to Mex. and Cent. Amer.	Mean temperature 2 years, 1873–74, 1907.	Mean precipitation 2 years, 1873–74, 1907.	Total number of species, etc.	Number of preceding species, etc., restricted to Mex. and Cent. Amer.	Mean temperature 13 years, 1895–1907.	Mean precipitation 13 years, 1895–1907.
			°C.	mm.			°C.	mm.			°C.	mm.			°C.	mm.
January	35	10	(19.9)	(822)					4		18.5	.5			14.5	41.1
February	46	7	(23.1)	(274)							17.2	17.7			15.2	63.4
March	25	5	(24.8)	(152)							21.8	11.3	2		17.9	48
April	19	5	(26.0)	(172)							23.1	23.3	1	1	18.9	64.9
May			(26.4)	(155)					10	4	23.3	94.6			20.4	80.7
June			(26.9)	(119)					16	7	21.9	298.9			19.8	284.5
July			(25.9)	(338)	7	1			14	5	20.7	228.7			18.8	199.1
August			(25.1)	(773)	5	3			5	3	20.5	170.9	3	1	19.2	163.4
September			(25.2)	(704)					10	4	20.5	213.6	9	3	18.9	208.8
October			(23.8)	(550)	27	10			23	10	20.6	56.2			17.8	138.8
November			(22.7)	(569)	19	8			1	1	20.4	23.4	8		16.6	97.7
December			(22.8)	(46)							18.1	18.2	1	1	14.5	71.5
Not dated					2	1			2	2			7	2		
Year	65	17	(24.4)	(4674)	42	16		1415	43	21	20.5	1157.3	24	6	17.7	1461.9

Period of Time.	Orizaba, Vera Cruz, Mexico.				San José, San José, Costa Rica.				Distrito Federal, Mexico.			
	Total number of species, etc.	Number of preceding species, etc., restricted to Mex. and Cent. Amer.	Mean temperature 2 years, 1895–96.	Mean precipitation 1 year, 1896.	Total number of species, etc.	Number of preceding species, etc., restricted to Mex. and Cent. Amer.	Mean temperature 12 years, 1889–1900.	Mean precipitation 12 years, 1889–1900.	Total number of species, etc.	Number of preceding species, etc., restricted to Mex. and Cent. Amer.	Mean temperature 15 years, 1877–91.	Mean precipitation 15 years, 1877–91.
			°C.	mm.			°C.	mm.			°C.	mm.
January			14.2				18.8	11.8			12.1	4.7
February			13.8				19.3	1.5			13.7	6.4
March	3	1	17.6		5	1	19.8	14.2			15.9	11.1
April			20.4				20.4	40.6	1		17.7	16.7
May			22.9		9	4	20.5	230.	10	3	18.1	54.1
June	6		21.9				20.1	291.	13	3	17.6	106.6
July			20.9		2	1	19.8	241.	12	4	16.9	109.8
August			20.8		7		19.7	257.	3		16.6	132.
September	1		20.6		1		19.8	312.	11	4	16.1	109.4
October			18.9	204.	2	1	19.6	325.	7	4	14.8	46.4
November			18.4	205.			19.4	154.	1	1	13.5	13.1
December	13	4	14.6	19.5			18.8	39.	1		12.0	4.6
Not dated	8	6										
Year	29	11	(18.2)		18	5	19.7	1917.	21	6	15.4	614.8

The climatic data quoted in this table have been obtained from the following sources. Those for Ixtacomitan, Chiapas, 210 m. alt., as the nearest point to Teapa, from *Meteorol. Zeitschr.* for 1895, p. 387; for Tepic from Escobar, *Mem. Soc. Cien.*, "Antonio Alzate," XX, pp. 40–1, 1903; for Cuernavaca from July 1, 1873, to June 30, 1874, from Reyes, *Bolet. Soc. Geog. Estadist. Rep. Mex.*, (3) IV, pp. 90–128, 1878. For those for Cuernavaca for 1907 and for Jalapa, 1895–1907, I am indebted to the Director of the Observatorio de Cuernavaca and to Señor G. M. Gonsalez, Director of the Observatorio Meteorológico de la Ciudad de Xalapa-Enriquez, both through the kindness of Señor Don Manuel E. Pastrana, Director of the Observatorio Meteorológico-Magnetico Central de Mexico. The data for Orizaba are from Moreno y Anda and Gomez, *El Clima de la República Mexicana*, Años I and II, Mexico, 1899 and 1900. The data for San José, Costa Rica, are from *Boletin Instit. Fisico-Geog. Costa Rica*, III, 1903; for the Federal District, Mexico, from the "Observatorio Meteorológico Central de Mexico," a summary of 12 pages and 2 tables issued by the Secretaría de Fomento, Mexico, 1892, and dedicated to the American Public Health Association.

and fall far short of giving a complete picture of the Odonate fauna. It is also clear, especially from the Cuernavaca list, where the same species appear at frequent intervals throughout the year, that a number of different, perhaps overlapping, broods must exist, as there is no reason for supposing that the life of an individual imago is prolonged for many months.

Rainfall and Odonata on the Atlantic and Pacific Slopes.—Various authors[32] have remarked the greater abundance of species of animals, including insects, on the Atlantic than on the Pacific slope of Mexico and much of Central America. Sumichrast (*l.c.*, p. 5) has attributed the relative poverty of the Pacific slope of Tehuantepec and adjoining areas in birds to "the extreme dryness of the soil; to the scarcity of vegetation and of insect life; and to the duration of the winds from the northeast and southwest which there prevail with great violence." Harrington[33] has concluded that for Central America, "The rainfall is greater on the Atlantic than on the Pacific side as two or three to one." Table 11 gives the distribution of the Odonata on these sides and on the Mexican plateau for the whole of our district, from which it appears that the total number of Atlantic slope species is 235 against 181 for the Pacific, a proportion of nearly 4 to 3. Tables 6–8 (pages 471–473) give the proportions for Mexico, Guatemala and Costa Rica respectively as, approximately, 4 to 3, 4 to 2, 4 to 4½.

Neither the rainfall nor the Odonate fauna can be summarized so briefly, however, as local conditions may cause both of these to vary. Not only the map of Puga,[34] but also the publications of Sapper[35] and of Lottermoser[36] show as heavy a rainfall on parts of the Pacific slope of Mexico and Guatemala as on the Atlantic side. The Odonate fauna of Altamira and Tampico, in Tamaulipas, numbers 40 species-that of Tepic 42; for Jalapa, Vera Cruz, we know 24 species, for Guada; lajara 50; for the vicinity of the city of Vera Cruz, including Medellin,

---

[32] Sumichrast, quoted by Lawrence (*Bull. U. S. Nat. Mus.*, No. 4, 1876) for birds of the Isthmus of Tehuantepec. Godman (*Biol. Cent. Amer. Lepid. Rhopal.*, I, p. vi, 1901) for Lepidoptera Rhopalocera generally "to perhaps as far south as Costa Rica." V. Martens (*Biol. Cent. Amer. Land and Freshw. Moll.*, p. xxvii) for this group to the same distance; he correlates the greater abundance of species with the greater area of the Atlantic slope of Mexico, Guatemala, Honduras and Nicaragua. Champion (*Entom. News*, XVIII, p. 33, 1907) for insects of Guatemala.

[33] *Bull. Philos. Soc.*, Washington, XIII, p. 7, 1895.

[34] "Distribucion de las Lluvias en la Republica Mexicana," *Mem. Soc. Cien.*, "Antonio Alzate," XVI, 1901.

[35] Petermann's *Mitth.*, XLIII, pp. 117 *et seq.* and map, 1897; *Das Nördliche Mittelamerika*, pp. 182–3; *Mittelamerikanische Reisen u. Studien*, pp. 299–300.

[36] *Meteorol. Zeitschr.*, XXIII, pp. 237 *et seq.*, 1906.

TABLE 11.—DISTRIBUTION OF THE SPECIES, ETC., OF ODONATA OF MEXICO AND CENTRAL AMERICA BY SLOPES AND (IN MEXICO) THE CENTRAL PLATEAU.
(A = Atlantic, P = Pacific, slope;[37] C = Central Mexican plateau.)

Subfamily.	Exact distribution unknown	Restricted to			Common to				Totals
		A	C	P	A C	A P	C P	A C P	
Calopteryginæ	1	13	0	3	0	3	0	3	23
Lestinæ		3	0	1	0	1	0	2	7
Agrioninæ	4	39	0	14	2	32	5	16	112
Gomphinæ	2?	9	1	7	1	2	3	3	28?
Cordulegasterinæ						1		1	2
Æshninæ	4	5	1	1	0	6	1	5	23
Cordulinæ		1							1
Libellulinæ		17	2	4	7	39	4	24	97
	11	87	4	30	10	84	13	54	293
Endemic species, etc.	4	59	1	22	2	30	10	13	141
Occur also in Northern Amer.	3	2	3	1	6	6	2	14	37
Occur also in S. Amer.	3	22	0	8	3	48	1	30	115
Occur also in W. Indies.	2	11	0	1	3	19	1	19	56

11 species are now recorded, for Acapulco 19. In Pacific Guatemala the highest number recorded for one locality is 26 at Santa Lucia, which is exceeded at various stations on the Atlantic slope, but this latter has received much more attention from the collectors whose material is accessible.

Generally we may conclude that the hot moist areas of Mexico and Central America are tenanted by the greatest number of forms of Odonata, present information pointing to the richest areas as lying in temperature zone III and the higher parts of zone II, on the Atlantic slope, from the centre of the State of Vera Cruz southward, these areas having a heavy annual rainfall.

In this connection may be mentioned the suggestion of a possible

[37] The terms "Atlantic" and "Pacific slopes" are here used in the wide sense as embracing: (*a*) in Mexico all the descending lands from the outlines of the plateau, as shown on our map (Plate XXVI), to the Gulf of Mexico on the one side and to the Pacific Ocean and Gulf of California on the other; (*b*) in Mexico south of the plateau and in Central America, as corresponding to the Atlantic and Pacific drainage areas respectively.

correlation between paleness of wing-veins and dryness of climate,[38] which seems to receive some support from *Argia mæsta*[39] and *Enallagma civile;*[40] but, on the other hand, appears to be negatived by specimens of *Enallagma prævarum* from many of the same localities which furnish *E. civile.*[41]

Whatever of a more exact character we learn in the future of the dependence of these insects on climatic conditions, we must conceive of the latter as operating in a manner which may be compared to the beating of the waves upon a shore. A higher temperature and a more copious rainfall, together or singly, advance upward to a greater elevation or northward to a higher latitude, making possible the existence of certain species in the larval state where they were previously unknown. The next year, or after several years, these favorable conditions retreat down the mountain slopes or southward along the coastal plains, and the species whose existence they permitted disappear from certain localities for a longer or shorter period of time until the necessary conditions are again established.[42] To demonstrate the correctness of this view such continuous observations at a number of stations as were mentioned above (page 479) are essential.

Relations of the Odonate Fauna to Vegetation Areas.

Dr. Charles C. Adams, whose recent researches have been directed chiefly to the detection of the relations of faunæ to their physiographic surroundings, has suggested to me to endeavor to correlate the distribution of these insects with that of vegetation areas, the latter to serve as indices of the general physical features of the country. In this attempt I have employed Dr. Karl Sapper's vegetation maps of Central America,[43] locating the various places at which the Odonata have been collected in his zones and tabulating the distribution of the species accordingly. The results, save in a few instances to be mentioned shortly, have been unsatisfactory, as the great majority of species appear in several columns of the tabulation. Thus of 133

[38] *Biol. Cent.-Amer. Neurop.*, p. 235.
[39] *L.c.*, p. 361.
[40] *L.c.*, pp. 110, 380.
[41] *L.c.*, p. 380.
[42] Some remarks by Mr. S. E. Meek (*Publicat. Field Columb. Mus. Chicago*, V, pp. xxvi–xxvii, 1904), on the effects on the fish fauna of fluctuations in bodies of water on the northern part of the Mexican plateau, may also be applied to Odonate larvæ.
[43] In *Das Nördliche Mittelamerika* (map dated 1895), 1897, and *Mittelamerikanische Reisen und Studien* (map dated 1900), 1902. There is also a larger scale map for Guatemala only, dated 1894, in Petermann's *Mittheil.*, Erganzungsband XXIV.

species so tabulated, six (*Hetærina cruentata, Argia fissa, A. extranea, Acanthagrion gracile, Ischnura ramburi* var. *credula, Perithemis domitia iris*) occur in all of the four zones in which these insects have been collected, viz. (names as given in Sapper's, 1895, map for Guatemala): 1. Savannas and stretches of primeval forest alternating (wet), 2. Tropical and subtropical rainy forests, 3. Oak and pine forests of the hot and temperate climates, 4. Grass- and bush-steppes and dry forests. Twenty-four species (*Hetærina tricolor, H. macropus, Argia pulla,* **A. indicatrix,** *A. ænea, Enallagma cæcum novæ-hispaniæ,* **Telebasis salva,** *Leptobasis vacillans, Uracis imbuta, Orthemis ferruginea, O. levis,* **Erythrodiplax funerea,** *E. umbrata, E. ochracea, E. connata* var. *d, Dythemis velox, D. cannacrioides, Brechmorhoga præcox, B. inequiunguis, Macrothemis pseudimitans, Paltothemis lineatipes,* **Sympetrum illotum virgulum,** *Erythemis verbenata, Lepthemis vesiculosa*) appear in three zones. More than thirty species (including such endemic forms as **Cora marina, Heteragrion tricellulare, Argia frequentula, Telebasis digiticollis, Neoneura amelia, Erpetogomphus viperinus, Brechmorhoga pertinax**) are common to zones 2 and 4, but not to others.

This does not necessarily mean that a correlation of Odonate species with vegetation formations does not exist. It may be that slight local differences of too small an area to be shown on the maps employed, or that our data based solely on the imagos, not on the larvæ, are responsible for its apparent absence.[44]

The few instances, above referred to, in which some correlation seems to exist are those of certain Odonata occurring in the tropical and subtropical rainy forest areas, as the species of *Protoneura, Paraphlebia, Argiallagma, Ephidatia* and *Nephepeltia*, and, less certainly, of other genera of the legions Podagrion and Protoneura. From the notes of collectors which have been quoted under the respective species[45] it would also appear that members of the legion Pseudostigma are dwellers in forests,[46] although not necessarily wet forests.

---

[44] Those disposed to make further researches as to the existence of such correlations will doubtless find assistance in Señor Jose Ramirez' "La Vegetacion de Mexico" (*Anales, Ministerio de Fomento, Repub. Mex.*, XI, pp. 227–489, 1898). His botanico-geographical regions, however, are not shown on any of the maps accompanying his memoir.

[45] *Biol. Cent.-Amer. Neurop.*, pp. 53, 56, 353. Cf. also Selys, *Mem. Couron. Acad. Sci. Belg.*, XXXVIII, p. 9, footnote, 1886.

[46] With the clearing of these forests, now apparently in progress (cf. Belt, *Naturalist in Nicaragua*, pp. 185–6; Sapper, *Mittelamerikanische Reis. u. Stud.*, pp. 308–9), we must probably expect the disappearance of these Odonata.

Relations of the Odonate Fauna to Altitude.

Table 9, page 476, in connection with the map (Plate XXVI), may be used as indicating not only temperature zones, but also the elevated or non-elevated character of the country in which Odonata have been found, the higher zone numbers corresponding to higher altitudes. Zone II in Central America and in Mexico south of 20° N. Lat. (25° N. Lat. on the Pacific side) embraces all the low coast lands. The highest point on the Atlantic slope of Mexico to which it attains appears to be Actopan,[47] in Vera Cruz (311 m.[48]), whence it descends to sea-level south of Tuxpan, while on the Pacific slope it reaches 487 m. at the city of Colima[49] and sea-level north of Culiacan. Its upper limit in Central America is about 270 m.

North of zone II the coasts of Mexico fall in zone III, which, with the higher parts of zone II, includes everywhere the gradually ascending slopes of the central plateaus and mountain ranges to an elevation of about 1,160 m. in Central America, 1,560 m. at Oaxaca City, 1,000 m. at Mirador, Vera Cruz, 700 m. in Nuevo Leon and higher than this last in Sonora.

In zones IV and V the larger rivers arise, to descend (except in some parts of northern Mexico) through zones III and II to the sea. Zone IV extends to an elevation of 2,050 m. in Central America, 2,200 m. in the southern part of the Mexican plateau, but to not above 1,200–1,300 m. in places in New Mexico.

The only species which appear to be exclusively confined to the actual sea-coast are *Æshna brevifrons, Erythrodiplax berenice næva* and *Tramea longicauda* var. *Libellula auripennis* is chiefly a sea-coast species, but in Mexico, as in the United States, has been found elsewhere. A larger number (16)[50] of forms are not known to descend below the lower limits of zone IV and are, in our district, markedly highland species. Such are **Hetærina tolteca, H. maxima, Cora skinneri,** *Lestes henshawi,* **Argia terira, herberti, chelata** and **tonto,** *Progomphus obscurus borealis,* **Cordulegaster godmani, Æshna dugesi,** *Plathemis subornata, Libellula comanche,* **foliata,** *nodisticta* and *luctuosa.* The remaining 274 forms have an intermediate or a more varied habitat,

[47] Moreno y Anda and Gomez, *El Clima de la Republ. Mex.*, Ano II, p. 136.
[48] *Revista Soc. Cien.*, "Antonio Alzate," XXIII, pp. 31, 32, 1905.
[49] Hann, *Hdb. d. Klimatologie*, IIte Aufgabe, II, p. 286.
[50] The apparent discrepancy between this figure (16) and that to be obtained (19) from Table 9, page 476, is due to the fact that the three other species or varieties, *Anax longipes* and *Erythrodiplax connata a′* and *c′*, while as yet found only in zone IV in Mexico and Central America, have been taken at lower levels in South America or in the West Indies.

in some cases restricted apparently to a single locality (**Hetærina rudis**), in others having a wide range of elevation, as from the sea-coast to the central plateau (*Anomalagrion hastatum*, *Ceratura capreola*). Where the same species of *Isçhnura* has been found at quite different altitudes, a slight increase in body size and in the number of post-cubitals has been detected in specimens from the higher stations.[51]

In concluding this discussion of the relations of the Odonata to various factors of their environment, lists of the forms recorded from a few localities of decidedly different physical character are appended. See also the lists given for the Distrito Federal, Cuernavaca and San José on page 481.

Guzman, Chihuahua (desert of Northern Mexican plateau, mean annual temperature probably near 18° C. or 64 F.; altitude 1,341 metres or 4,400 feet), all the following species were seen or taken Aug. 6 and 7, 1906: **Argia moesta**, *Enallagma civile*, *Ischnura ramburi* var. *credula*, *Anax* (*junius*?), *Plathemis subornata*, *Orthemis ferruginea*, *Tramea* sp., *Pantala flavescens*, *Sympetrum corruptum*, *Erythemis simplicicollis* or its subspecies *collocata*.

Mazatlan (Pacific sea-coast, mean annual temp. 1880–1902, 24.9° C. or 76.8° F.; mean ann. rainfall 1880–1901, 806 mm. or 32.25 inches): *Mecistogaster ornatus*, *Argia pulla*, *Enallagma cœcum novæ-hispaniæ*, *Leptobasis vacillans*, *Ischnura ramburi* and var. *credula*, **Pseudoleon superbus**, *Orthemis ferruginea*, **Erythrodiplax funerea**, **Brechmorhoga postlobata**, *Macrothemis inacuta*, *Miathyria marcella*, *Tramea longicauda* var., *T. onusta*, *Pantala flavescens*, *P. hymenæa*, *Perithemis domitia intensa*, *Cannacria batesii*, *Erythemis verbenata*, *Lepthemis vesiculosa*.

Atoyac, Vera Cruz (moist Atlantic slope of Mexico, cf. page 480, *antea*; mean ann. temp. probably about 22.7° C. or 72.9° F.; alt. 400 m. or 1,314 ft.): *Hetærina cruentata*, *H. titia*, *H. macropus*, **H. infecta**, **Cora marina**, *Archilestes grandis*, *Lestes tenuatus*, *Megaloprepus cœrulatus*, **Pseudostigma aberrans**, *Mecistogaster ornatus* and **modestus**, *Heteragrion chrysops*, *Hyponeura funcki*, **Argia percellulata**, *translata*, **frequentula**, **ulmeca**, *oculata*, **cuprea**, *œnea*, *fissa* and *extranea*, **Anisagrion lais**, *Enallagma cœcum novæ-hispaniæ*, *Acanthagrion gracile*, *Leptobasis vacillans*, **Palæmnema paulina** and **angelina**, **Protoneura aurantiaca**, **Gomphoides suasa**, **Erpetogomphus viperinus** and **ophibolus**, **Cyanogomphus** (?) **tumens**, *Æshna cornigera*, *virens* and *perrensi*, *Gynacantha trifida* and *tibiata*, *Libellula herculea*, **Pseudoleon superbus**, *Tholymis citrina*, *Micrathyria didyma*, *dissocians* and *ocellata*, *Orthemis ferruginea* and *levis*, *Cannaphila vibex*, *Anatya guttata*, **Erythrodiplax funerea**, *umbrata*, *ochracea*, *connata* vars. *d* and *e*, *Dythemis velox*, **Brechmorhoga vivax**, *præcox*, **pertinax**, and *inequiunguis*, *Macrothemis pseudimitans* and *hemichlora*, *Miathyria simplex*, **Tauriphila azteca**, *Perithemis domitia iris* and *d. mooma*, *Erythemis peruviana*, *attala* and *verbenata*, *Lepthemis vesiculosa*.

Puerto Barrios (Atlantic coast of Guatemala, see page 480; mean ann. temp. for 1896, 26.8° C. or 80.3° F.): *Hetærina tricolor*, *titia* and **miniata**, *Heteragrion chrysops*, *Argia translata*, **gaumeri**, **frequentula** and **indicatrix**, *Acanthagrion gracile*, **Telebasis digiticollis**, *Anomalagrion hastatum*, *Ceratura capreola*, **Neoneura paya**, **Protoneura amatoria**, *Ephidatia longipes cubensis*, *Uracis imbuta*, *Micrathyria debilis* and *eximia*, *Nephepeltia phryne*, *Anatya normalis*, *Erythrodiplax umbrata*, *ochracea*, *connata* vars. *c*, *d*, *e*, *Dythemis velox*, *Macrothemis hemichlora*, *Tauriphila argo*, *Tramea insularis*, *Pantala flavescens*, *Perithemis domitia iris*, *Erythemis verbenata*, *Lepthemis vesiculosa*.

San Geronimo (dry, elevated central Guatemala; mean ann. temp. probably 20°–21° C. or 68°–69.8° F.; mean ann. rainfall less than 1,000 mm. or 40 inches; alt. 900 m. or 2,950 ft.): *Hetærina cruentata*, *capitalis* and **rudis**, *Amphipteryx*

[51] *Biol. Centr.-Amer. Neurop.*, pp. 387–389.

agrioides, **Cora marina**, *Archilestes grandis*, **Heteragrion tricellulare**, *Hyponeura funcki*, *Argia fissa*, *Acanthagrion gracile*, **Telebasis salva**, *Anomalagrion hastatum*, *Progomphus pygmæus*, **Erpetogomphus viperinus** and **elaps**, *Anax amazili*, *Æshna multicolor* and *luteipennis*, *Gynacantha septima*, *Orthemis ferruginea*, *Cannaphila vibex*, **Erythrodiplax funerea**, *umbrata* and *connata* var. *d*, *Dythemis velox* and **maya**, **Brechmorhoga pertinax**, *rapax* and *inequiunguis*, *Macrothemis pseudimitans*, *Paltothemis lineatipes*, *Tramea abdominalis*, *Pantala flavescens*, *Lepthemis vesiculosa*.

CACHI, Costa Rica (moist Atlantic slope; mean ann. temp. probably about 20.6° C. or 69° F.; mean ann. rainfall 1902–04, 2,200 mm. or 86.78 inches; alt. 1,020 m. or 3,345 ft.): *Hetærina cruentata*, *macropus*, *capitalis* and *majuscula*, *Archilestes grandis*, *Megaloprepus cœrulatus*, **Mecistogaster modestus**, *Heteragrion chrysops* and **erythrogastrum**, **Argia frequentula**, **rogersi**, *fissa*, **variabilis**, and *extranea*, **Anisagrion allopterum** and var. **rubicundum**, *Enallagma cæcum novæ-hispaniæ*, **Epigomphus tumefactus** and **subobtusus**, *Anax amazili*, *Æshna luteipennis*, *Gynacantha trifida*, *Libellula herculea*, *Orthemis ferruginea*, *Cannaphila vibex*, **Erythrodiplax funerea** and *connata* var. *d*, **Brechmorhoga vivax**, **pertinax** and *rapax*, *Paltothemis lineatipes*, *Pantala flavescens*.

SURUBRES, Costa Rica (Pacific slope, drier; mean ann. temp. probably about 25° C. or 77° F.; alt. about 250 m. or 820 ft.): **Hetærina fuscoguttata**, *cruentata* and *macropus*, *Mecistogaster ornatus*, **Heteragrion erythrogastrum**, *Perilestes fragilis*, *Argia translata*, **tezpi**, *pulla*, **frequentula**, **adamsi**, *difficilis*, *cupraurea* and *ænea*, *Acanthagrion gracile*, *Ceratura capreola*, *Uracis imbuta* and *fastigiata*, *Orthemis ferruginea*, **Erythrodiplax funerea** and *connata* vars. **c** and *e*, *Dythemis velox*, **Brechmorhoga vivax**, *Macrothemis hemichlora*.

EXPLANATION OF PLATE XXVI.

Map showing the distribution of actual mean temperatures in Mexico and Central America.

This map was especially prepared by the writer for the *Biologia Centrali-Americana*, volume *Neuroptera*. Acknowledgment is due to Dr. F. D. Godman, editor of that work, for permission to reproduce it here. It is based on data from the following sources:

For the *United States*: Prof. A. J. Henry's "The Climatology of the United States" (*Bulletin Q, U. S. Weather Bureau*, Washington, D. C., 1906, 4to).

For *Mexico*: 1. A map, 97 x 71.5 cm., in the library of the Academy of Natural Sciences of Philadelphia, inscribed merely "Carta Climatologica. Sebastian Reyes. P. I. Senties. A. Donamette Imp. Escala de 1: 3,000,000. Gravée chez Monrocq fr. Paris." Thanks to the Secretaria de Estado y del Despacho de Fomento Colonizacion e Industria of Mexico, I am informed, under date of July 30, 1907, "que dicha Carta fué publicada en 1889 por disposicion de esta Secretaria, haciendo los trabajos relativos los Sres. Pedro J. Senties, que era Director de la Escuela Nacional de Agricultura y Comisionado de México en la Exposicion de Paris del mismo año y Sebastian Reyes que fué Profesor del Plantel antes mencionado." This map was reproduced without alteration, but on a reduced scale (1 : 6,000,000), in Tome XI, *Anales del Ministerio de Fomento de la República Mexicana*, Mexico, 1898.

2. A map entitled "Reparticion de la Temperatura en la República Mexicana" for the "Año Meteorológico de 1902," published as Plancha 16, *Boletin Mensuel, Observatorio Meteorológico-Magnetico Central de México*, Noviembre, 1902. Señor Don Manuel E. Pastrana, Director of the Observatorio, has kindly informed me (Sept. 6, 1907) that the maps for later years have not been published.

3. A number of temperature data for 70 stations in the State of Vera Cruz and 49 in other parts of Mexico, gathered from all accessible sources and published by the writer in the *Monthly Weather Review*, Vol. XXXVI, No. 4, pages 93-97, Washington, D. C., April, 1908. Issued June 16, 1908.

4. The topography of the country as given in the map issued by the Bureau of American Republics, Washington, D.C., 1900. The limits of the central plateau are taken from the map published in the *Boletin Mensuel, Observat. Meteor.-Mag. Cent. Mex.* for July, 1901.

It should be added that the existence of zone I, with a mean annual temperature of more than 30° C., rests solely on the authority of the map of Senties and Reyes, that it is doubted by Señor Pastrana, and that I have not succeeded in finding any records of temperature observations in the valley of the Rio de las Balsas for a period of more than two months.

For *Central America*, the temperature records quoted in the paper in the *Monthly Weather Review*, above mentioned, indicate that in Guatemala and Costa Rica the annual isotherms of 25°, 20°, 15°, 10° and 5° C. are situated approximately at elevations of 270, 1,160, 2,050, 2,950 and 3,840 metres respectively. The present map, so far as Central America is concerned, has been made from the topographical maps of Dr. Sapper (Petermann's *Mittheilungen*, L, 1904, and *Erganzungsbänder* XXVII and XXXII, 1899 and 1905; and *Mittelamerikanische Reisen und Studien*, Braunschweig, 1902) and of the Bureau of American Republics for Guatemala (1902), Nicaragua (1903) and Costa Rica (1903), by using these equivalents.

A REVIEW OF THE GENUS PIAYA Lesson.

BY WITMER STONE.

While rearranging the Cuckoos in the collection of the Academy of Natural Sciences my attention was attracted to the type specimen of *Piaya macroura* Gambel. The apparent omission of this species from Dr. Bowdler Sharpe's *Hand List of Birds* led me to make a critical study of the genus, the results of which are embodied in the present paper.

I am under obligations to the United States National Museum through Dr. Charles W. Richmond, and to the American Museum of Natural History through Mr. Frank M. Chapman, for the loan of large series of specimens of the genus, without which my investigation would not have been possible. The material loaned by these institutions, together with that in the Academy's Museum, numbers 259 specimens distributed as follows: Mexico, 64; Central America, 59; Panama, 13; Colombia, 26; Venezuela, 18; Ecuador, 8; Brazil, 32; Guiana, 6; Bolivia, 2; Peru, 4; Paraguay, 2; Trinidad, 8.

The genus *Piaya* includes two very well-marked species, *P. melanogastra* and *P. rutilus*, and a number of allied geographic races which have generally been combined under the name *P. cayana*.

The first two offer but few difficulties, and it is the *cayana* group that has caused confusion in the nomenclature of the genus. The forms of *Piaya cayana* may be roughly divided into three groups according to the color of the upper surface. In group (1) it is bright ferruginous;[1] (2) bay inclining to chestnut; (3) walnut brown tinged with chestnut. Beginning at the northern part of the range of the genus, we have in western Mexico a large form of the ferruginous group (*mexicana*), while in eastern Mexico, extending throughout Central America and Panama, is a totally different form of the chestnut-backed group (*mehleri*). The individuals are quite uniform over this large area, with the exception of the size of the bill, which is smaller in Mexican and Yucatan birds than in those from Nicaragua and Costa Rica.

In the Cauca river valley of Colombia is a slightly different form (*caucæ*), in which the flanks as well as the crissum are black, this

[1] All colors are based on Ridgway's nomenclature of colors.

color encroaching farther upon the gray abdomen than in any other form. In northeastern Colombia (Santa Marta to Bogota) and the western portion of Venezuela is a light bird of the "ferruginous" group (*columbiana*), practically identical with the form of western Mexico except for its much larger bill. Farther east, from the Orinoco valley throughout Guiana, is another of the chestnut-backed forms (*cayana*), similar to that from Central America, while to the southwest is still another (*nigricrissa*), ranging over eastern Colombia through Ecuador and Peru. Both of these differ from the Central American bird in dimensions and in the almost total lack of brown on the under surface and the tail which is uniform black, while the Guiana form differs further in having gray under-tail coverts instead of dull black. On the island of Trinidad is a diminutive ferruginous-backed bird (*insulana*), otherwise similar to the Central American form. In southern Brazil, from Bahia and Matto Grosso, is a larger very pale bird (*pallescens*) of the ferruginous type.

In Paraguay, and doubtless in parts of Argentina and southern Brazil, occurs the largest form of all (*macroura*), with a different coloration from any of the more northern races, the back being walnut brown tinged with chestnut. In Bolivia and southern Peru is a smaller race of this same style of bird (*boliviana*), differing further in its gray instead of black under-tail coverts.

Three of the races of *Piaya cayana* seem to have been described by early non-binomial authors. Hernandez's Quapactotl being in all probability the east Mexican bird, while Brisson's *Cuculus cayenensis* is undoubtedly the form from Cayenne and Azara's Tingazu the very large dark bird of Paraguay.

Linnæus established Brisson's bird in binomial nomenclature as *Coccyzus cayanus* and Gmelin gave the name *Coccyzus ridibundus* to the Quapactotl of Hernandez, quoting the original more or less indefinite description, as was done also by Ray, Buffon and Latham, the last of whom designated it as the Laughing Bird. Later Stephens inadvertently changed Gmelin's name to *rubicundus*, but added nothing to the original diagnosis. This—viz.: "C. fulvus, gula, jugulo, et pectore cinereis, abdomine, femoribus et tectricibus caudæ inferioribus nigris. L. 16 ins. Tail half the length of the body. Hab., Nova Hispana"—seems not clearly identifiable, although it is added to the synonymy of *Piaya cayana* by Capt. Shelly without question in Vol. XIX of the British Museum Catalogue of Birds, where all these forms are lumped under the above name.

Vieillot, in 1817, gave the name *macrocercus* collectively to the

P. cayana of Linnæus and allied forms, several of which were described but not named.

Swainson, 1827, named the light-colored western Mexican bird *mexicana*, and 1837 modified Linnæus' name *cayanus* into *cayennensis*, which was the form in which it had been used by Brisson.

Gambel, 1849, described the large Paraguay bird as *Piaya macroura*, but erroneously credited his specimen to Surinam, as pointed out by Cabanis (*Mus. Hein.*, IV, p. 87). Dr. J. A. Allen (*Bull. Amer. Mus. Nat. Hist.*, V, p. 137, 1893) correctly states that Gambel regarded *P. cayana* L. and *P. mexicana* as identical, but his description of *macroura* could never apply to *cayana* as Dr. Allen claims. Gambel states that the crissum is black and the length of tail is 15 inches, while *P. cayana* has a gray crissum and a tail only 9.50 inches in length (Dr. Allen's measurement)!

Bonaparte, 1850, also describes the large Paraguay bird as *P. circe* from a specimen erroneously recorded as from Colombia (error in locality also pointed out by Cabanis, *l.c.*) and describes as new another bird, *P. mehleri*, from Bogota. This name has caused much trouble to subsequent authors. For a time it was used for the small form occurring from southeastern Colombia to Ecuador and Peru. Then Dr. Sclater examined the type in the Paris Museum and stated (*P. Z. S.*, 1860, p. 285) that it was identical with the east Mexican and Central American bird, claiming that the type locality must have been wrong. Subsequently Dr. Allen and also Mr. Hartert (*Nov. Zool.*, V, 499) have used the name again for the Ecuador bird, and it so stands in Sharpe's *Hand List*.

The examination of the type ought to settle a question of this kind, and I can see no reason why Dr. Sclater's statement should be ignored.

Cabanis' review of the genus (*Mus. Hein.*, IV, p. 82, 1862) is a remarkably accurate piece of work. He describes as new the well-marked forms *pallescens*, *guianensis* and *columbianus*, and clearly diagnoses as distinct *mexicanus* Swainson, *macrourus* Gambel, *nigricrissa* Sclater, *cayana* Linn. and *mehleri* Bon. His new species *mesurus*, however, seems not separable from his *columbianus*.

In Dr. J. A. Allen's brief review of the genus (*Bull. Amer. Mus. Nat. Hist.*, V, p. 136, 1893) he falls into several errors, largely through lack of material, having no specimens of the light colored bird of northern Colombia and Venezuela, nor of the very large dark form from Paraguay.

He ignored Cabanis' exlpanation of the true nature of Gambel's *macroura*, making it a synonym of *cayana* in spite of the discrepancies in size and color; and then identified the *macroura* of Cabanis with his new race *cabanisi*, a pale bird differing only slightly in measurements from *pallescens* Cab., from which it does not seem separable.

As a matter of fact *macroura* and "*cabanisi*" differ more in color than do *mexicana* and *mehleri*, which Dr. Allen regarded as the most distinct of any of the races.

Dr. Allen used Bonaparte's name *mehleri* for the Ecuador bird, apparently overlooking Sclater's statement, but he rightly surmised that the Bolivian birds were separable, though he allied them to the Ecuador form instead of to *macroura*, to which they are closely related. *P. circe* Bon., correctly referred to *macroura* by Cabanis, is doubtfully referred to *mehleri* by Dr. Allen.

Hellmayr (*Nov. Zool.*, XIII, p. 43) describes as new the Trinidad bird, calling it *insulana*, and gives a good résumé of the several forms recognized by him. He here distinguishes *guianensis* from *cayana*, although he later regards them as not separable; he also adopts Dr. Allen's *cabinisii* for the big dark colored *macroura*, apparently overlooking the fact that Dr. Allen's bird, which "differs little in color from *pallescens*," could hardly have the "crissum black."

Von Ihring (*Revista Museo Paulista*, 1904, p. 448) recognizes Allen's error in writing *P. macroura* and *P. cabanisi* and again renames the former var. *guarania*.

Key to the Species and Subspecies.

Plicum gray sharply contrasted with the rest of the upper parts, *melanogastra*.
Pileum uniform with the upper parts or very nearly so.
- Size very small; wing 4.12 in.; throat cinnamon rufous, . *minuta*.
- Size medium or large, wing 5.50–6.80; throat vinaceous.
  - ferruginous above.
    - large, tail 11.30–12.70.
      - tail strongly rufous below, black subterminal bands strongly defined.
        - bill large, ... *columbiana*.
        - bill small, ... *mexicana*.
      - tail dull blackish brown below, black subterminal bands not clearly defined, ... *pallescens*.
    - small, tail 9.30, ... *insulana*.
  - bay above.
    - tail uniform dull black beneath, no trace of subterminal bands.
      - crissum gray, ... *cayana*.
      - crissum black, ... *nigrocrissa*.
    - tail below with rusty on the outer webs at least.
      - thighs gray, tail 10.50–11, ... *mehleri*.
      - thighs black, tail 12, ... *caucæ*.

walnut brown above, tail uniform dull black beneath.
tail 15.10, crissum black, ... *macroura.*
tail 11.25, crissum gray, ... *boliviana.*

Piaya melanogastra (Vieillot).

Cuculus melanogaster Vieillot, Nov. Dict., VIII, p. 236, 1823 ['Java,' loc. err. = South America].
Piaya brachyptera Lesson, Traité, p. 140, 1831 [Cayenne].
Melias corallirhynchus Lesson, Rev. Zool., 1840, p. 1 [Hab. ?].

Length of wing, 5.46 inches; tail, 8.85.

Above ferruginous, tail and wings glossed with wine purple, entire pileum, nape and eye region ashy gray, rectrices with white tips and black subterminal bands, remiges with dusky tips, throat and breast cinnamon rufous, rest of under surface dull black; specimens examined from Cayenne; Demarara; Napo River, Ecuador; Amazonia.

The nomenclature of this species is considered under *P. rutila.*

Piaya rutila (Illiger).

Cuculus rutilus Illiger, Abhl. Berl. Akad. Wiss., 1812, p. 224 [Cayenne].
Coccyzus minutus Vieillot, Nov. Dict., VIII, p. 275, 1817 [Cayenne].
Macropus caixana Spix, Av. Bras., I, p. 54, 1824 [Brazil].
Coccycua monachus Lesson, Traité, 1831, p. 142 [Cayenne].

Length of wing, 4.12; tail, 6.15.

Above ferruginous chestnut, tail and wings glossed with wine purple, rectrices with white tips and black subterminal bars, remiges dusky at their tips, throat, breast and cheeks cinnamon rufous, rest of under parts gray, tinged with buff on abdomen and flanks.

Specimens examined from Panama, Colombia, Orinoco, Cayenne, headwaters Huallaga River, Guyaquil.

This bird was first described by Brisson as *Cuculus cayanensis minor,* and is entered by Linnæus and Gmelin as var. β under *Cuculus cayanus.* Gmelin also adds a description of a var. γ, which from its '*capite cinereo*' must be *Piaya melanogaster.*

Illiger (1812) regarded these as sexes of the same species and gave them the name *Cuculus rutilus,* while Spix (1824) did the same thing, calling them *Macropus caixana.* The figure and description of his female (= *melanogaster*) is defective in that he does not give the abdomen as black; furthermore he showed by a query that he was not sure whether this was the same species as the smaller bird, therefore his name must unquestionably be restricted to the latter. Illiger's name could be allotted to either bird, but as the smaller one, var. α, stands first, and as it was not subsequently named *minutus* until *after* the name *melanogaster* was proposed for var. γ, I think *rutilus* should be used for 'var. α,' currently known as *Piaya minuta.*

Piaya cayana.

Common characters. Above some shade of ferruginous, bay or walnut brown, rectrices and remiges with more or less wine purple gloss, tips of remiges dusky, rectrices tipped with white with a subterminal black bar above; central pair usually rusty beneath, others varying from rusty to black in the various races, the white tips always distinct, the subterminal band present or absent, lower surface of body pale gray, thighs sometimes and crissum always darker, throat and breast vinaceous cinnamon.

The races vary in the color of the upper parts and of the lower side of the tail, as well as in the color of the crissum; the latter, however, is not always constant. There is also marked difference in size, and in the proportions of the bill.

The extremes of coloration are seen in fresh specimens of *P. columbiana*, *nigricrissa* and *macroura*, which on the upper surface are respectively ferruginous, bay and walnut brown of Ridgway's Nomenclature of Colors.

The relationship of the other forms, so far as the color of the upper parts is concerned, is shown below:

P. c. columbiana, ferruginous.
P. c. mexicana, ferruginous.
P. c. pallescens, ferruginous, a trifle paler.
P. c. insulana, ferruginous, a trifle darker.
P. c. nigricrissa, bay.
P. c. mehleri, chestnut tinged with bay.
P. c. cayana, chestnut tinged with bay.
P. c. caucæ, similar to the last but more ferruginous.
P. c. macroura, walnut brown.
P. c. boliviana, walnut brown.

Piaya cayana cayana Linn.

Cuculus cayanus Linnæus, Syst. Nat., I, p. 170, 1766 [Cayenne].
Coccyzus macrocercus Vieillot, Nov. Dict., VIII, p. 275, 1817 [Cayenne].
Coccyzus cayanensis Swainson, Class. Bds., II, p. 323, 1837 [Cayenne].
Pyrrhocorax guianensis Cabanis and Heine, IV, p. 85, 1862 [British Guiana].

Length of wing, 5.65; tail, 11.10.

Above chestnut strongly tinged with bay, grayer on the head, wings and tail glossed with wine purple, flanks smoke gray, crissum mouse gray, under side of rectrices dull black except for the white tips, no trace of subterminal bands.

Some birds have the crissum paler than others. Mr. Hartert at one time (*Nov. Zool.*, XIII, p. 43) regarded this as a distinctive character separating the bird of French Guiana from that ranging from

Dutch Guiana through the Orinoco valley (*P. c. guanensis*), but later (XIV, p. 35) he considers the difference not constant, in which opinion I heartily agree.

Specimens examined from *Guiana*—Cayenne, Annai, Surinam; *Venezuela*—Maupa, Suapure, Lourde 1700 m.

Piaya cayana columbiana (Cab.).

Pyrrhocorax columbianus Cabanis, Jour. f. Orn., 1862, p. 170 [Cartagena, Colombia].

Pyrrhocorax mesurus Cabanis and Heine, Mus. Hein., IV, 1862, p. 83 [Bogota].

Length of wing, 5.65; tail, 11.85; length of culmen, 33 mm.; height, 12.5 mm.

Above ferruginous, slightly paler on the head, tail and ends of wings, with a gloss of wine purple in certain lights, flanks and crissum as in *cayana;* under side of retrices rusty, more or less minutely flecked or watered with black on the inner webs, broad, well-defined subterminal black bands and white tips.

This bird is indistinguishable from *mexicana* above, and differs below only in the greater amount of black shading on the rectrices; the greatest difference is found in the much larger bill. Bogota specimens have a still greater amount of black on the under side of the rectrices.

Specimens examined from *Colombia*—Santa Marta, Bonda, Bogota; *Venezuela*—Cumanacoa, El Pilar, Valencia, Macuto, Santo Domingo, 2,000 m.

Piaya cayana insulana Hellmayr.

Piaya cayana insulana Hellmayr, Nov. Zool., XIII, p. 40 [Trinidad].

Length of wing, 5.58; tail, 9.30.

Above ferruginous with a slight chestnut tint, closer in color to *columbianus* and *mexicanus* than to *cayana*, tail rather darker with a purplish gloss, thighs and crissum as in *cayana*. Under side of rectrices dull black, the outermost one rusty on outer vane near the quill for two-thirds of its length, the others largely rusty on the outer vane except for a subterminal black area, some of them rusty, in certain lights at least, on parts of the inner web, which helps to bring out an obscure ill-defined subterminal band.

Specimens examined from Trinidad.

Piaya cayana mexicana (Swains.).

Cuculus mexicanus Swainson, Philos. Mag., I, p. 440, 1827 [Tableland of Temascaltepec].

Length of wing, 5.90; tail, 12.65. Length of culmen, 30 mm.; height, 10 mm.

Above ferruginous with wine purple reflections on the tail and ends of the wings, below like *colombianus* except that crissum is paler and the rectrices are uniform rusty brown or pale ferruginous, except for the subterminal black band and white tips; some of the feathers have the black flecking near the base, but it is not apparent unless the tail is fully spread.

Specimens examined from *Mexico*—Esquinapa, Mazatlan, Juanacatlan, Barranca, Ibarra, Calete, Tupila River, Arroyo de Lemones.

Piaya cayana mehleri (Bonap.).

Piaya mehleri Bonaparte, Conspct. Avium, I, p. 110, 1850 [Santa Fé de Bogota—loc. err. fide Sclater, P. Z. S., 1860, p. 285 = Cent. Amer.].
Piaya thermophila Sclater, P. Z. S., 1859, p. 368 [Mexico and Guatemala].
? *Cuculus ridibundus* Gmelin, Syst. Nat., I, p. 414, 1788 [New Spain].
? *Cuculus rubicundus* Stephens, Shaw's Gen. Zool., IX, p. 109, 1815 [Mexico].

Length of wing, 5.80; tail, 10.90.

Above like *cayana*, below darker, crissum dull black, thighs dark gray; under side of rectrices dull black, outermost feather usually uniform, the others with the outer vane more or less rusty, except for a subterminal black area. Mexican birds average less rusty than those from farther south. Occasional specimens have a slight watering of rusty on some of the inner webs; the subterminal band is never defined. The coloration of the tail below is practically intermediate between *cayana* and *insulana*.

Mexican and Yucatan birds have the bill distinctly smaller than those from Nicaragua and Panama. Mexican birds average larger than those from the Central American countries and Yucatan specimens average smaller, but these differences do not seem sufficiently marked to deserve recognition in nomenclature.

Specimens examined from *Mexico*—San Tan, Jalapa, Tampico, Tehuantepec, Tabasco, Vera Cruz, Orizaba, Potrero, Yucatan; *Guatemala*; *Honduras*—Ceiba, Truxillo, San Pedro Sula, Yaruca, Segovia River; *Salvador*; *Nicaragua*—Managua, Chinnudeza, Escondido; *Costa Rica*—San José, Guayabo, Pigres, Volcan de Irazu, Bonilla, Talamanca, San Domingo de San Mateo; *Panama*—Boco del Toro, Chiriqui David, Boquete.

Piaya cayana caucæ subsp. nov.

Length of wing, 5.60; tail, 12.

Above bay strongly tinged with chestnut or dull ferruginous, wings and tail with a wine purple gloss. Below similar to *nigracrissa*, but the thighs as well as the crissum are deep black and the lower part of the abdomen, so that this color encroaches upon the gray area more than in any other race; under side of rectrices almost exactly as in *insulana*, the rusty tint being mainly restricted to the outer vanes of the feathers and the black subterminal bands scarcely perceptible.

This race is the brightest of the 'bay-backed' series and approaches *insulana*, the dullest of the 'ferruginous-backed' series, in the color of the upper parts.

Type No. 71,581, Amer. Mus. Nat. Hist. Rio Cauca, Colombia, May 27, 1898. ♂. J. H. Batty. Wing, 5.55 ins.; tail, 12.10 ins.

Piaya cayana nigricrissa (Sclater).

Piaya nigricrissa Sclater, P. Z. S., 1860, p. 285 and 297 [New Grenada and Peru].

Length of wing, 5.45; tail, 10.20.

Above bay with a strong wine purple gloss on wings and tail, thighs dark gray, crissum blacker, less sooty than in *mehleri*; under side of rectrices as in *cayana*, uniform dull black with the exception of the white tips.

Specimens examined from *Colombia*—Bogota; *Ecuador*—Napo River, Archidona, Guayaquil; *Peru*—headwaters of the Huallaga River, Pebas.

Piaya cayana pallescens (Cab. and Heine).

Pyrrhocorax pallescens Cabanis and Heine, Mus. Hein., IV, p. 86, 1862 [North Brazil].
Piaya cayana cabanisi Allen, Bull. Amer. Mus. Nat. Hist., V, p. 136, 1893 [Chapada, Matta Grosso, Brazil].

Length of wing, 5.95; tail, 11.75.

Upper parts similar to *columbiana* but paler, the bright ferruginous modified by a tone of ochre; crissum and thighs paler than in *colombiana*, and abdomen paler than in any other race, under side of rectrices nearly uniform rusty brown except for the white tips; the pale rusty tint usually pervades the whole dark area instead of forming definite patches, in some lights, however, the dusky subterminal bands are clearly discernible.

I have studied Dr. Allen's series of *cabanisi* from Chapada, Matto Grosso, and cannot find sufficient difference between them and birds from more northern Brazilian localities to warrant separation from *pallescens*. Five specimens of the latter give average length of wing 5.90 and tail 11.30, while ten Matto Grosso birds give wing 6, tail 12. These differences are less than those shown by series of *mehleri* from different parts of its range and since, as Dr. Allen admits, there are practically no color differences, there seems to be no ground for recognizing *cabanisi* as distinct.

Dr. Allen was misled by the general recognition accorded to the more southern *macroura*, to which he thought his bird must be referred, and which he thought required a new name.

Specimens examined from Chapada, Matto Grosso, Corumba, Matto Grosso, Bahia, Para and Rio Janeiro.

The Para specimen approaches *cayana*, while those from Rio Janeiro are darker, showing a possible tendency toward *macroura*.

Piaya cayana macroura (Gambel).

Piaya macroura Gambel, Journ. Acad. Nat. Sci. Phila., 1849, p. 215 ['Surinam' loc. err. fide Cabanis and Heine, Mus. Hein., IV, p. 87 = Paraguay].
Piaya circe Bonaparte, Consp. Avium, I, p. 110, 1850 ['Colombia,' loc. err. fide Cabanis and Heine = Paraguay].
P. c. var. *guaurania* von Ihring, Rev. Mus. Paulista, 1904, 448 [S. Brazil].

Length of wing, 6.75; tail, 15.10.

Above walnut brown sometimes tinged with burnt umber, wings tinged with chestnut and tail with bay, slightly glossed with wine purple, head distinctly gray; thighs dark gray, crissum nearly black; under side of rectrices dull black excepting the white tips, no trace of a subterminal band.

Specimens examined from *Paraguay*; *Brazil*—Rio Grande do Sul.

Piaya cayana boliviana subsp. nov.

Length of wing, 5.85; tail, 11.50.

Above walnut brown, wings and rump tinged with chestnut, tail tinged with bay, both glossed with wine purple; flanks dark gray, crissum slightly darker; under side of rectrices dull black with tips white, no trace of a subterminal band.

This race is exactly like *macroura* except for the gray crissum and much smaller size.

Type No. 30,850, Amer. Mus. Nat. Hist. Yungas, Bolivia. Dr. H. H. Rusby. 6,000 ft. 1885. Wing, 5.90; tail, 11.60.

Specimens examined from *Bolivia*—Yungas, La Paz; *Peru*—Inca Mine.

NOVEMBER 3.

ARTHUR ERWIN BROWN, Sc.D., Vice-President, in the Chair.

Twenty-five persons present.

The Committee on the Hayden Memorial Award reported as follows:

THE COMMITTEE ON THE HAYDEN MEMORIAL GEOLOGICAL AWARD reports in favor of conferring the medal this year on John Mason Clarke, State Geologist of New York, in recognition of the value of his work in geology and especially of his memoir, *Early Devonic History of New York and Eastern North America.* In the opinion of the Committee he ranks with the others who have received the recognition.

(Signed) HENRY FAIRFIELD OSBORN,
R. A. F. PENROSE, JR.,
AMOS P. BROWN,
FREDERICK PRIME,
SAMUEL G. DIXON,
Committee.

JOHN MASON CLARKE was born at Canandaigua, N. Y., April 15, 1857. His early education was received in the Canandaigua Academy, of which his father was principal. In 1877 he graduated from Amherst College and studied in the University of Göttingen from 1882 to 1884. For a period he taught at the Canandaigua Academy and the Utica Academy and in 1879 was instructor in geology at Amherst. From 1880 to 1882 he was professor of geology and zoology at Smith College, and in 1885 lecturer on geology at the Massachusetts Agricultural College. In 1886 he was appointed assistant in paleontology under Prof. James Hall, State geologist of New York; in 1892 assistant State geologist and paleontologist; in 1898 State paleontologist; in 1904 State geologist and paleontologist, director of the State Museum and the Science division of the Education department; in 1894 he was made professor of geology and mineralogy in the Rensselaer Polytechnic Institute. In 1908 the Iroquois Nation received him into their membership as keeper of their historic archives with the ancient title of this office. His scientific publications, chiefly on geology and paleontology, and extending over a period of thirty years, are somewhat voluminous, and, though largely relating to the State of New York, include also parts of Canada, Maine, South America and Germany. His most comprehensive treatises are *The North American Devonian Crustacea* (1888), *Introduction to the Study of the Genera of the Paleozoic Brachiopoda* (1892 and 1894), and *The Paleozoic Reticulate Sponges* (1898), all published in titular conjunction with James Hall; *The Naples Fauna* (1899 and 1904), *The Early Devonic of New York and Eastern North America* (1908). In addition to numerous other papers on problems in geology he has also written on ceramics.

He received the degrees of A.M. and Ph.D. (*honoris causa*) from the University of Marburg in 1898; LL.D. from Amherst, 1902.

November 17.

The President, Dr. Samuel G. Dixon, in the Chair.

Thirty-nine persons present.

The Chair announced the death of Alfred Whelen, November 18, 1907; William Potts, July 29, 1908, members, and of William K. Brooks, a correspondent, November 12, 1908.

In association with the Biological and Microscopical Section, Mr. Charles S. Boyer made a communication on the synonymy and relationships of *Surirella* and described a new species of diatom from the miocene deposits of Barbadoes, for which he proposed the name *Cymatopleura Shulzi*.

Dr. Thomas S. Stewart spoke of the bacillus of syphilis and suggested methods of staining.

Mr. Frank J. Keeley exhibited slides illustrating secondary crystallization of early limestone and showing the Brownian motion of smoke particles on dark-ground illumination.

Dr. Henry A. Pilsbry spoke of the geographical distribution of *Strobilops*.

The following papers on the report of the Publication Committee were accepted for publication:

"On the Cicindelinæ of Angola." By F. Creighton Wellman, M.D., and Walther Horn, M.D. (September 26).

"Remarks on Prof. Chamberlin's Revision of North American Lycosidæ." By Thomas H. Montgomery (October 27).

Sydney L. Wright, Jr., was elected a member.

The following were ordered to be printed:

ON THE CICINDELINÆ OF ANGOLA.

BY F. CREIGHTON WELLMAN, M.D., F.E.S., AND WALTHER HORN, M.D.

Very little has been known until now about the Cicindelinæ of Angola. Most of the species described are represented by uniques or a few specimens, excepting, of course, those occurring in other parts of Africa. The discovery of the "typical" Angolan forms is almost entirely connected with the names of four collectors, namely: Friedrich Welwitsch, the distinguished Austrian botanist who collected for the Museum of Lisbon; A. v. Hohmeyer and Dr. P. Pogge, whose collections now belong to the Royal Zoological Museum of Berlin, and Major von Mechow, whose specimens are at present in the collection of Réné Oberthür. These last were described by Quedenfeldt, Sr., Harold worked up the material for the Berlin Museum, and Putzeys published concerning the Portuguese collections.

Beyond these only a few species, mostly based on single specimens and some without exact localities, have from time to time been sent to Europe, most of them described by one of the authors of the present paper (W. H.).

While not less than six genera in thirty-five species[1] are known from this so highly interesting part of Africa, yet this is the first time that large material with exact bionomical notes has become available —material which permits of a distinct advance in our knowledge of this interesting family. It seems, therefore, a suitable opportunity to present our notes on the habits and relations of the species occurring in Angola, and we have made the list complete by including the species reported by other observers as well as ourselves. One very peculiar and interesting new form is described.

In taking up a faunistic study of this kind it is always interesting to note the general features of the climate, soil and flora of the region discussed, as these must always have a bearing on the habits and distribution of its animal life. For the purposes of this paper our district may be divided into three regions: lowlands, mountainous slopes, and

[1] Twenty species of these were taken in Angola by one of us (F. C. W.) during 1906-08.

plateau. The first of these extends from the sea to a point 30 to 100 miles inland, according to the configuration of the country, and its most typical plant may be said to be the cocoanut palm, which will grow wherever moisture enough is obtainable. The soil is over parts of this belt strongly calcareous, being of recent geological formation, abounding in various fossils such as ammonites and trilobites. Other parts are the result of silt being carried down by erosion of the older interior mountains. The rainfall in this part is very scanty, as the storms come from the east and are intercepted by the highlands and mountains, only the heaviest and most general rains for a small portion of the year reaching the lowlands to the west. The vegetation is in consequence sparse, consisting of a few shrubs and thorny or fleshy trees. The grass grows in little discrete clumps and dries up and almost disappears during the greater part of the year. In this region only five species of Cicindelinæ were encountered: *Cicindela brevicollis intermedia* Klug, *C. melancholica* F., *C. nitidula* Dej., *C. cabinda* Bat. and *Eurymorpha cyanipes mouffleti* Fairm., the last three of which occur on the seashore.

The second region may be said to extend inland from the first region to a point marked by the limits of the occurrence of the baobab tree (*Adansonia digitata*). The basis of this is a vast primary system, consisting of various metamorphic rocks, chiefly granite and sandstone. The soil is a sandy loam alternating with red clays. Of course, there is a great mixture of soils in the lower levels and valleys of this region. Huge granite mountains and boulders abound. The vegetation is very dense in canons and valleys and along rivers; and in the rainy season the grass is often long, coarse and dense, forming a sort of jungle. Many large trees (Anonaceæ, Anacardaceæ, Guttiferæ, etc.) abound in the jungles near streams. The most inland valleys of this region have a flora approaching that of the highland region yet to be described, and it was here that most of the species discussed in this paper were taken, our specimens including *Cicindela Mechowi* Qued., *C. lutaria* W. Horn, *C. saraliensis* Guér., *C. uncivittata* Qued., *C. infuscata* Qued., *C. Putzeysi* W. Horn, *C. angusticollis* Boh., *C. villosa* Putz., *C. flavipes* Putz., *C. Wellmani* W. Horn, *C. reticostata* n. sp., *Odontochila erythropyga* Putz., *Cosmema Wellmani* W. Horn, *C. marginepunctata* W. Horn, *C. auropunctata* Qued., etc. The climate of this region is intermediate between that of the foregoing and that of the region about to be described, being cooler and moister than the lowlands, without equalling in these respects the highlands.

The third region is the high plateau forming the Bihé and parts of the Bailundo and Andulo countries. This is part of the alpine region of Africa, and is to be classed with Abyssinia, Ruenzori and the Nyassa-Tanganyika highlands. The soils are about as in the middle region and the country is, geologically speaking, very old, being entirely underlaid with archaean metamorphic rocks. The grass is comparatively short and thickly set together, quite covering the ground. The bulk of the trees are Leguminosæ and are as a rule not large, forming what is known as "bush." One of the Rosaceæ (*Paranarium mobola*) is the largest and most striking tree. Many Malvaceæ and Ampelidæ add to the smaller aspects of the landscape. The climate is moist and cool and is essentially subtropical and not tropical. The species found in the center of this last region are *Cicindela suturalis* Putz., *C. Mechowi* Qued., *Ophryodera rufomarginata* Boh., and *Mantichora congoensis*" Pér. At the western border of this region, almost at a point where it joins the second region (*vide suprà*) were taken several other species, namely: *Cicindela angusticollis* Boh., *C. uncivittata* Qued., *C. infuscata* Qued., *C. Putzeysi* W. Horn, *C. flavipes* Putz., *C. villosa* Putz. and *Cosmema auropunctata* Qued.

Following is a list of all recorded species[2] from Angola, including our own material, much of which is here reported for the first time, together with our notes on the habits of the beetles and the description of a new species.

CICINDELINÆ.

CICINDELINI.

Odontochilina.

1. **Odontochila erythropyga** Putz., Jorn. Sci. Lisb., 1880, p. 24.
   = *variventris* Qued., Berl. Ent. Zeitschr., 1883, p. 245.

Without exact locality (Welwitsch); Malange (Mechow); Ekekete Mountain, two hours south of Ekuiva River, November, 1907 (Wellman). The specimens were taken in thin grass near a large swarm of Meloid beetles (*Lytta amethystina*) which at some distance they distinctly resembled.

Cicindelina.

2. **Cicindela aulica** Dej., Spec. V, 1831, p. 250.

Without exact locality (Welwitsch). An intermediate form between the typical *aulica* and the subsp. *polysita* Guér. occurs in Loanda.

3. **Cicindela asperula** Duf., Ann. Sc. Phys., VIII, 1821, p. 359, pl. 130, f. 1.

Kuango (Mechow).

---

[2] All the material collected by Wellman is in W. Horn's collection, where also all the other species are represented, except *Cicindela leucopicta* Qued.

4. **Cicindela nitidula** Dej., Spec. I, 1825, p. 120.

Without exact locality (Welwitsch); Landana, Loango (U. More); Lobito Bay, April, 1908 (Wellman). Taken on the beach (that part which is kept more or less wet by the tides), and by its coloring the beetle is rendered inconspicuous as it sits on the sand, and is usually noticeable only when flying.

5. **Cicindela cabinda** Bat., Cist. Ent. II, 1878, p. 331.

Landana, Loango (U. More); Lobito Bay, April, 1908 (Wellman). Habits exactly like *C. nitidula*, with which it was found in company.

6. **Cicindela brevicollis clathrata**[3] Dej., Spec. I, 1825, p. 115.

Mossamedes.

brevicollis neglecta[4] Dej., Spec. I, 1825, p. 114.

Malange (Mechow); without exact locality (Welwitsch). There occurs near Mossamedes an intermediate form between this last and the var. *damara* Pér.

brevicollis discoidalis Dej., Spec. I, 1825, p. 114.

Kuango.

brevicollis intermedia Klug, Monatschr. Berl. Acad., 1853, p. 245.

Quanza (Homeyer), Loanda.

7. **Cicindela uncivittata**[5] Qued., Berl. Ent. Zeitschr., 1883, p. 242.

Malange (Mechow); north bank of Ekuiva River, November, 1907 (Wellman). Found on the path, dark soil.

exigua[6] Kolbe, Ent. Nachr., 1885, p. 50.

South bank of Ekuiva River, November, 1907 (Wellman), clayey soil.

8. **Cicindela obtusidentata** Putz., Jorn. Sci. Lisb., 1880, p. 22.

Bocagei Chd. *in litt.*, Cat. Coll. Cic., p. 28.

Without exact locality (Welwitsch).

9. **Cicindela wellmani** W. Horn, Deutsch. Ent. Zeitschr., 1907, p. 421.

Chiyaka, November, 1906, and November, 1908 (Wellman). In paths or on other bare places, clayey soil, on which the coloring of the beetle makes it hard to see. Very ant-like in its movements.

[3] Putzeys gave to this subspecies (and some specimens of the following) the wrong name *Cicindela senegalensis*, cf. *Jorn. Sci. Lisb.*, 1880, p. 21.
[4] Putzeys thought this to be *Cicindela pudica* Boh., cf. *Jorn. Sci. Lisb.*, l.c.
[5] This is the blackish form.
[6] This is the brownish form.

10 **Cicindela mechowi**[7] Qued., Berl. Ent. Zeitschr., 1883, p. 248, pl. 3, f. 3.

Malange (Mechow), Huilla (Welwitsch), Kakonda, Duque de Bragança, Bihé, Chiyaka, Ekuiva River (Wellman). Several forms occur, with and without white sutural stripe, both brownish and green. These beetles appeared to be very scarce until a large artificial bare place was prepared, when *mechowi* and several other species appeared in great numbers. The brownish form usually appears on clayey soil. When alive they have a strong verbena-like smell. They are strong flyers and very pugnacious. A specimen kept over night in a cage with some other beetles was found next morning chewing the thorax of a Meloid beetle (*Eletica rufa* F.).

11. **Cicindela grandis** W. Horn, Ent. Nachr., 1897, p. 240.

Without exact locality, one single ♀.

12. **Cicindela prodotiformis** W. Horn, Deutsch. Ent. Zeitschr., 1892, p. 88; 1894, pl. 3, f. 7.

Without exact locality, one single ♀.

13. **Cicindela leucopicta** Qued., Berl. Ent. Zeitschr., 1888, p. 157.

Lunda kingdom (between Kuango and Loango), 1 ♀ (Mueller), 10, IX, 1884, on open places of the savannas.

14. **Cicindela interrupta** Fabr., Syst. Ent., 1775, p. 225.
graphica Bat., Cist. Ent., II, 1878, p. 330.

Kuango (Mechow); without exact locality (Rogers); common.

15. **Cicindela saraliensis** Guér., Rév. Zool., 1849, p. 80.
flammulata Qued., Berl. Ent. Zeitschr., 1883, p. 241, pl. 3, f. 1.

This last is nothing but a form with more yellow spots on the elytra. Malange (Mechow); Chiyaka, Mt. Elende, November, 1906; Ekuiva River, November, 1907 (Wellman). Our specimens are the *flammulata* form, and were found on dark soil. The beetle does not fly, and is often found in the edge of woods *near* certain *Cosmemæ*, but not *with* them. On one occasion a living specimen was taken with an ant (*Pheidole punctulata* Mayr.) hanging to its leg.

16. **Cicindela angusticollis** Boh., Ins. Caffr., I, 1848, p. 15.

Mossamedes, Chiyaka, November, 1906; Ekuiva River, November, 1907 (Wellman). Does not fly, a very rapid runner; common.

17. **Cicindela muata** Har., Mittheil. Münch. Ent. Ver., 1878, p. 99.

Malange (Mechow); interior (possibly Congo Free State), without exact locality (Pogge).

---

[7] *Cicindela lugubris* Putz., *Jorn. Sci. Lisb.*, 1880, p. 22, is the true *C. mechowi*.

18. **Cicindela (Ophryodera) rufomarginata**[8] **bohemani** Pér., Ann. Mag. Nat. Hist., 1888, p. 220.

Huilla. There also occur individuals with less broadly confluent pattern.

rufomarginata poggei Har., Mittheil. Münch. Ent. Ver., 1878, p. 99; Col. Hefte, 1879, p. 11, pl. 1, f. 1.

Interior (perhaps Congo Free State) without exact locality (Pogge).

rufomarginata distanti Heath, Entomol., 1905, p. 97.

Duque de Bragança, Bihé, Kuango (Mechow). Lunda (Buchner), Chipeyo, November 18, 1906 (Wellman). Found on white sand. Flies rather heavily.

rufomarginata richteri[9] W. Horn, Deutsch. Ent. Zeitschr., 1892, p. 72; 1894, pl. 3, f. 9; 1906, pl. 1, f. 16.

Malange (Mechow).

19. **Cicindela reticostata** nov. spec.

Cicindelæ quadricostatæ W. Horn ♀ affinis, differt statura minore; labro medio non producto, parte centrali dentes 3 ferente a lobis lateralibus incisura majore separata; prothoracis parte media globosiore, lateribus ad strangulationem basalem magis curvatis (ita ut pars basalis distinctior appareat), disco sulcum basalem versus evidenter magis declivi, superficie æqualiter grosse sed irregularius rugata atraque: elytris fere parallelis, solummodo in medio levissime ampliatis, humeris latioribus quam in illa specie, apice (conjunctim) brevius rotundato, signatura nulla, sculptura æqualiter subtili, sed punctis reticularibus fere ubique variis in directionibus (aut transversaliter, aut longitudinaliter, aut oblique aut in lineis distincte curvatis) confluentibus: rugis hoc modo formatis non quam cetera sculptura grossioribus; "striis" 2 vix elevatis basi incipientibus fere longitudinalibus (perparum suturam versus postice vergentibus) indistinctis in utroque elytro visibilibus (irregularius confluenter quam partibus adjacentibus sculptis), altera prope suturam ultra medium, altera in disco centrali fere ad medium ducta, postice sensim evanescentibus; 3^a etiam leviore indistinctioreque in disco laterali ante medium omnino disparente solummodo visu obliquo percipienda; depressionibus ("sulcis," ut ita dicam) inter has 3 "strias" (quæ vix costulæ possunt nominari) et spatio juxtasuturali modice cuprascentibus; antennis non foliaceis, articulis 5°–8° solum-

[8] *Ophryodera rufomarginata*, as recorded by Putzeys, consists of the subspecies *bohemani* and *distanti*, cf. *Jorn. Sci. Lisb.*, 1880, p. 25.

[9] Recorded by Quedenfeldt as *O. rufomarginata*, *vid. Berl. Ent. Zeitschr.*, 1883, p. 247.

modo paullo dilatatis; palpis (articulo ultimo nigro) flavis; capite elytrisque nigricantibus opacis, vix hinc inde perparum æneseentibus; corpore subtus modice nitente nigricante; genis anticis, meta-episternis cum parte adjacente metasterni, elytrorum epipleuris cyanescentibus; pedibus, coxis, trochanteribus nigricantibus, hinc inde perparum viridi aut æneo-variegatis; totis pectoris partibus (metasterni parte discoidali et postico-centrali nuda), abdominis et coxarum posticarum lateribus late modice dense breviter pilosis; fronte nuda, solummodo prope antennarum insertionem setis 2 ornatis, pronoto in specimine unico nudo (semper?); 2 primis antennarum articulis nudis, 3° et 4° supra breviter modice sparsim setosis. Long. 17 mm. (sine labro).

A single ♂ from the Enyalanganja or great plains, 3 hours south of the Ekuiva River, November, 1907 (Wellman).

It is one of the most peculiar species of the whole genus, belonging to the interesting *laeta-quadristriata* group, reported only from the tropics of Africa. The labrum is black with a testaceous patch in the middle, the 3 middle teeth are just a little less prominent than the lateral tooth. Front and pronotum are roughly and deeply wrinkled. The sutural angle of the elytra is rectangular without a developed spine. All tarsi, as in *Cicindela quadristriata*, sulcated. The 1st, 3d and 4th articles of the antennæ are on their upper part slightly carinate.

The size, color and sculpture of this species, and especially its *movements*, lend it when alive the appearance of a Carabid. It did not attempt to fly when pursued, although it was in bright sunshine.

20. **Cicindela villosa** Putz., Jorn. Sci. Lisb., 1880, p. 22.
= *semicuprea* Qued., Berl. Ent. Zeitschr., 1883, p. 244.

Malange (Mechow); Huilla (Lobo d'Avila); Chipeyo, November, 1906; Chiyaka, Ekuiva River, November, 1907 (Wellman). Taken on dark soil, often in short grass. It has a good cryptic coloring and is hard to see.

21. **Cicindela flavipes** Putz., Jorn. Sci. Lisb., 1880, p. 23.
= *nubifera* Qued., Berl. Ent. Zeitschr., 1883, p. 243, pl. 3, f. 2.

Malange (Mechow); Duque de Bragança; Chipeyo, November, 1906; Chiyaka, Ekuiva River, Kasenya Mines, November, 1907 (Wellman). This species occurs almost entirely on feldspathic soil, against which its indistinct light-colored markings make it almost impossible to see, except when it is in motion. It was only taken once or twice on red or dark soil, but one could count on finding it in abundance as soon as a bit of whitish soil rich in kaolin was reached.

22. **Cicindela suturalis** Putz., Jorn. Sci. Lisb., 1880, p. 25.

Huilla (Lobo d'Avila), Bihé, December, 1906 (Wellman). Taken in short grass, after most Cicindelidæ had disappeared.

23. **Cicindela Putzeysi** W. Horn, Deutsch. Ent. Zeitschr., 1900, p. 207.

Kakonda; Chiyaka, November, 1906; Ekuiva River, 1907 (Wellman). This reddish species almost always occurred on clayey soil, and usually together with *C. mechowi* (*vide suprà*) In Chiyaka it was taken on the artificial bare place made for the purpose of attracting Cicindelidæ. A peculiar point noted is that this beetle jumps and flies like a small grasshopper which is always found with it. On one occasion a large Asilid fly was observed to catch a specimen of *C. putzeysi*.

24. **Cicindela infuscata** Qued., Berl. Ent. Zeitschr., 1883, p. 245.

Malange (Mechow); Chipeyo, November, 1906; Chiyaka, Ekuiva River, November, 1907 (Wellman). Three forms occur: coppery, green and blackish. It was noted that the coppery form occurred in the valleys on clayey soil, together with *Cicindela mechowi* and *C. putzeysi*, while the green form was taken on the mountain sides among moss, etc., in company with *Odontochila erythropyga* (*vide suprà*).

25. **Cicindela melancholica** Fabr., Ent. Syst., Suppl., 1798, p. 63.

Malange (Mechow); Chincoxo, without exact locality (Welwitsch); Loanda (Hohmeyer); Benguella, edges of city, April, 1908 (Wellman). This species was taken on mud from partially dried-up pools; very common. In the same places (on the dry sand around the pools) occurred great numbers of a Carabid beetle (*Graphipterus* sp.).

26. **Cicindela vicina** Dej., Spec. V, 1831, p. 244.

Without exact locality (Welwitsch).

27. **Cicindela lutaria** Guér., Rev. Mag. Zool., 1849, p. 118; Mag. Zool., 1845, pl. 161, figs. 5, 6.

Ekuiva River, November, 1907 (Wellman). This species was found at the edge of the river, in a place which had been previously overflowed. The habits seem to be identical with those of *Cicindela melancholica*.

28. **Cicindela octoguttata** Fabr., Mant., I, 1787, p. 187.

29. **Eurymorpha cyanipes mouffleti** Fairm., Ann Soc. Fr., 1856, p. 95.

Cape Negro, Mossamedes.

Dromicina.

30. **Dromica tricostata** W. Horn, Ent. Nachr., 1897, p. 237.

Without exact locality; a single ♀.

31. **Dromica (Cosmema) auropunctata** Qued., Berl. Ent. Zeitschr., 1883, p. 249, pl. 3, f. 4.

Malange (Mechow); Chiyaka, Chipeyo, November, 1906 (Wellman). This species may be found in rather thick bush, and when pursued will hide under dry leaves like ants, which insects it greatly resembles in its movements.

32. **Dromica (Cosmema) marginepunctata** W. Horn, Notes Leyd. Mus., 1908, p. 32.

Chiyaka, Ekuiva River, November, 1907 (Wellman). Is even more shade-loving than the preceding (which is often found in the open) and occurs in enormous numbers in the bush. Its habits are like *auropunctata.*

33. **Dromica (Cosmema) wellmani** W. Horn, Notes Leyd. Mus., 1908, p. 31.

Ciyaka, Ekuiva River, November, 1907 (Wellman). Habits just like the preceding species, which it so closely resembles that it is impossible to distinguish them in the field and in company with which it usually occurs.

MEGACEPHALINI.

Megacephalina.

34. **Megacephala regalis** Boh. Ins. Caffr., I, 1848, p. 2.

Cuissange, 1 ♂; near Impulu River, November, 1899, 1 ♂. Both of more elongate elytra than the typical form.

MANTICHORINI.

35. **Mantichora congoensis** Pér., Ann. Nat. Hist., 1888, p. 219.
= *Livingstonei* Har., Col. Hefte, 16, 1879, p. 9.

Bihé; interior without exact locality, possibly Congo Free State (Pogge).

In conclusion: there are still two species of *Cicindela* known in tropical Africa, and very common to the north, east and south of Angola, which almost surely occur in Angola itself, although not yet found there, namely, *Cicindela nilotica* Dej. and *C. dongalensis imperatrix* Srnka. It is also probable that the common *Cicindela regalis* Dej., which is widespread in the regions to the north, east and southeast of the district here discussed, will be one day reported from Angola. *Cicindela cincta* Fabr., the common species reported from the mouth of the Senegal to Bahr-al-Ghazal and the Kassai, may likewise touch the boundaries of Angola somewhere.

REMARKS ON PROF. CHAMBERLIN'S REVISION OF NORTH AMERICAN LYCOSIDÆ.

BY THOMAS H. MONTGOMERY, JR.

In Part II of Volume LX of the *Proceedings of the Academy of Natural Sciences of Philadelphia,* 1908, Prof. R. V. Chamberlin has a memoir entitled a "Revision of North American Spiders of the Family Lycosidæ." This paper is one of decided importance in introducing generic characters based upon the structure of the copulatory organs, and in presenting detailed descriptions of the species. But it is only fair to my antecedent studies on the same group that I should make certain brief criticisms, lest later students might consider Prof. Chamberlin's paper as finally conclusive and authoritative.

In my "Description of North American Araneæ of the Families Lycosidæ and Pisauridæ" (*Proc. Acad. Nat. Sci. Phila.,* 1904) I recognized among other valid species twenty that had been described and named by me, whereby I relegated to the synonymy certain few species that I had described as new in two preceding papers. Of these twenty species of which I am the author Prof. Chamberlin regards only two worthy of recognition under the names I had given them, to which treatment I would enter the following partial criticism:

(1) Prof. Chamberlin fails to mention at all two of my species, *Lycosa mccooki* and *Trochosa contestata.*

(2) He places my *Trochosa noctuabunda* as a questionable synonym of his *Allocosa degesta*; but if these species are identical my name should have the priority.

(3) He makes my *Lycosa antelucana* a synonym of *L. apicata* Banks; but my description was published in March, and that of Banks not until June, 1904, hence the name *antelucana* has the priority.

(4) He enters five of my species as synonyms of four of those of Hentz, by resuscitating Hentz's *Lycosa saltatrix, fatifera, milvina* and *funerea.* For each of the first two of these species Hentz gave a four-line description, for *milvina* a five-line, and for *funerea* only three lines, and his figures are lacking in all necessary details. In 1904 I had written: "At the present time it is practically impossible to identify most of the species of Walckenaer, Blackwall, Hentz and some others,

because some of their species are so insufficiently described that a particular description applies equally well to a number of species." Thus Prof. Chamberlin makes, it seems to me, and I take no unusual stand, a grave mistake in resuscitating these and certain other names of Hentz, for the descriptions are practically valueless, the figures in many cases of little more importance, and nothing but uncertainty is to be gained by replacing names based upon detailed descriptions with ones founded upon inadequate diagnoses unsupported by type specimens. Then Prof. Chamberlin places my *Lycosa relucens* and *L. charonoides* as synonyms of *saltatrix* Hentz, though these species of mine differ in important structural characters; and similarly he classes my *Pardosa scita*, that is clearly separable from *P. nigropalpis* Emerton, with the latter as synonyms of *Lycosa milvina* Hentz.

(5) Prof. Chamberlin subjugates my *Pardosa mercurialis* to *lapidiana* Emerton, though these differ in proportion of the legs and in the genital armature. Then he places my *Geolycosa texana* under *Lycosa carolinensis* Hentz, though these exhibit a marked difference in the eyes of the anterior row. Further, he brings my *Lycosa euepigynata*, *L. insopita* and *Trochosa purcelli* all under *Lycosa gulosa* Walckenaer, though Walckenaer in his brief seven-line description states only the color and a few details concerning the eyes, and though I had shown that *Lycosa insopita* "comes closest to *L. euepigynata*, but differs from it in slightly shorter relative length of the legs, in greater relative width of the cephalothorax (in *insopita* less than one-quarter longer than broad, in *euepigynata* decidedly more than one-quarter), in the dark coloration of the venter, and in the structure of the genitalia. It differs also from *L. purcelli*, the epigynum of which is very similar, in the slightly greater relative length of the legs, in greater size, and markedly in the coloration."

(6) Prof. Chamberlin has also withdrawn *Geolycosa* mihi (of which *Scaptocosa* Banks is a synonym) into *Lycosa* Latreille. Yet *Geolycosa* differs markedly from any true *Lycosa* in the size and length of the first legs and in their possession of thick scopulæ.

Had I the time to do so, I believe I could satisfactorily re-establish all of my species that Prof. Chamberlin has tried to disestablish. He has not seen any of the type specimens in my private collection, though I would gladly have given him access to them had I known he was preparing a revision. His revision needs a considerable amount of emendation. What we should all of us do in such matters is not to work apart but in co-operation, and this is almost essential for progress in systematic studies. When the time has come for a taxonomic revision of any group, those who have contributed most to the subject should bring their collections together in one place, and there they should institute their comparisons conjointly. I stated in my memoir of 1904: "This paper is by no means a comprehensive monograph, but is intended to be a help to the one who comes later with sufficient material at his disposal to make the monograph." The main deficiency in Prof. Chamberlin's revision seems to have been insufficient type material.

DECEMBER 1.

ARTHUR ERWIN BROWN, Vice-President, in the Chair.

Ninety-seven persons present.

The Publication Committee reported that papers under the following titles had been presented for publication:

"Synopsis of the Cyprinidæ of Pennsylvania." By Henry W. Fowler (November 30).

"On the Meloidæ of Angola." By F. Creighton Wellman, M.D. (December 1).

"On a New Species of Diatom of the Genus Cymatopleura." By Charles S. Boyer (December 1).

Dr. F. Creighton Wellman made a communication on the natural history of West Africa. (No abstract.)

DECEMBER 15.

The President, SAMUEL G. DIXON, M.D., in the Chair.

Thirty-two persons present.

The reception of papers under the following titles was announced by the Publication Committee:

"Notes on Polinices didyma, with Description of a new Australian Species." By H. A. Pilsbry and E. G. Vanatta (December 5).

"On the Teeth of Hawaiian Species of Helicina." By H. A. Pilsbry and C. Montague Cooke (December 5).

"Clausiliidæ of the Japanese Empire, XII." By Henry A. Pilsbry (December 10).

"New Land Mollusca of the Japanese Empire." By H. A. Pilsbry and G. Hirase (December 11).

The following were ordered to be printed:

A SYNOPSIS OF THE CYPRINIDÆ OF PENNSYLVANIA.

BY HENRY W. FOWLER.

Though my studies on our local fishes began in 1897 and have since continued, I have not paid especial attention to the Cyprinidæ till recently. The more or less complete collections made in that time, in the southeastern portion of the State at least, have made it possible for me to give some study to the individual variation of certain characters in detail and to local distribution. The results are introduced in the present paper, together with notes and redescriptions of typical specimens of species described from within the prescribed limits. The examination of the mass of material, which in the cases of the common forms usually consists of large series of hundreds of specimens, has enabled me to present a fairly accurate summary.

As so many of our western streams are polluted, or becoming so, the fish-fauna will probably soon be largely, if not wholly, exterminated, especially in the larger basins. I have found this condition to exist in a number of streams of lesser size. This is all the more unfortunate for our present purpose, as the greater variety of forms is found in these larger streams, or about them, the mountain-brooks usually being noteworthy for their paucity of species.

The first complete account of our Cyprinidæ was Cope's elaborate memoir published many years ago.[1] Though exhaustive so far as his material and observations would permit at the time, the work is very incomplete, besides being encumbered by various notes, descriptions and discussions more or less irrelevant. It is, however, of great value, not only in making known a number of new forms and as a contribution to systematic ichthyology, but in discussing the distribution and to some extent the habits of the various species. Previous to this work all the accounts or records of the Cyprinidæ of Pennsylvania were to be found in a few scattered papers. Later, in Cope's account of the fish-fauna of the State,[2] a work intended more as

[1] Synopsis of the Cyprinidæ of Pennsylvania, *Tr. Am. Philos. Soc. Phila.*, XIII, n. s., 1869, pp. 351–399, Pls. 10–13.

[2] The Fishes of Pennsylvania, *Rep. State Comm. Fish.*, 1879–80 (1881), pp. 59–145, figs. 1–44.

a semi-popular descriptive catalogue, the Cyprinidæ are again treated as a whole. Bean then gives[3] a largely compiled account of the same nature, introducing also several hypothetical species. These latter I have placed in foot-notes in the present paper. The contribution by Evermann and Bollman[4] on the Monongahela fishes is especially valuable in furnishing us with an account of a basin which is now much polluted. Finally, in a recent paper,[5] I have mentioned a number of localities where much of my own material was obtained, and thus mapped out the local distribution of some species.

I have not recorded any examinations of the stomachs of some of the species, leaving the details to be incorporated in future work. Little attention is, therefore, given here to the food of the different forms.

The introduced species, such as the carp and gold fish, are not treated in this paper.

In explanation of the squamation formulas it may be said that the median lateral longitudinal count of scales is in the lateral line, when present, to the base of the caudal fin, and that the few on the latter to be added are signified by the interpolated plus mark. Above the lateral line the scales are counted obliquely down from the origin of the dorsal fin posteriorly, and below obliquely up from the origin of the anal fin forward.

Acknowledgment is here made to those who have so kindly assisted me in securing material used in this work, their names being mentioned elsewhere in my local works.

All of the specimens used in the preparation of this paper are now contained in the Academy's collections.

Campostoma anomalum (Rafinesque).

Head $3\frac{1}{2}$ to $4\frac{1}{3}$; depth $3\frac{7}{8}$ to 5; D. iii, 7, I, rarely iii, 8, I; A. iii, 6, I; scales 43 to 55 + 2 to 4, usually 2 or 3; usually 7 scales above l. l., occasionally 8; usually 6 scales below l. l., occasionally 7; 13 to 16 scales transversely from dorsal in young with incomplete l. l.; 18 to 25 predorsal scales; snout $2\frac{1}{5}$ to $3\frac{2}{3}$ in head; eye $3\frac{1}{4}$ to $6\frac{1}{2}$; maxillary 3 to $4\frac{1}{2}$; interorbital $2\frac{1}{5}$ to $3\frac{1}{3}$; teeth 4–4. Body stout, moderately compressed, predorsal gibbous in adult. Snout moderately convex. Scales crowded anteriorly. Color brownish, tinted olive or green

---

[3] The Fishes of Pennsylvania, *Rep. State Comm. Fish.*, 1889–91 (1892), pp. 1–149, Pls. 1–35.

[4] Notes on a Collection of Fishes from the Monongahela River, *Ann. N. Y. Acad. Sci.*, III, 1883–85 (1886), pp. 335–340.

[5] Records of Pennsylvania Fishes, *Am. Nat.*, XLI, 1907, pp. 5–21.

above. Scales somewhat mottled. Dusky vertical bar behind opercle. Dusky cross-bar on dorsal and anal, other fins bright red in spring-males, olive in females. Nearly entire upper surface of spring-males tuberculous, and iris golden. Very variable, young differ in appearance from adults. Length $1\frac{5}{8}$ to $6\frac{1}{4}$ inches. Many examples from Beaver and Kiskiminitas Rivers, Port Allegany (McKean Co.), and Newcastle (Lawrence Co.).

Found in the more quiet waters of our streams, frequently in small runs and the deeper pools. It feeds on the bottom, frequently associated with other small fishes, and is rather sluggish, though active if disturbed. I have not found it in the small colder mountain brooks. In the spring it ascends small brooks to spawn. I have found it sometimes infested with a fungus, appearing as a white fluffy growth, in which cases the fish appears sickly or stupid. Not being very hardy it is of little use as bait. It reaches a length of 8 inches and is little valued as a pan fish. In our limits it is distributed only west of the Alleghanies.

Chrosomus erythrogaster (Rafinesque).

Head $3\frac{7}{8}$; depth $4\frac{1}{4}$; D. iii, 7, I; A. iii, 7, I; scales about 88 + 4; 28 scales transversely from dorsal to ventral origin; 40 predorsal scales; snout $3\frac{3}{7}$ in head; eye $3\frac{1}{6}$; maxillary $3\frac{2}{5}$; interorbital 3. Body compressed, fusiform, deepest medianly. Head compressed, rather tapering. Eye rounded, about first third in head. Mouth moderate, oblique, terminal. Jaws about equal. Maxillary to eye. Rakers about 2 + 7 short stumps. L. l. short, scarcely beyond middle of pectoral. Dorsal origin about midway between front eye margin and caudal base. Anal little behind dorsal base. Caudal emarginate, lobes equal. Pectoral almost to ventral, latter inserted little before dorsal, reaches vent. Color olive-brown, often with blackish spots, and dusky dorsal line. Sides silvery between 2 black lateral bands, upper straight from upper opercle angle to caudal, sometimes broken up behind, and broader lower one curved down little to end in caudal black spot. Belly silvery. Length $1\frac{7}{8}$ inches. Kiskiminitas River.

This fish is only found west of the Alleghanies. It reaches 3 inches in length, and is a beautiful little minnow, the spring males having the sides between the black bands, belly and bases of the vertical fins scarlet, the other fins orange, and the body everywhere minutely tuberculate. The females are plainly colored, and usually with little if any red. It is said to be very hardy and therefore attractive in the aquarium, as well as desirable bait for bass and yellow perch. It is also said to occur in clear cold brooks formed about spring-heads, be very active, and not very abundant anywhere. The above example, obtained by Cope, is the only one I have from our limits.

Chrosomus erythrogaster eos (Cope).

C. eos Cope, Proc. Acad. Nat. Sci. Phila., 1861, p. 523. Meshoppen Creek, Susquehanna Co.

Head $3\frac{3}{4}$; depth $4\frac{3}{5}$; D. iii, 7, I; A. iii, 7, I; P. i, 15?; V. i, 8; scales 80? + 5?; 24? scales transversely from dorsal to middle of belly; 50? predorsal scales; head width 2 its length; head depth $1\frac{3}{4}$; mandible $2\frac{3}{5}$; first branched dorsal ray $1\frac{3}{5}$; anal ray $1\frac{2}{3}$; upper caudal lobe $1\frac{1}{6}$; least depth of caudal peduncle $2\frac{3}{5}$; pectoral $1\frac{2}{5}$; ventral $1\frac{9}{10}$; snout $4\frac{1}{4}$ in head measured from upper jaw tip; eye $3\frac{1}{3}$; maxillary $3\frac{2}{5}$; interorbital 3.

Body elongate, compressed, edges convex, profiles apparently about evenly fusiform, deepest midway in length. Caudal peduncle compressed, least depth about $1\frac{1}{2}$ its length.

Head moderate, robust, compressed, above rather broadly convex, lower profile more inclined convexly. Snout surface broadly convex, length about $\frac{2}{3}$ width. Eye large, circular, about first $\frac{2}{5}$ in head. Mouth well inclined, oblique, gape curved, closed mandible slightly protruding. Maxillary narrow, mostly concealed by preorbital, exposed end almost to eye. Mouth moderately small, jaw edges rather blunt and not especially hard. Lips thin. Tongue thick, fleshy, rounded, scarcely free. Nostrils together on snout above, about last third its length, posterior larger, anterior with cutaneous rim. Interorbital broad, slightly evenly convex. Preorbital width about $\frac{2}{3}$ its length, latter $1\frac{1}{2}$ in eye, lower margin convex. Lower posterior preopercle corner rather evenly convex.

Gill-opening last $\frac{2}{5}$ of head. Rakers reduced, short small fleshy points. Filaments about $\frac{4}{7}$ of eye. Pseudobranchiæ little shorter than filaments. Teeth 5–5, elongate, compressed, tips hooked, grinding-surfaces narrow.

Scales small, cycloid, in nearly even horizontal series, considerably smaller along dorsal and ventral body edges. Scales on caudal base little reduced. L. l. incomplete, on first few scales, curving down little below middle of side. Tubes simple, persisting to each scale edge.

Dorsal origin about midway between hind eye margin and caudal base, first branched ray highest, last about $\frac{3}{5}$ of first. Anal inserted about midway between pectoral medianly and caudal base just behind dorsal base, first branched ray highest, fin rounded like dorsal. Caudal emarginate, pointed lobes about equal. Pectoral pointed, upper rays longest, $\frac{3}{5}$ to ventral. Ventral inserted little before dorsal origin or about midway between front eye margin and caudal base, reaching vent close before anal.

Color in alcohol faded dull or pale brownish, belly and below slightly silvery-white. Faint trace of dark streak from eye to caudal base, another from upper side of head back to upper caudal peduncle surface hardly evident, fading out behind though possibly joining lower? Fins all faded pale whitish. Iris leaden-white.

Length about 2 inches (caudal slightly damaged).

No. 22,116, A. N. S. P., cotype (type) of *C. eos* Cope. Meshoppen Creek, Susquehanna Co. (Cope).

Also Nos. 22, 117 and 22, 118, same data, showing: Head $3\frac{3}{5}$; depth $4\frac{3}{8}$ to $4\frac{1}{5}$?; D. iii, 7, I; A. iii, 7, I; scales 76 to 82 + 5; 26 scales transversely; snout $3\frac{1}{2}$ to 4 in head; eye 3 to $3\frac{2}{7}$; maxillary $3\frac{1}{4}$ to $3\frac{1}{2}$; interorbital $3\frac{1}{8}$ to $3\frac{1}{3}$; teeth 5–5; length $1\frac{3}{4}$ to $1\frac{13}{16}$ inches.

This fish is only known to me from the above examples, though Cope mentions 4, all of which were taken in September of 1861. Nothing is known of the species, aside from Cope's short description.

Hybognathus nuchalis Agassiz.

Recorded by Cope. Occurs west of the Alleghanies. I have no examples.

Hybognathus nuchalis argyritis (Girard).

H. nuchalis Fowler, Am. Nat., XLI, 1907, p. 8. Kiskiminitas R. (Not of Ag.)

Head $3\frac{3}{4}$ to $4\frac{1}{5}$; depth 4 to $4\frac{1}{2}$; D. iii, 7, I; A. iii, 6, I; scales 37 to 42 + 2; 7 scales above l. l.; 4 or 5 scales below l. l.; 23 predorsal scales; snout $3\frac{1}{2}$ to $3\frac{2}{3}$ in head; eye $2\frac{4}{5}$ to $3\frac{1}{3}$; maxillary $3\frac{1}{2}$ to $3\frac{3}{4}$; interorbital $2\frac{1}{4}$ to 3; teeth 4–4. Body moderately compressed, somewhat fusiform. Head rather short. Snout broadly convex. Eye little elongate, rather large. Mouth rather wide. Maxillary to eye. Preorbital broad, width $\frac{4}{5}$ its length. Rakers 2 + 7? short weak points. L. l. median. Dorsal origin about midway between front nostril and caudal base. Anal behind dorsal base. Caudal apparently little emarginated. Pectoral about $\frac{5}{8}$ to ventral, latter inserted trifle before dorsal reaching $\frac{4}{5}$ to vent. Color largely silvery. Length $1\frac{1}{2}$ to 2 inches. Four examples from the Kiskiminitas R. (Cope).

This fish is closely related to *H. nuchalis*, with which I recently confused it, but differs apparently in the much larger maxillary. It occurs west of the Alleghanies and is said to attain a length of 4 inches.

Hybognathus nuchalis regius (Girard).

Head 4 to $4\frac{1}{3}$; depth $3\frac{5}{7}$ to $4\frac{1}{4}$; D. iii, 7, I; A. iii, 7, I, rarely iii, 6, I; scales 34 to 40, usually 36 to 39 + usually 2, occasionally 3, rarely 1; 6 scales above l. l.; usually 4 scales, occasionally 5, below l. l.; 14 to 18 predorsal scales; snout $3\frac{1}{5}$ to 4 in head; eye 3 to 4; maxillary $3\frac{1}{4}$ to $4\frac{1}{2}$; interorbital $2\frac{2}{7}$ to 3; teeth 4–4. Body compressed, somewhat slender. Head short, blunt. Snout blunt, broad, convex. Eye small. Mouth small. Maxillary not quite to eye. Preorbital moderate, width about 2 its length. Rakers 4 + 7? short weak points, tips sometimes bifurcate. L. l. median. Dorsal origin little nearer snout tip than caudal base. Caudal rather broad, forked, lobes pointed. Pectoral about $\frac{3}{5}$ to ventral, latter inserted about opposite dorsal origin and $\frac{2}{3}$ to anal. Color largely silvery, pale olive above. Fins pale. Iris silvery. Length $2\frac{1}{16}$ to $4\frac{3}{4}$ inches. Many examples from the Delaware R. at Holmesburg (Philadelphia Co.), Bristol and Hulmeville (Bucks Co.).

This handsome fish is very abundant in the lower or tidal region of the Delaware and its larger tributaries. I have not yet found it in the Susquehanna. Though usually brilliant silvery-white in life, brassy-tinted individuals are often met with. It attains a larger size than any of the related forms, and is said to reach 9 inches in length. It may be of some use as a pan fish, frequently varying the luck of perch fishermen, as it readily takes the hook. It seems to prefer the still tidal waters of our open rivers and creeks, and is frequently found in shoals about sand bars, and in little bays or guts, frequently associated with killies or other small fishes. The sexes are alike, and without tubercles or brilliant variegated pigment.

Pimephales promelas Rafinesque.

Head $3\frac{7}{8}$; depth $3\frac{3}{5}$; D. iii, 7, I; A. iii, 7, I; scales 42 + 2 (12 tubes forming l. l., then skipping 3 scales, then tube, then skipping 2 scales, and tube at caudal base); 9 scales above l. l.; 5 scales below l. l.; 23 predorsal scales; snout $3\frac{1}{5}$ in head; eye 4; maxillary $4\frac{3}{5}$; interorbital $2\frac{1}{5}$; teeth 4–4. Body deep, well compressed, rather short. Head robust, convex. Snout broad. Eye circular. Mouth small, low. Maxillary to front nostril, oblique. Rakers 4 + 11 short weak points, some ends little bifurcated. Scales rather narrowly imbricated. Dorsal origin midway between front eye margin and caudal base, second simple ray detached from third. Anal little behind dorsal base. Caudal emarginate, equal lobes rounded. Pectoral $\frac{4}{5}$ to ventral, latter little before dorsal and reaching vent. Color olive-brown, scale edges dusky. Head dusky-black, opercle edge creamy-brown. Iris gray-white. Dorsal gray, second simple ray pale, others medianly largely dusky-gray, anterior ones blackish. Caudal and pectoral grayish, other fins whitish. Several large tubercles on muzzle. Length $2\frac{9}{16}$ inches. One example from Port Allegany (McKean Co.) on June 2d, 1906 (Keim and Fowler).

The above is the only example I have secured from our limits. This fish prefers sluggish brooks or pools and varies greatly with season, age or sex. The head is almost globular in adult males. It is interesting in the aquarium. It feeds on green algæ and mud, and is sometimes met with in muddy pools. Only reaching a length of 3 inches it is of no use as a pan fish. Found west of the Alleghanies.

Pimephales notatus (Rafinesque).

Head $3\frac{7}{8}$ to $4\frac{3}{4}$; depth 4 to 5; D. iii, 7, I; A. iii, 6, I; scales 37 to 45 + usually 2, seldom 3, rarely 1; usually 7 scales, sometimes 6, above l. l.; usually 4 or 5 scales, rarely 3, below l. l.; 20 to 30 predorsal scales, usually 22 to 26; snout 3 to $3\frac{2}{3}$ in head; eye $2\frac{1}{2}$ to $4\frac{1}{4}$; interorbital 2 to 3; teeth 4–4. Body somewhat elongate, moderately compressed. Head robust, convex. Snout blunt, convex. Eye circular. Mouth small, low. Maxillary to hind nostril. Rakers about 4 + 7 short weak points. Scales narrowly imbricated. L. l. complete in adult. Dorsal origin midway between snout tip and caudal base, second simple ray detached from third. Anal behind dorsal base. Caudal forked, lobes rounded. Pectoral $\frac{2}{3}$ to ventral, latter inserted about opposite dorsal origin and reaching first branched anal ray base. Color olivaceous. Head blackish, gill-opening edged buff, in spring males, otherwise buff. Iris black and bronze. Pale dusky lateral diffuse band. Dorsal brownish, edge whitish, base blackish. Caudal dull olive, other fins paler. Large tubercles on muzzle of spring males. Length $1\frac{3}{16}$ to $3\frac{3}{16}$ inches. Many examples: from the Kiskiminitas R.; Cole Grove and Port Allegany (McKean Co.); York Furnace (York Co.); Foxburg (Clarion Co.); Erie (Erie Co.).

Closely resembling the preceding, especially when young, but distinguished by its more inferior mouth, rather more slender body, and slightly protruding blunt snout. The l. l. is variable, though absent in the young of both species it soon appears in the present. It is found in most of our western streams, though extending into the Susquehanna and thus farther east than the last. I have not found it in the Delaware. It prefers quiet streams and pools, often when muddy, and associates with other small fishes. It is variable in color, spring males being strikingly colored, though otherwise both sexes are pale olive with a dark blackish lateral band ending in a black caudal spot. A good bait minnow, as it is active and tenacious, reaching 4 inches in length.

Semotilus bullaris (Rafinesque).

Squalius hyalope Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 280. Conestoga Creek, Lancaster Co.

Head $3\frac{3}{4}$; depth $4\frac{1}{2}$; D. iii, 7, I; A. iii, 7, I; scales 44 + 3; 7 scales above l. l.; 6 scales below l. l.; 20 predorsal scales; snout $3\frac{1}{5}$ in head; eye $3\frac{1}{5}$; maxillary 3; interorbital $2\frac{2}{5}$; pectoral $1\frac{5}{7}$; ventral $1\frac{7}{8}$; least depth caudal peduncle $2\frac{1}{2}$; teeth 2, 5–4, 2. Body little elongate, compressed. Head large, rather conic, compressed. Snout convex, length about $\frac{7}{8}$ its width, slightly protruding. Eye little ellipsoid, high, trifle anterior. Maxillary to eye. No barbel. Interorbital broad, nearly flat. Rakers 3 + 5 short weak obsolete denticles. Scales striate, predorsal but little smaller. L. l. complete, slightly decurved. Dorsal inserted nearer caudal base than snout tip. Anal inserted about midway between pectoral tip and caudal base. Pectoral about $\frac{2}{3}$ to ventral, latter inserted about opposite dorsal origin, reaches vent close before anal. Color in alcohol dull brownish, sides and below paler to whitish with silvery traces. Iris brassy. Length $3\frac{1}{2}$ inches. No. 4,882, A. N. S. P., cotype (type) of *S. hyalope* Cope. Conestoga Creek, Lancaster Co. (Stauffer). From Cope. Nos. 4,883 to 4,886, same data.

Head $3\frac{1}{4}$ to $4\frac{1}{10}$; depth $3\frac{2}{3}$ to 5; D. iii, 7, I; A. iii, 7, I; scales 40 to 49, usually 41 to 47 + 2 or 3; usually 8, occasionally 7, seldom 9, scales above l. l.; usually 6 scales, frequently 5, rarely 4 or 7, below l. l.; usually 21 predorsal scales, frequently 20 or 22, often 19 or 23, seldom 24, and rarely 18 or 25; snout $2\frac{3}{5}$ to $3\frac{3}{5}$ in head; eye $2\frac{3}{5}$ to $6\frac{1}{3}$; maxillary $2\frac{1}{3}$ to $3\frac{1}{2}$; teeth 2, 5–4, 2, occasionally 2, 4–4, 2, rarely 2, 5–5, 2 or 2, 5–3, 2 or 1, 5–4, 2. Body robust, compressed. Head compressed, convex. Snout convex, about broad as long. Eye round, high. Mouth large, nearly horizontal. Mandible included. Jaws heavy. Maxillary nearly to eye, with short barbel above near end, latter absent in most young. Rakers 3 + 4 short weak denticles. Scales large, well exposed. Dorsal origin little nearer caudal base than snout tip. Anal behind dorsal base. Caudal forked. Pectoral about $\frac{3}{4}$ to ventral, latter inserted little before dorsal, reaches about $\frac{3}{4}$ to anal. Color largely silvery-white below, bluish and olive on back. Spring males brilliant vermilion on sides of head and body, lower fins and dorsal base, iris orange and front of head tuberculate. Length $1\frac{3}{8}$ to 15 inches. A very large series of all ages: from the Delaware R. basin at Kennett Square, Willistown Barrens, Crum Creek 2 miles east of White Horse, Ring's Run (Chester Co.); Markam, near Wawa, Collar Brook (Delaware Co.); Holmesburg, Torresdale (Philadelphia Co.); Cornwells, near Langhorne (Bucks Co.); Delaware Water Gap

(Monroe Co.); Dingmann's Ferry (Pike Co.): Susquehanna R. basin in the Conestoga Creek (Lancaster Co.); Emporium (Cameron Co.).

This is the largest and gamiest member of the family in our limits. It occurs only east of the Alleghanies or in our Atlantic basin, seemingly more abundant in the Delaware than in the Susquehanna. It is a vigorous fish, reaching about 18 inches in length. It often occurs about rapids and falls, from which it has earned the name of fall fish. The large ones occur in the rivers or other large bodies of water, though small ones are mature when only a few inches long and found living in small brooks. It is a very variable species, especially as to age, sex or season. Small adults resemble the young of large adults, being silvery with a dark lateral stripe, the latter fading out with age. It is omnivorous, and is often abundant about mouths of sewers, with suckers. It will take most bait, also the fly, and may be taken by trolling. It is usually angled in the summer, though often bites well in the fall. One often sees Thoreau quoted that "the chub is a soft fish and tastes like brown paper salted," which is not altogether true, as it is often a very acceptable pan fish and, perhaps not possessing the qualities of flavor of some of our other fishes, is not always to be compared to salted brown paper. It must be eaten when fresh and is then very good. It is said to spawn in the spring in quiet shallow places, accumulating large patches of gravel or pebbles, the so-called "nests."

Semotilus atromaculatus (Mitchill).

Head $3\frac{1}{5}$ to 4; depth $3\frac{4}{7}$? to $5\frac{1}{4}$?; D. iii, 7, I, rarely iii, 8, I; A, iii, 7, I, rarely iii, 8, I; scales 49 to 61, usually 50 to 58 + 2 to 4, usually 3; 9 to 12 scales above l. l., usually 10, frequently 11, otherwise rarely; 5 to 8 scales below l. l., usually 6, frequently 7, otherwise rarely; 27 to 38 predorsal scales, usually 30 to 34; snout 3 to $3\frac{7}{8}$ in head; eye $3\frac{1}{4}$ to $7\frac{3}{7}$; maxillary $2\frac{2}{7}$ to $3\frac{1}{6}$; teeth 2, 5–4, 2, occasionally 2, 4–4, 2, rarely 2, 6–6, 2 or 2, 5–5, 2 or 2, 3, 2–5, 2 or 2, 5–3, 4, 5 or 2, 5, 3–4, 3, 2 or 3, 4–4, 2. Body robust forward, compressed. Head robust, broad, obtusely conic, heavy. Snout broad, convex, length $\frac{3}{4}$ its width. Eye round, rather high. Mouth broad, rather large, little inclined. Mandible included. Jaws heavy. Maxillary about to eye, with short barbel above near end, latter absent in young. Rakers 2 + 6 short weak points. Scales small, crowded and smaller anteriorly. Dorsal origin about midway between front pupil margin and caudal base. Anal behind dorsal base. Caudal forked. Pectoral about $\frac{5}{8}$ to ventral, latter inserted little before dorsal and reaching about $\frac{2}{3}$ to anal. Color dusky-olive above. Dull diffuse band of same laterally, usually ending in blackish spot at caudal base, especially in young. Below silvery-white, rosy-red in spring males. Dusky bar behind opercle. Iris orange and yellow. Black spot at dorsal base in front margined orange-red. Dorsal and caudal pale olive, other fins with vermilion in spring males. Several large tubercles on snout and front of spring males. Length $1\frac{3}{8}$ to $8\frac{3}{4}$ inches. A very large series: from the Delaware R. basin in the Schuylkill R.; Cobb's Creek, Collar Brook, Fawkes Run, first brook above Whetstone Run (Delaware Co.); Philadelphia: Susquehanna R. basin at Emporium (Cameron Co.); Muncy (Lycoming Co.); Octoraro Creek at Nottingham (Chester Co.); near Ephrata, Denver and Swamp Bridge (Lancaster Co.): Genesee R. basin at Gold and Raymonds (Potter Co.): Youghiogheny R., Meadow Run (Fayette Co.): Kiskiminitas R.: Beaver R.: Allegheny R. basin at Warren (Warren Co.); Port Allegany (McKean Co.).

This chub is found everywhere in our limits more or less abundantly, not only in the larger streams but very often in the small clear mountain brooks, where it often associates with *Rhinichthys atronasus*. It is very voracious, and will eagerly take a hook with most baits, or even a fly. Reaching a length of about 10 inches, it is said to be a fair pan fish. It is also used as bait. The young differ considerably from the adult in the blackish lateral band. I have found this fish especially abundant in cold rapid trout streams, such as those in the upper Allegheny valley. It is said to spawn in the spring or early summer, constructing the "nests" about riffles or coarse gravel bars.

Leuciscus vandoisulus Valenciennes.

Head $3\frac{3}{5}$ to 4; depth $3\frac{3}{4}$ to 4; D. iii, 7, I, rarely iii, 8, I; A. iii, 8, I, occasionally iii, 7, I; scales 44 to 52, usually about 48 + 2 or 3, usually 2; usually 10 scales, seldom 9 or 11, above l. l.; usually 6 scales, frequently 5, below l. l.; 21 to 28, usually about 24, predorsal scales; snout $3\frac{1}{8}$ to $3\frac{7}{8}$ in head; eye $2\frac{7}{8}$ to $3\frac{1}{2}$; maxillary 2 to $2\frac{1}{3}$; teeth 2, 5–4, 2. Body compressed, deep. Head compressed. Snout convex. Eye round, high. Mouth large, well inclined, mandible protruding. Maxillary to pupil. Rakers 2 + 5 short denticles. Scales well exposed. L. l. well decurved, complete. Dorsal origin midway between front eye margin and caudal base. Anal inserted below last dorsal ray. Caudal deeply forked, lobes pointed. Pectoral reaching little beyond ventral, latter inserted well before dorsal origin and reaches anal. Color olivaceous above, each scale margined dusky and sides finely punctate with dusky. Leaden streak from snout and shoulder back opposite ventral, bounded below on trunk by streak of bright orange-red. Below white. Dorsal and caudal dull olivaceous, other fins pale. Iris brownish with golden ring. Head above minutely tuberculate. Young nearly plain-colored and females usually without tubercles. Length $1\frac{3}{4}$ to $3\frac{3}{16}$ inches. Many examples from the Susquehanna R. basin in tributaries of the Octoraro Creek and the head-waters of the North East Creek, North East R. basin, near Nottingham (Chester Co.).

This little minnow is found in small streams of clear water, usually about pools, and often associated with other small fishes. It is said to reach 5 inches in length. The males are very gaudy in spring dress, which some attain when half grown. It occurs only in our Atlantic basin and, though I found it in the lower Susquehanna valley, have not yet met with it in the Delaware, where, however, it has been recorded by Cope.

Leuciscus elongatus (Kirtland).

Head $3\frac{1}{5}$ to 4; depth $4\frac{1}{8}$ to $5\frac{1}{3}$; D. iii, 7, I; A. iii, 8, I, seldom iii, 7, I, rarely iii, 9, I; scales 60 to 75, usually about 60 to 69 + usually 2, frequently 3, rarely 4; usually 13 scales, frequently 12, seldom 11, rarely 14, above l. l.; usually 7 scales, frequently 8, below l. l.; 25 to 38, usually 28 to 35, predorsal scales; snout $3\frac{1}{8}$ to $3\frac{3}{4}$ in head; eye $2\frac{3}{4}$ to $4\frac{1}{8}$; maxillary $2\frac{1}{10}$ to $2\frac{4}{7}$; teeth 2, 5–4, 2, frequently 2, 4–4, 2. Body compressed, elongate. Head compressed, rather pointed. Snout convex. Eye round, high. Mouth large, well inclined, mandible protruding. Maxillary trifle beyond pupil front. Rakers about 2 + 5 short points. Scales small, about uniform. L. l. little decurved, complete in adult, incomplete or absent in young. Dorsal origin little nearer caudal base than snout tip. Anal little behind dorsal base. Caudal emarginate. Pectoral $\frac{7}{8}$ to ventral, latter inserted little before dorsal origin and fin $\frac{4}{5}$ to anal. Color olivaceous above, scales mottled darker. Lateral band of blackish, first half bright red in spring males. Below silvery-white. Lower fins reddened in spring males. Dark median dorsal streak. Iris silvery, dark lateral band passing through. Length $1\frac{1}{2}$ to $3\frac{3}{8}$ inches. Many examples from the Allegheny R. basin at Cole Grove and Port Allegany (McKean Co.).

Resembles the preceding. Found only in the clear mountain streams west of the Alleghanies, usually associated with other small fishes. Said to reach 5 inches and be a good bait minnow.

Leuciscus margarita (Cope).

Clinostomus margarita Cope, Trans. Am. Philos. Soc. Phila., (2) XIII, 1869, p. 377, fig. (teeth), Pl. 13, fig. 1. The Conestoga, near Lancaster.

Head 4; depth $4\frac{3}{5}$; D. evidently iii,? 7, I (damaged); A. iii, ? 7?

(damaged); P. i, 10?; scales about 58 to caudal base; l. l. formed of about 35 distinct tubes anteriorly; 11 scales above l. l.; 7 scales below l. l.; 31 predorsal scales; head width $1\frac{7}{8}$ its length; head depth at occiput $1\frac{1}{2}$; mandible about $2\frac{7}{8}$; dorsal base about 2; least depth caudal peduncle $2\frac{1}{5}$; snout 4 in head, measured from upper jaw tip; eye $3\frac{1}{3}$; interorbital $2\frac{3}{5}$; maxillary $3\frac{1}{10}$.

Body moderately elongate, well compressed, edges rounded, deepest near dorsal origin and upper profile apparently more evenly convex anteriorly than lower. Caudal compressed, rather deep, least depth about $1\frac{3}{8}$ its length.

Head moderately small, robust, compressed, little broad above and becoming slightly constricted below. Profiles similarly inclined, upper little more convex anteriorly than lower. Snout convex, length about $\frac{3}{4}$ its width. Eye circular, large, high, placed about first $\frac{3}{7}$ in head. Mouth small, well inclined, gape nearly straight in profile. Mandible protruding, rather shallowly convex, rami well elevated inside mouth. Maxillary mostly concealed, robust, well inclined, end past eye front, not quite to pupil. Jaw edges firm. Lips thin, evidently little developed. Tongue rather thick, fleshy, not free. Nostrils lateral on snout above, near eye, anterior with cutaneous margin, posterior larger, in crescent. Interorbital rather broadly convex. Preorbital large, trapezoidal, width about $\frac{4}{5}$ its length, latter about $1\frac{1}{2}$ in eye. Other suborbitals narrow. Preopercle margin inclined forward, angle rather broadly convex.

Gill-opening about to middle of head. Rakers 2 + 4? short weak points, about 4 in filaments, latter $\frac{3}{4}$ of eye. Pseudobranchiæ rather large. Teeth 2, 5–4, 2, hooked, slender, compressed, without evident grinding surfaces.

Scales rather small, adherent, mostly uniform, in series parallel with l. l. Predorsal scales small, little crowded. Breast scales still smaller. L. l. apparently complete, first slightly decurved, ascending median caudal peduncle side. Tubes simple, well exposed, though posterior rather indistinct.

Dorsal origin about midway between front eye margin and caudal base, fin moderately high, first branched (damaged) rays longest. Anal origin about opposite last dorsal ray base or about midway between caudal base and depressed pectoral tip. Caudal damaged. Vent close before anal.

Color in alcohol above dull brownish generally, sides and below pale or whitish with shining mercury tints. Sides uniform in color, and sprinkled all over with minute brownish dots or specks. Fins plain or pale brownish. Iris brassy.

Length $1\frac{3}{4}$ inches (caudal nearly absent).

No. 5,320, A. N. S. P., cotype of *C. margarita* Cope. A tributary of the Conestoga, near Lancaster (Cope).

Also No. 5,321, same data. Though this example is larger it is broken in pieces and mostly macerated. As it agrees in having the last few tubes in the scales of the l. l. discontinued before the caudal base it was probably largely the basis of the original description.

I only have the above material of Cope. He says it is bright crimson below during midsummer and that it was found in a stream inhabited by *Rhinichthys* and *Semotilus*. It has not yet been taken out of the Susquehanna basin in our limits.

Abramis crysoleucas (Mitchill).

Head $3\frac{3}{7}$ to $4\frac{2}{3}$; depth $2\frac{1}{2}$ to $4\frac{4}{7}$; D. iii, 7, I, rarely iii, 6, I or iii, 8, I, once abnormally iii, 7–4; A. usually iii, 12, I or iii, 13, I, occasionally iii, 14, I, rarely iii, 10, I or 11, i, or iii, 15, I, once abnormally iii, 8–2; scales usually 40 to 45, mostly 41 to 43, often 38, 39 or 46, seldom 47, rarely 48 or 50 + usually 2 or 3, rarely 1 or 4; usually 11 scales, often 10, frequently 12, rarely 9 or 13, above l. l.; usually 4 scales, frequently 5, rarely 3, below l. l.; usually 15 scales, frequently 14 or 16, rarely 17, transversely from dorsal origin, in young; usually 23, frequently 21 to 25, often 20, 27 or 28, seldom 29, and rarely 16, 17, 18, 19 or 30, predorsal scales; snout $3\frac{1}{3}$ to $4\frac{1}{2}$ in head; eye $2\frac{1}{4}$ to $4\frac{1}{4}$; maxillary 3 to $4\frac{1}{3}$; interorbital $2\frac{1}{5}$ to 3; teeth 5–5, occasionally 5–4, rarely 4–5 or 7–5 or 6–5 or 5–5, 2 or 1, 4–4, 2. Body well compressed, postventral trenchant. Head compressed, upper profile slightly concave. Snout broadly convex, length $\frac{1}{2}$ its width. Eye circular. Mouth small, oblique, mandible scarcely protruding. Maxillary not quite to eye. Rakers about 5 + 11 firm compressed points. Scales narrowly imbricated. L. l. greatly decurved, complete in adult, incomplete in young. Dorsal origin midway between hind eye margin and caudal base. Anal trifle behind dorsal base. Caudal widely forked, lobes pointed. Pectoral $\frac{4}{5}$ to ventral, latter inserted well before dorsal, fin $\frac{3}{4}$ to anal. Color bluish-olive above, whitish below. Sides often with bright deep bluish or golden reflections. Dorsal and caudal like back, lower fins yellowish-vermilion in spring males. Iris silvery. Length $1\frac{3}{8}$ to $5\frac{1}{2}$ inches. Very many examples: from the Delaware R. basin at Kennett Square, Ring's Run and Willistown Barrens (Chester Co.); Chadd's Ford, Hunter's Run, Collingdale (Delaware Co.); Holmesburg, Bustleton (Philadelphia Co.); Cornwells, Hulmeville, near Langhorne, Neshaminy Falls, Bristol, Emilie, Tullytown, Scott's Creek, Yardley (Bucks Co.); Hatboro (Montgomery Co.); Dingman's

Ferry (Pike Co.): Susquehanna R. basin, at York Furnace (York Co.); Nottingham (Chester Co.); near Denver and Witmer's Mills (Lancaster Co.); Lopez (Sullivan Co.): Lake Erie at Erie (Erie Co.).

This is one of our most abundant species. It occurs in all our waters and is sometimes found in large schools of thousands of individuals in the Delaware tide-water. It is especially characteristic of pools, ponds, cut-offs, in shallow or weedy places, and in still water. It readily takes the hook, and though sometimes reaching a foot in length is not considered much of a game fish. As a pan fish it is fair. It is not much in demand for bait as it is not very hardy, though its bright color is an advantage as a lure. Variation is quite noticeable, and in color often extremes of bluish and golden are found. It is very gregarious, and the large schools of shiners one so often sees along the shores of our creeks and quiet streams are frequently made up of this fish, though it often associates with other species. The young are quite different in color from the adult, having a black lateral band, which disappears after they have grown several inches.

Ceratichthys vigilax Baird and Girard.

Known to me only from Evermann and Bollman's record from the Monongahela River.

Notropis bifrenatus (Cope).

Head $3\frac{1}{2}$ 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, rarely iii, 7, I; scales usually 33, frequently 32 or 34, often 30, 31 or 35, seldom 29 and rarely 36 + usually 2, often 3, seldom 1; usually 11 scales transversely from dorsal origin to ventral, frequently 12, seldom 10, rarely 13; usually 6 scales above l. l., frequently 5; usually 4 scales below l. l., rarely 5; usually 12, frequently 13, often 11 and 14, seldom 10, rarely 15, predorsal scales; snout $3\frac{1}{8}$ to $4\frac{1}{4}$ in head; eye $2\frac{1}{4}$ to $3\frac{3}{5}$; maxillary $3\frac{1}{8}$ to $4\frac{1}{8}$; interorbital 2 to 3; teeth 4–4, rarely 4–3. Body rather compact, caudal peduncle little constricted. Head moderate. Muzzle obtuse. Eye circular, high. Mouth oblique. Jaws even. Rakers 2 + 5 weak points. Scales well exposed. L. l. incomplete, usually only of about 11 tubes anteriorly. Dorsal origin nearer snout tip than caudal base. Anal just behind dorsal base. Caudal long, forked, lobes rather pointed. Pectoral not to ventral. Ventral inserted about opposite dorsal origin and reaching trifle beyond anal. Color pale straw-brown, scales on back brown-edged. Shining black band with bluish tinge, from snout to caudal base, including mandible edge. Orange band above this on snout in spring males. Below silvery. Fins pale. Length $1\frac{1}{16}$ to $2\frac{5}{16}$ inches. Many examples: from

Ring's Run and Black Horse Run (Chester Co.); Collingdale (Delaware Co.); Holmesburg and Torresdale (Philadelphia Co.); Hatboro (Montgomery Co.); Cornwells, Hulmeville, Neshaminy Falls, Little Neshaminy Creek, Bristol, Emilie, near Langhorne, Scott's Creek (Bucks Co.): Susquehanna R. at York Furnace (York Co.).

This pretty little minnow may best be known from the other members of the genus by its incomplete lateral line. It closely resembles *N. procne*, but may be distinguished by this character. It is usually found in clear and rather still water, in schools of moderate size, and associated with other small fishes, such as killies and roach. They occur both in tide-water and above, in the small creeks and runs, and I have found them in the open rivers, though along shore. The sexes are colored alike, though during the spawning season, in May and June, the gravid females are much deeper-bodied. The young do not differ much from the adults. Altogether it is a weak little fish, but quite attractive, and said to be of use as bait. I have met with it only in the lower Delaware and Susquehanna basins. Cope's types of this species (*Hybopsis bifrenatus*) seem to be lost.

Notropis deliciosus (Girard).

Recorded from the Monongahela R. as *N. d. stramineus* by Evermann and Bollman. I have not seen any examples.

Notropis procne (Cope).

Hybognathus procne Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 283. The Conestoga.

Head $3\frac{3}{4}$; depth $4\frac{3}{4}$; D. iii, 6, I; A. iii, 6, I; P. i, 13; V. i, 7; scales 32 + 2; 5 scales above l. l.; 4 scales below l. l.; 12 predorsal scales; head width $1\frac{7}{8}$ its length; head depth at occiput $1\frac{4}{7}$; snout $3\frac{1}{2}$; eye $2\frac{1}{5}$; maxillary $3\frac{1}{3}$; interorbital $2\frac{3}{4}$; dorsal base $1\frac{7}{8}$; anal base $2\frac{1}{2}$; least depth caudal peduncle $2\frac{1}{4}$; pectoral $1\frac{1}{3}$; ventral $1\frac{4}{5}$.

Body elongate, well compressed, profiles similarly fusiform or upper only slightly more convex, deepest at dorsal origin, edges convexly round. Caudal peduncle compressed, least depth about $2\frac{1}{8}$ its length.

Head moderate, robust, wider than trunk, profiles about similar. Snout obtuse, convex, length $\frac{2}{3}$ its width. Eye large, high, little longer than deep, center near first $\frac{2}{3}$ in head. Mouth moderate, inferiorly terminal. Mandible slightly included, rather shallowly depressed, rami slightly elevated inside mouth. Lips thin. Premaxillaries protractile down. Maxillary very slightly beyond front eye margin. Jaw edges rather firm, trenchant. Tongue thick, fleshy, adnate. Nostrils large, together, on snout above near eye, crescentic posterior larger. Interorbital broad, flat. Preorbital width about $1\frac{2}{3}$ its length, latter $1\frac{1}{2}$ in eye. Infraorbital broadest of other narrow suborbitals. Posterior preopercle margin nearly straight, but slightly inclined forward.

Gill-opening to hind pupil margin, isthmus width at this point $2\frac{1}{2}$ in eye. Rakers 2 + 4 short weak points, much shorter than filaments, latter 2 in eye. Pseudobranchiæ large, less than filaments. Isthmus rather broadly depressed. Teeth lost.

Scales moderately large, series parallel with l. l., mostly uniform except smaller ones on caudal base, with fine radiating striæ. L. l. continuous, first decurved slightly, then about midway along caudal peduncle side. Tubes simple, each about $\frac{2}{3}$ exposed scale.

Dorsal origin midway between caudal base and snout tip, fin graduated down from first branched ray (damaged) and longest? Caudal (damaged) emarginate, lobes equal? Pectoral $\frac{2}{3}$ to ventral, upper rays longest. Ventral inserted little before dorsal origin, not quite to vent. Vent close to anal.

Color in alcohol faded mostly dull or pale brownish, not darker above. Edges of back scales slightly darker than ground-color. Head above brownish, below paler or translucent, sides washed silvery-white. Entire side of body bright silvery-white with underlaid median lateral streak from shoulder to caudal base medianly. From snout tip, back over underlaid leaden streak, dull brown band, inconspicuous and narrower than vertical eye. Iris pale silvery, leaden lateral streak passing through. Fins pale or plain dull brownish.

Length $1\frac{13}{16}$ inches (caudal damaged).

No. 3,152, A. N. S. P., cotype (type) of *H. procne* Cope. Conestoga, tributary of the Susquehanna (Stauffer). Also Nos. 3,153 to 3,162, same data.

Head $3\frac{1}{3}$ to $4\frac{1}{4}$; depth $3\frac{5}{8}$ to $5\frac{1}{2}$; D. iii, 7, I, rarely iii, 6, I; A. iii, 6, I, rarely iii, 7, I or iii, 5, I; scales usually 33, frequently 32, often 34, occasionally 35, seldom 31, rarely 36 + usually 2, occasionally 3; usually 6 scales, occasionally 5, above l. l.; 4 scales below l. l.; 13 predorsal scales usually, often 12 or 14, seldom 15, rarely 16; snout $3\frac{1}{8}$ to 4 in head; eye $2\frac{3}{7}$ to $3\frac{1}{4}$; maxillary 3 to $3\frac{2}{7}$; interorbital $2\frac{1}{6}$ to $3\frac{1}{2}$; teeth 4–4, rarely 5–4. Body elongate, compressed, rather slender, caudal peduncle long, constricted. Head moderate. Muzzle short. Eye circular, little high. Mouth oblique. Jaws even. Rakers 2 + 5 short weak points. Scales well exposed. L. l. complete, little decurved at first. Dorsal origin midway between snout tip and caudal base. Anal inserted well behind dorsal base. Caudal long, forked, lobes pointed. Pectoral $\frac{3}{4}$ to ventral, latter inserted little before dorsal origin, reaches vent. Color above pale brownish. Dark lateral band overlaid with grayish. Median dark streak down back. Sides and below silvered. Fins pale brownish. Iris silvery, crossed by dark lateral band. Length $1\frac{1}{8}$? to $2\frac{1}{16}$ inches. Many examples, including the above cotypes: from the North East Creek headwaters near Nottingham (Chester Co.): Susquehanna R. basin in the Pequea Creek at Paradise and in the Cocalico Creek at Swamp Bridge, Witmer's Mills and run near Blainsport (Lancaster Co.): Delaware R. basin in Darby Creek at Collingdale (Delaware Co.); Schuylkill R.; Holmesburg (Philadelphia Co.); Hulmeville, above Newtown, Neshaminy Falls (Bucks Co.); Abrams (Montgomery Co.).

This species is closely related to *N. bifrenatus*, differing in the complete lateral line, even in young an inch long. It is found in clear streams or creeks, not too rapid, and usually about gravel bars, where it associates in shoals with other species. It prefers the more upland streams, and I have not yet found it in tide-water. The adult is a beautiful little fish, averaging about $2\frac{1}{2}$ inches in length. It is subject to some variation. Though hardly brilliant in color, it is handsome, in certain lights the dark lateral band gleaming violet, blue or greenish. It probably spawns in late spring and early summer. It is said to be excellent bait, and good in the aquarium. I have met with it only in the Susquehanna and Delaware basins.

Notropis keimi sp. nov. Plate XXVII.

N. cayuga Fowler, Am. Nat., XLI, 1906, p. 595. Allegheny R. above Port Allegany, McKean Co. (Not of Meek.)——Fowler, *l.c.*, XLI, 1907, p. 10, copied.

Head $3\frac{4}{5}$; depth $4\frac{7}{8}$; D. iii, 6, I; A. iii, 7, I; P. i, 11; V. i, 7; scales 37 + about 3; 5 scales above l. l.; 3 scales below l. l.; 15 predorsal scales; head width $1\frac{7}{8}$ its length; head depth as occiput $1\frac{3}{5}$; snout $3\frac{1}{4}$; eye $3\frac{2}{3}$; maxillary 3; mandible $2\frac{1}{5}$; interorbital $3\frac{1}{8}$; first branched dorsal ray $1\frac{1}{5}$; first branched anal ray $1\frac{3}{5}$; least depth caudal peduncle $3\frac{1}{10}$; lower caudal lobe trifle longer than head, about space equal to pupil diameter; pectoral $1\frac{2}{5}$; ventral $1\frac{1}{3}$.

Body elongate, slender, compressed, edges rather broadly convex, profiles similarly tapering from greatest depth at dorsal origin. Caudal peduncle slender, compressed, least depth $2\frac{3}{4}$ its length.

Head rather large, elongate, compressed, rather flattened sides not convergent below, upper profile little more inclined than lower. Muzzle obtuse. Snout obtuse, surface and profile convex, length about $\frac{2}{3}$ its width. Eye large, close to upper profile, trifle before middle head length, rather ellipsoid or trifle longer than deep. Mouth inferior, rather large, jaws about even. Maxillary large, rather exposed, to front eye margin, scarcely beyond. Premaxillaries protractile. Mandible rather broad, depressed, rami well elevated inside mouth. Lips rather firm, little fleshy, rather narrow. No barbel. Jaw edges tough, rather firm, though not especially trenchant. Tongue small, thick, fleshy, not free in mouth. Nostrils large, together, superolateral on snout to upper front pupil margin, posterior exposed in crescent, much larger. Interorbital broad, flattened, scarcely elevated convexly over eye. Preorbital elongate, greatest width about $\frac{2}{3}$ its length, latter $1\frac{2}{7}$ in horizontal eye. Other suborbitals all narrow. Posterior preopercle margin straight, slightly inclined posteriorly.

Gill-opening forward about opposite posterior preopercle margin. Rakers iii, 2 + 2 short weak blunt stumps, much shorter than filaments. Latter about half of horizontal eye. Pseudobranchiæ large, little shorter than filaments. Isthmus broad, level, least width about $1\frac{1}{2}$ in horizontal eye. Teeth 1, 4–4, 1, rather conic, hooked, with grinding surfaces.

Scales large, cycloid, disposed in longitudinal series parallel with l. l., rather broadly exposed or coloration producing vertical rhombs, each with many very minute obsolete radiating striæ, of about uniform size, and a few small ones crowded on caudal base. Small rounded adnate scaly flap in ventral axil, about $\frac{1}{5}$ of fin. L. l. continuous, little decurved anteriorly, and ascending behind dorsal midway along caudal peduncle side. Tubes simple, each well exposed, or after first 5 extending all way to each scale edge.

Dorsal origin midway between snout tip and caudal base, graduated down from highest or first branched ray, depressed fin about $\frac{3}{7}$ to caudal base. Anal origin inserted just after dorsal base, graduated down from first branched or longest ray, fin base $1\frac{1}{5}$ its depressed length. Caudal long, deeply forked, lobes rather long, pointed, lower much longer. Pectoral rounded, uppermost rays longest, fin about $\frac{9}{10}$ to ventral. Latter inserted trifle before dorsal origin, reaches anal. Vent close to anal.

Color in alcohol faded but little from that described below, when fresh.

Color when fresh rather clear dull olivaceous-brown above, margin of each scale dusky till low as l. l. at least, and producing a network of diamonds or rhombs in appearance. Head dusky-brown above, and this forming into a median dusky dorsal line. Side of body more or less silvered. Lower surface of head and body mostly translucent whitish. Iris bright silvery, slightly dusky above. Jaws pale or translucent, upper slightly brownish. Costal region silvery, merging into plumbeous or grayish longitudinal streak along caudal peduncle side. Each scale of l. l. with a number of dusky-brown points along tubes. Dorsal and caudal pale transparent grayish-dusky, other fins paler.

Length $2\frac{9}{16}$ inches.

Type, No. 31,126, A. N. S. P. Tributary of the Allegheny River above (south of) Port Allegany, McKean County. August of 1904. T. D. Keim and H. W. Fowler.

Head $3\frac{2}{3}$ to $3\frac{7}{8}$; depth $4\frac{1}{3}$ to 5; D. usually iii, 6, I, rarely iii, 7, I; A. usually iii, 7, I, rarely iii, 6, I; scales 33 to 37, usually about 33 + 2; scales above l. l. usually 6, rarely 5; scales below l. l. 4; predorsal scales usually 16, sometimes 15; snout $3\frac{1}{3}$ to $3\frac{3}{4}$ in head; eye 3 to $3\frac{1}{10}$; maxillary $3\frac{1}{10}$ to $3\frac{1}{5}$; interorbital $2\frac{3}{4}$ to $2\frac{7}{8}$; teeth 1, 4–4, 1. Length $1\frac{11}{16}$ to $1\frac{13}{16}$ inches. Tributary of the Allegheny R. at Cole Grove, McKean Co. July 23, 1899. S. P. G. Lindsay and H. W. Fowler. Nos. 24,045 to 24,047, A. N. S. P., paratypes.

This species seems to be most closely related to *N. hudsonius*, but differs in the larger and more slender caudal peduncle, different physiognomy, and coloration. It differs from *N. deliciosus* and *N. boops* in the same characters, besides others, such as the eye and fin rays. It differs from *N. ariommus*, *N. scabriceps*, *N. jejunus* and allied species, in the fewer pharyngeal teeth, and other characters in combination, when the proper extent of variation is allowed. It may, therefore, be considered a member of the subgenus *Hudsonius*.

Only the type was obtained at Port Allegany. At the type locality the stream was of clear cold water, flowing rather rapidly over a shallow place of considerable extent, and with a bottom of small stones and pebbles. The fish was rather shy, and though several others were seen at the same time, the one secured was rather difficult to capture. They all seemed to lurk about the banks, under large stones, or in the deeper places, and were quite agile in their movements. *Cottus gracilis* and *Semotilus atromaculatus* were found in the same places, the latter especially abundant.

At Cole Grove several small examples were taken some years previously. They were all found in pools, associated with *Exoglossum maxillingua* and *Leuciscus elongatus*. In coloration they did not seem to differ much from the type, their caudal lobes being about equal.

(Named for my friend, Mr. Thomas D. Keim, who assisted me in procuring the type, besides many interesting local collections of fishes for the Academy.)

Notropis hudsonius (Clinton).

Head $4\frac{2}{7}$; depth $4\frac{7}{8}$; D. iii, 7, I; A. iii, 7, I; scales 37 + 1; scales above l. l. 5; scales below l. l. 5; predorsal scales 15; snout $3\frac{1}{8}$ in head; eye $3\frac{1}{5}$; interorbital $3\frac{1}{6}$; teeth 2, 4–4, 1? Body compressed. Head small, compressed. Snout broadly convex, length $\frac{3}{4}$ its width. Eye high. Mouth large, well inclined. Maxillary to eye. Mandible included. Interorbital depressed. Rakers 3 + 5 short firm points. Scales well exposed. L. l. almost straight, slightly decurved, complete. Dorsal origin about midway between posterior nostril and caudal base. Anal rather close behind dorsal base. Caudal forked, lobes pointed, equal. Pectoral $\frac{4}{5}$ to ventral, latter inserted little before dorsal origin, $\frac{3}{4}$ to anal. Color pale brownish above, below white. Broad silvery band along side. Black spot at caudal base. Iris silvery-white. Length $2\frac{3}{4}$ inches. Lake Erie at Erie (Erie Co.).

This fish, closely related to the next, occurs only west of the Alleghanies. It is characterized chiefly by the ever present jet-black caudal spot. It is said to reach 10 inches in length, and not frequent small streams. Desirable as a bait minnow.

Notropis hudsonius amarus (Girard).

Head $3\frac{2}{3}$ to $4\frac{3}{7}$; depth $3\frac{5}{6}$ to 5; D. iii, 7, I, rarely iii, 8, I; A. iii, 7, I, rarely iii, 8, I; scales usually 35 or 36, frequently 34 or 37, occasionally 33, 38 or 39, rarely 31, 40 or 42 + usually 2, rarely 1 or 3; usually 6 scales, seldom 5, rarely 7, above l. l.; usually 5 scales, seldom 4, rarely 6, below l. l.; usually 15, frequently 14, often 16, seldom 13, rarely 17 or 22, predorsal scales; snout 3 to $3\frac{1}{5}$ in head; eye $2\frac{3}{4}$ to $3\frac{3}{4}$; maxillary $2\frac{3}{4}$ to $3\frac{3}{4}$; interorbital $2\frac{1}{4}$ to $3\frac{1}{10}$; teeth usually 1, 4–4, 1, frequently 2, 4–4, 2 or 2, 4–4, 1 or 1, 4–4, 2, rarely 0, 4–4, 1 or 2, 4–4, 0 or 2, 4–3, 0 or 1, 4–4, 0 or 0, 4–4, 0. Body compressed, rather robust. Head rather broad, compressed. Snout convex, length $\frac{3}{4}$ its width. Eye little elongate, rounded. Mouth somewhat oblique. Jaws about even. Maxillary to hind nostril. Interorbital convex, middle flattened. Rakers 2 + 5 short weak points. Scales well exposed. L. l. complete, little decurved, midway along caudal peduncle side. Dorsal inserted little nearer snout tip than caudal base. Anal inserted little behind dorsal base. Caudal forked, lobes pointed. Pectoral about $\frac{3}{5}$ to ventral, latter inserted slightly before or opposite dorsal origin, reaches $\frac{2}{3}$ to anal. Color pale olivaceous-brown largely. Scale edges on back dusted darker. Broad silvery-white lateral band from eye to caudal, margin above on trunk behind leaden. Caudal spot faint or absent. Iris silvery-white. Length $2\frac{1}{16}$ to $5\frac{1}{4}$ inches. Many examples: from the Delaware R. basin, in Black Horse Run and first tributary below Mill Run, Ring's Run (Chester Co.); Holmesburg, Torresdale (Philadelphia Co.); Hulmeville, Neshaminy Falls, Bristol (Bucks Co.); Dingman's Ferry (Pike Co.): Susquehanna R. basin, Pequea Creek at Paradise, Cocalico Creek near Denver and at Witmer's Mills (Lancaster Co.).

A very abundant minnow in the lower Delaware and Susquehanna basins. It is usually found in the larger creeks and rivers, and readily takes a hook. It is good as bait and though said to reach 8 inches in length, it is seldom that examples are met with over 4 or 5 inches, thus being too small as a rule to use as pan fish. I have never seen any over 6 inches. It is distinguished from the preceding chiefly by the very faint or pale caudal spot, though in the young it is always somewhat in evidence. Young examples also have the lateral line incomplete, only as a few tubes at the beginning of its course. It usually occurs in schools and while more a feature of open rivers, both at the head of tide and above, it does occur, contrary to the statements of some writers, in our smaller streams or runs. It is also subject to considerable variation in structure, though the coloration remains about the same throughout the season, there evidently being no gaudy nuptial-dress.

Notropis whipplii (Girard).

Head $3\frac{4}{5}$ to $4\frac{1}{4}$; depth $3\frac{3}{4}$ to $4\frac{3}{4}$; D. iii, 7, I; A. iii, 7, I, rarely iii, 8, I; scales usually 38, sometimes 36, 37 or 39, rarely 35 + usually 2, frequently 3; usually 7 scales, frequently 6, above l. l.; usually 4 scales, frequently 5 below l. l.; predorsal scales usually 17, frequently 16, rarely 15, 18 or 19; snout 3 to $3\frac{4}{7}$ in head; eye $3\frac{1}{2}$ to $4\frac{2}{3}$; maxillary 3 to $3\frac{2}{3}$; interorbital $2\frac{1}{5}$ to $2\frac{7}{8}$; teeth 1, 4–4, 1. Body moderately slender, compressed, profiles similar. Head pointed, compressed. Snout convex, length $\frac{3}{4}$ its width. Eye small, little longer than deep, rather high. Maxillary not quite to eye. Mouth moderate, inclined. Mandible included. Interorbital broadly convex. Rakers 3 + 8, slender, pointed, short. Scales narrowly imbricated. L. l. complete, decurved, little low along caudal peduncle side. Dorsal origin trifle nearer front nostril than caudal base. Anal origin slightly behind dorsal base. Caudal well forked, slender lobes pointed, equal. Pectoral about $\frac{3}{5}$ to ventral, latter inserted well before dorsal, reaches vent. Color olivaceous on back, each scale dusky-edged. Iris silvery-white. Sides bluish silvery-white, below white. Satin-white ends to fins of spring males. Black spot on dorsal behind middle above, equals eye, variable, less conspicuous in female and young. Front and head minutely tuberculate in spring males. Length $2\frac{3}{8}$

to $3\frac{1}{2}$ inches. Many examples, from Kiskiminitas and Youghiogheny Rivers, and Erie (Erie Co.).

Found in the clear waters of the Ohio valley and Lake Erie. It is a beautiful little fish, reaching 4 inches in length. At all times it is largely bluish-silvery in general color. A good bait minnow. It greatly resembles its eastern relative.

Notropis whipplii analostanus (Girard).

Head $3\frac{1}{3}$ to $4\frac{1}{5}$; depth $3\frac{1}{6}$ to $4\frac{3}{4}$; D. iii, 7, I; A. usually iii, 8, I, occasionally iii, 7, I, seldom iii, 9, I, rarely iii, 6, I; scales usually 34, frequently 32 or 33, often 35, 31 or 30, occasionally 36, seldom 37 or 39, rarely 38, 28 or 27 + usually 2, often 3; usually 6 scales, seldom 5 or 7, above l. l.; usually 4 scales, rarely 5, below l. l.; predorsal scales usually 14 or 15, frequently 13 or 16, seldom 17, rarely 12 or 11; snout 3 to 4 in head; eye $2\frac{1}{3}$ to $4\frac{1}{3}$; maxillary $2\frac{2}{5}$ to $4\frac{1}{5}$; interorbital $2\frac{1}{5}$ to 3; teeth 1, 4–4, 1. Body moderately slender, usually rather deep in adult males, compressed, profiles similar. Head pointed, compressed. Snout conic, about long as wide. Eye small, little longer than deep, rather high. Mouth moderate, inclined. Mandible included. Interorbital broadly convex. Rakers 2 + 7 short points. Scales narrowly imbricated. L. l. complete, decurved, low along caudal peduncle side. Dorsal origin midway between eye front and caudal base. Anal inserted just behind dorsal base. Caudal forked, lobes equal. Pectoral $\frac{4}{5}$ to ventral, latter inserted trifle before dorsal origin, fin reaches anal. Color olivaceous on back, scale edges dusky. Iris silver-white. Sides bluish-white, below white, all silvery. Fins in spring males with satin-white borders. Black dorsal spot behind middle of fin above equals eye, variable, less evident in female and young. Head above, muzzle and predorsal region finely tuberculate in spring males. Length $1\frac{1}{8}$ to $3\frac{1}{4}$ inches. A very large series: from the Delaware R. basin at Kennett Square, Ring's Run (Chester Co.); Brandywine Summit, Concordville, Markam, Collingdale (Delaware Co.); Barren Hill, Abrams (Montgomery Co.); Holmesburg, Torresdale (Philadelphia Co.); Cornwells, Hulmeville, Little Neshaminy Creek, Neshaminy Falls, near Langhorne, Bristol, Emilie (Bucks Co.); Dingman's Ferry (Pike Co.): Susquehanna R. basin at Paradise, Conestoga Creek, Trout and Akron Runs at Ephrata, Cocalico Creek near Denver, Swamp Bridge, Witmer's Mills and run near Blainsport (Lancaster Co.); York Furnace (York Co.).

The silver fin is the most abundant of its genus in the Delaware, contrary to the impression of some writers. It prefers clear water, and usually the smaller streams and creeks, though often found in tide-water if not brackish. During the late spring and on through the early summer the males assume high coloration. Brilliant pigment of satin-white color is found about the ends of all their fins, the rays of which become somewhat enlarged or swollen, and thus earning for the fish the very appropriate name of silver fin. Tubercles of small size also appear on the upper surface of the body, though disappearing by late summer, along with the brilliant coloring. The females are but rarely tuberculous, and never so brilliant as the males. The young are not brilliantly colored, but are usually to be distinguished by their reticulated scale pattern being made up of narrowly imbricated scales, though the lateral line is complete. The silver fin sometimes collects in large shoals of possibly a thousand or more individuals, and associates sometimes with other small fish. They are equally active throughout the year, in certain localities, and may sometimes be found under the ice. They will usually bite at a small worm or other bait on a small minnow-hook, though of no use as food on account of their small size, the largest I know of not exceeding 4 inches. They are good bait and live well in the aquarium. Only found in the Delaware and Susquehanna basins. Closely related to *N. whipplii*, and differing in the deeper body and larger scales.

Notropis cornutus (Mitchill).

Head $3\frac{1}{4}$ to 5; depth 3 to $4\frac{1}{5}$; D. usually iii, 7, I, rarely iii, 8, I or iii, 6, I; A. usually iii, 8, I, seldom iii, 9, I, rarely iii, 7, I; scales usually about 30, frequently 31, 32, 33, 34, 35 and 36, often 37 to 40 and 27 to 29, rarely 25, 26, 41 or 44 + usually 3, frequently 2, rarely 4; scales above l. l. usually 8, frequently 7, occasionally 9, rarely 6 or 7; scales below l. l. usually 5, seldom 4 or 6, rarely 7; predorsal scales usually 17 or 18, frequently 15, 16, 19 or 20, occasionally 14, sometimes 21 or 22, seldom 23 to 25, rarely 12, 13, 26 or 27; snout $2\frac{1}{2}$ to 4 in head; eye $2\frac{1}{5}$ to $4\frac{1}{2}$; maxillary $2\frac{3}{5}$ to 4; interorbital $2\frac{1}{5}$ to $3\frac{1}{3}$; teeth 2, 4–4, 2 usually, rarely 2, 4–4, 1. Body compressed, rather deep, predorsal swollen, form more elongate in young. Head compressed, heavy. Muzzle obtuse. Snout convex, length about $\frac{4}{5}$ its width. Eye small, large in young, circular, rather high. Mouth moderate, little inclined. Jaws about equal. Maxillary to eye in adult. Interorbital well convex. Rakers 2 + 8 short firm points. Predorsal scales usually small and crowded and narrowly imbricated, or elongated vertically, on costal region. L. l. complete, well decurved, about midway along caudal peduncle side. Dorsal origin about midway between front nostril and caudal base. Anal origin trifle behind dorsal base. Caudal forked. Pectoral about $\frac{4}{5}$ to ventral. Ventral inserted little before dorsal, reaches anal. Color above dark bluish-olive, scale edges and bases dusky. Sides and below silvery-white, tinged rosy in spring males. Golden streak along upper side or back, most conspicuous as seen from above when fish swims in the water. Dusky streak behind gill-opening. Dorsal dusky, other fins plain, all edged broadly bright vermilion in spring males. Red on fins pale or absent in females or young. Muzzle and head above in spring males tuberculous. Iris silvery, golden in spring males. Length $1\frac{3}{16}$ to $5\frac{3}{16}$ inches. Very many examples: from the Delaware R. basin at Kennett Square, Ring's Run, Black Horse Run and first tributary below, Mill Run, Willistown Barrens (Chester Co.); Collar Brook, Whetstone Run, Langford's Run, Trout Run, Lewis's Run, Markam, Wawa (Delaware Co.); Schuylkill R.; Abrams (Montgomery Co.); Holmesburg, Bustleton, Torresdale (Philadelphia Co.); Cornwells, Hulmeville, Neshaminy Falls, Little Neshaminy Creek, Newtown, Bristol, near Langhorne (Bucks Co.); Dingman's Ferry (Pike Co.): Susquehanna R. basin at Emporium (Cameron Co.); Muncy (Lycoming Co.); Carlisle (Cumberland Co.); Paradise, near Denver, Swamp Bridge, Trout Run near Ephrata (Lancaster Co.); Meshoppen (Elk Co.): Port Allegany and Cole Grove (McKean Co.): Newcastle (Lawrence Co.): Kiskiminitas R.

Like the silver fin this is a most abundant species. It often associates with this, its smaller relative, especially when young. The breeding-dress of the spring male is very gorgeous, and is much more brightly colored than that of the silver fin. The head above, and predorsal region, are much more coarsely tuberculate, and the former, together with most of the fin-rays, becomes adipose-like or with a swollen appearance. The red fin has an interesting habit of resorting to clear shallows in the spawning season, which occurs about Philadelphia from late April to early summer. Schools of probably several hundred of the brilliantly-colored males may be found, closely packed together as a mass of crimson and purple, in these places. The females did not seem to take part in these gatherings, or at least I was unable to identify any in the several schools captured. From this it appears that they precede the males to the spawning grounds. Sometimes the males are herded in clear riffles, but usually where there is a sandy or clear pebble bottom. The females, besides being paler in color, lack the tubercles usually. The young are without any red, though generally with pale bluish or violet reflections on their sides, and only in the very young is the lateral line incomplete. The largest examples examined were $7\frac{1}{2}$ inches long, and I doubt if they seldom exceed 8 inches. The red fin is frequently found in rock pools about cascades, and seems perfectly at home in turbulent foamy water. They are frequently angled on a small hook, and though palatable as a pan fish are usually too small to be of any value. As bait they are excellent. It occurs usually in the smaller streams, being entirely distributed over our region. I have not yet taken it in tide-water.

Notropis chalybæus (Cope).[6]

Head $3\frac{2}{5}$ to 4; depth $3\frac{1}{2}$ to $4\frac{3}{4}$; D. iii, 7, I; A. iii, 7, I, rarely iii, 8, I; scales usually 30, frequently 31, often 29, 32, 33, 34, 35, rarely 28, 36 or 39 + usually 2, seldom 3, rarely 1; scales above l. l. usually 6, occasionally 7, rarely 5; scales below l. l. usually 4, seldom 3, rarely 5; predorsal scales usually 15, frequently 14, 16 or 17, rarely 13 or 18; snout 3 to $4\frac{1}{8}$ in head; eye $2\frac{1}{4}$ to $3\frac{1}{2}$; maxillary $2\frac{1}{5}$ to $3\frac{1}{5}$; interorbital $2\frac{2}{7}$ to 3; teeth 2, 4–4, 2. Body well compressed, heavy forward. Caudal peduncle slender. Head compressed. Snout convex, length $\frac{3}{4}$ its width. Eye rounded, high. Mouth inclined, mandible slightly protruding. Maxillary to eye. Interorbital broadly convex. Rakers 3 + 6 short slender points. Scales well exposed. Predorsal scales slightly smaller. L. l. complete in adults, incomplete in young. Dorsal origin about midway between front nostril and caudal base. Anal inserted little behind dorsal base. Caudal forked. Pectoral $\frac{6}{7}$ to ventral, latter inserted trifle before dorsal origin, fin reaches vent. Color dark brown, scales dark-edged on back. Black lateral band from snout to caudal base, purple, blue or green in some lights, and ending in black caudal blotch. Just over this a light brownish streak and within none of scales dark-edged like back above. Below whitish. Length $1\frac{1}{4}$ to $2\frac{3}{16}$ inches. Many examples from the Delaware R. basin in Mill Creek at Bristol and the Neshaminy Creek at Neshaminy Falls (Bucks Co.).

This is a very brilliant little fish in full breeding-dress, the lower surface of the body and pale area of brown adjoining the black lateral band being rich orange. This is only the case with the male, which is also covered with minute tubercles rather sparsely over the upper surface of the head, though much larger on preorbital and mandible. All of predorsal scales edged rather coarsely with corrugations or tubercles. The females lack the tubercles, and may easily be known at this time by their swollen abdomens, due to being gravid with ova. They all associate with other small fishes in rather still or quiet water, usually in large schools of several hundred individuals, and are largely

[6] Cope includes *N. scabriceps* (Cope) from our limits, in western Pennsylvania, hypothetically

preyed on by the common pike (*Esox americanus*). When a school is found in such a place the individuals are invariably all headed in one direction, and moving as if by one impulse when disturbed. Sometimes, however, they flash a little of their silvery sides as they move about. When greatly agitated they do not seem to swim far, but soon form into another school further on. I have only met with them in the lower Delaware valley.

Notropis jejunus (Forbes).

Recorded from the Monongahela by Evermann and Bollman. I have no material.

Notropis atherinoides Rafinesque.

Head $4\frac{1}{8}$ to $4\frac{1}{4}$; depth $5\frac{1}{5}$ to $5\frac{1}{2}$; D. iii, 7, I; A. usually iii, 9, I, occasionally iii, 10, I; scales usually about 40, sometimes 38 or 34 + usually 2, sometimes 3; scales above l. l. usually 6, occasionally 7; scales below l. l. 4; predorsal scales 16 to 19; snout $3\frac{1}{5}$ to $3\frac{3}{4}$ in head; eye 3; maxillary $2\frac{9}{10}$ to $3\frac{3}{7}$; interorbital $2\frac{1}{3}$ to $3\frac{1}{5}$; teeth 2, 4–4, 2. Body compressed, elongate, slender. Head compressed, blunt. Snout conic, length $\frac{7}{8}$ its width. Eye rounded. Mouth rather small, inclined, jaws about even. Maxillary not quite to eye. Interorbital evenly convex. Rakers 2 + 7 rather weak points. Scales rather narrowly imbricated along middle of side. L. l. decurved, complete. Dorsal origin about midway between eye center and caudal base. Anal origin trifle behind dorsal base. Caudal forked. Pectoral $\frac{3}{5}$ to ventral. Ventral inserted well before dorsal. Color transparent greenish above. Dark streak down back medianly. Sides bright silvery-white. Spring males with rosy snout. Length $2\frac{1}{2}$ to 4 inches. Two examples from the Beaver R. and 2 from Lake Erie at Erie (Erie Co.).

This handsome species is said to reach 6 inches in length. It occurs in rivers and lakes west of the Alleghanies, usually in schools, and in still water.

Notropis rubrifrons (Cope).

> *Alburnus rubrifrons* Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 85. Kiskiminitas River.

Head $3\frac{7}{8}$; depth $4\frac{3}{5}$; D. iii, 7, I; A. iii, 8, I; P. i, 13?; V. i, 7; scales 36 + 3; scales above l. l. 7; scales below l. l. 4; predorsal scales 18; head width $2\frac{1}{10}$ its length; head depth at occiput $1\frac{3}{5}$; mandible $2\frac{1}{4}$; depressed dorsal length $1\frac{1}{3}$; anal length $1\frac{3}{5}$; least depth caudal peduncle $2\frac{9}{10}$; pectoral $1\frac{1}{3}$; ventral $1\frac{9}{10}$; snout $3\frac{1}{3}$ in head from upper jaw tip; eye $3\frac{1}{10}$; maxillary $2\frac{7}{8}$; interorbital $3\frac{1}{10}$.

Body elongate, compressed, deepest at ventral origin, profiles similarly convex, edges rounded. Caudal peduncle compressed, rather slender, least depth $2\frac{1}{3}$ its length.

Head compressed, rather pointed, flattened sides rather convergent below, profiles similar, lower little more evenly and convexly inclined. Snout rather conic, surface convex, length about equals its width. Eye rounded, little high, near first $\frac{3}{7}$ in head. Mouth moderate, little inclined, jaw edges rather firm. Premaxillaries protractile. Maxillary slender, to eye front. Lips rather thin. Mandible depressed, rami not elevated inside mouth. Tongue depressed, fleshy, not free. Nostrils together on side of snout, crescentic posterior larger. Interorbital broadly convex. Preorbital little ovoid, width about $\frac{3}{4}$ its length, latter $1\frac{1}{5}$ in eye. Preorbital width about equals pupil. Posterior preopercle margin nearly vertical.

Gill-opening forward little before hind eye margin, not quite to pupil. Rakers about 2 + 6? short weak points, longest $\frac{1}{4}$ of filaments, latter $1\frac{3}{5}$ in eye. Pseudobranchiæ large, little smaller than filaments. Isthmus width at front $1\frac{1}{4}$ in pupil.

Scales in series parallel with l. l., all mostly broadly exposed, smaller on breast and preventral, each with several striæ. Ventral axil with pointed scaly flap, 5 in depressed fin. L. l. complete, decurved at greatest depth to lowest third. Tubes simple, each well over exposed scale not quite to edge.

Dorsal origin midway between hind eye margin and caudal base, fin highest anteriorly, depressed $1\frac{1}{4}$ to caudal base. Anal origin just behind dorsal base, fin highest anteriorly, depressed 2 to caudal base. Caudal damaged. Pectoral rather long, upper rays longest, fin $\frac{3}{4}$ to ventral. Ventral inserted little before dorsal, depressed $\frac{1}{5}$ to anal. Vent close before anal.

Color in alcohol dull brownish generally, back but little darker than rest of general color. Sides and below silvery to whitish. Fins pale brownish. Iris silvery.

Length $2\frac{1}{4}$ inches (caudal damaged).

No. 4,035, A. N. S. P., cotype (type) of *A. rubrifrons* Cope. Kiskiminitas River (Cope).

Also Nos. 4,036 to 4,039, same data, in poor preservation, showing: Head 4 to $4\frac{1}{6}$; depth $4\frac{3}{4}$ to $4\frac{1}{5}$; D. iii, 7, I; A. iii, 9, I or iii, 10, I; scales 30 to 37 + 2; scales above l. l. 6 or 7; scales below l. l. 4; predorsal scales 17 to 20; snout $3\frac{1}{10}$ to $3\frac{1}{4}$ in head; eye $3\frac{1}{10}$ to $3\frac{1}{2}$; maxillary $2\frac{1}{5}$ to $2\frac{7}{8}$; interorbital $2\frac{7}{8}$ to 3; teeth 2, 4–4, 2; length $2\frac{3}{10}$ to $2\frac{1}{4}$ inches.

Found in clear streams west of the Alleghanies. In life this fish is olivaceous in color, sides and lower surface silvery-white. Spring males have the forehead, side of head and dorsal base rosy-red, and the snout tuberculous. Along base of anal row of dark specks, and dark streak down middle of back. Said to reach $2\frac{3}{4}$ inches.

Notropis photogenis (Cope).

Squalius photogenis Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 280. Youghiogheny River, Pennsylvania.

Head 4; depth about 5 (emaciated); D. iii, 7, I; A. iii, 8?; P. i, 12?; V. i, 7; scales about 30? (squamation injured) + 2; scales above l. l. 6; scales below l. l. 4; predorsal scales 16; head width $1\frac{9}{10}$ its length; head depth at occiput $1\frac{4}{7}$; snout $3\frac{1}{4}$; eye $3\frac{1}{5}$; maxillary $3\frac{1}{8}$; interorbital 3; first branched dorsal ray $1\frac{2}{7}$; anal ray $1\frac{1}{2}$; least depth of caudal peduncle 3; upper caudal lobe 1; pectoral $1\frac{1}{4}$; ventral $1\frac{2}{3}$.

Body elongated, compressed, edges apparently rounded, profiles similar, deepest at dorsal origin. Caudal peduncle compressed, least depth $2\frac{1}{2}$ its length.

Head compressed, flattened sides convergent below, profiles similar. Snout convex, length $\frac{7}{8}$ its width. Eye large, little longer than deep, high, near first $\frac{3}{7}$ in head. Mouth inclined, moderate, jaw edges firm. Premaxillaries protractile. Maxillary slender, to eye front. Mandible depressed, rami well elevated inside mouth, symphysis slightly protruding in front when mouth closes. Lips rather thin. Tongue fleshy, depressed, rather far back. Nostrils together on snout side above near eye, posterior larger. Interorbital broadly convex. Preorbital width about $\frac{3}{4}$ its length, latter $1\frac{1}{2}$ in eye. Postorbital width equals pupil, other suborbitals narrow.

Gill-opening forward to last third in head. Rakers 2 + 7 weak points, longest about 4 in filaments, latter $2\frac{1}{3}$ in eye. Pseudobranchiæ little shorter than filaments. Isthmus width about $1\frac{1}{6}$ in pupil, surface flattened. Teeth 2, 4–4, 2, hooked, with slight grinding-surface.

Scales about uniform, in longitudinal series parallel with l. l., little smaller on breast. No evident axillary ventral scale. L. l. continuous, well decurved, ascending rather low along caudal peduncle side. Tubes simple, well over scales, though not quite to margins.

Dorsal origin midway between front nostril and caudal base, graduated down from first branched ray or longest, depressed $\frac{3}{7}$ to caudal base. Anal origin trifle behind dorsal base, first branched ray highest depressed $\frac{3}{5}$ to caudal base. Caudal well forked, pointed lobes about equal. Pectoral $\frac{3}{4}$ to ventral, upper rays longest. Ventral inserted little before dorsal, reaching anal?

Color in alcohol plain pale brownish generally, of uniform tint. Iris with slight silvery tinge.

Length $1\frac{7}{8}$ inches.

No. 22,280, A. N. S. P., cotype (type) of *S. photogenis* Cope. Youghiogheny River (Cope), Pa.

Also No. 22,281, same data, showing: Head $3\frac{1}{5}$; depth 5; D. iii, 7, I; A. iii, 8?; scales 33? + 3?; scales above l. l. 6; scales below l. l. 4; predorsal scales 14?; snout $3\frac{1}{2}$ in head; eye $2\frac{3}{4}$; maxillary $3\frac{1}{3}$; interorbital 3; length $1\frac{11}{16}$ inches. Both examples in poor preservation.

Found in streams west of the Alleghanies and said to reach 3 inches in length.

Notropis photogenis amœnus (Abbott).[7]

Head $3\frac{3}{5}$ to $4\frac{1}{4}$; depth $4\frac{3}{4}$ to $5\frac{3}{4}$; D. usually iii, 7, I, rarely iii, 8, I; A. usually iii, 10, I, occasionally iii, 9, I, rarely iii, 11, I; scales usually about 38, though ranging from 31 to 40 + usually 2, frequently 3, rarely 1; scales above l. l. usually 7, seldom 6 or 8; scales below l. l. 4; predorsal scales usually 18 to 21, seldom 17, 22, 23 or 24; snout 3 to $3\frac{1}{5}$ in head; eye $2\frac{3}{4}$ to $3\frac{1}{3}$; maxillary $2\frac{4}{5}$ to $3\frac{1}{5}$; interorbital $2\frac{2}{5}$ to $3\frac{1}{10}$; teeth 2, 4–4, 2. Body compressed, slender. Head compressed. Snout convex, length $\frac{7}{8}$ its width. Eye rounded, rather high. Mouth well inclined, moderate, mandible included evenly. Maxillary to eye. Interorbital broadly convex. Rakers 2 + 6 short weak points. Scales rather broadly exposed, crowded on predorsal region. L. l. complete, decurved about lowest third. Dorsal origin midway between eye and caudal base. Anal origin below last dorsal ray base. Caudal long, deeply forked. Pectoral $\frac{5}{6}$ to ventral. Ventral inserted little before dorsal, fin $\frac{4}{5}$ to anal. Color translucent olive on back, sides and below silvery-white. Leaden streak along side sometimes, offsetting color of back and belly, extending from eye to caudal, where little darker. Iris silvery-white. Length $1\frac{1}{8}$ to $3\frac{1}{8}$ inches. Many examples: from the Delaware R. basin at Holmesburg (Philadelphia Co.); Neshaminy Falls, Hulmeville, Bristol, Emilie (Bucks Co.); Dingman's Ferry (Pike Co.): Susquehanna R. basin at Paradise and Swamp Bridge near Denver (Lancaster Co.).

Found only in the lower Delaware and Susquehanna basins by me. It was especially abundant in the Neshaminy Creek and also occurs rather frequently in the Delaware tide-water. It is a beautiful bright silvery little minnow, and is said to reach $3\frac{3}{4}$ inches. It seems to differ from *N. photogenis* chiefly in the smaller predorsal scales. I have usually found it associated with large schools of other minnows or small fishes.

---

[7] Cope records *N. umbratilis ardens* (Cope) from west of the Alleghanies, evidently hypothetically, as no definite locality is mentioned.

Ericymba buccata Cope.[8]

Proc. Acad. Nat. Sci. Phila., 1865, p. 88. Kiskiminitas River.

Head $3\frac{1}{2}$; depth 5; D. iii, 7, I; A. iii, 7, I; P. i, 14; V. i, 7; scales 34 + 2; scales above l. l. 5; scales below l. l. 4; predorsal scales 17; head width 2 in its length; head depth at occiput $1\frac{3}{4}$; snout 3; eye $3\frac{1}{4}$; maxillary 4; interorbital $3\frac{1}{5}$; first branched dorsal ray $1\frac{1}{3}$; anal ray $1\frac{3}{4}$; least depth caudal peduncle $2\frac{7}{8}$; upper caudal lobe trifle over 1; pectoral $1\frac{1}{2}$; ventral 2.

Body compressed, elongate, slender, back not elevated though upper profile little more convex than lower, deepest at dorsal origin, edges mostly rounded and only upper and lower caudal peduncle surfaces with traces of median low obsolete keel. Caudal peduncle rather long, compressed, least depth about $2\frac{1}{3}$ its length.

Head elongate, moderately compressed, somewhat flattened sides slightly convergent above with lower surface slightly broader than upper, upper profile somewhat evenly convex, more inclined than straight lower one. Snout convex, slightly protruding, long as wide. Eye large, ellipsoid, near upper profile, center trifle before head center. Mouth small, inferior, scarcely inclined, obtuse edges not firm. Premaxillaries protractile down in front. Maxillary rather concealed, to front nostril. Lips fleshy. Mandible depressed, small, rami little elevated inside mouth. Tongue thick, fleshy, depressed, rather far back. Nostrils together, on snout side above, frenum last fourth in snout, anterior circular, posterior crescentic. Interorbital broad, slightly evenly convex. Preorbital about $1\frac{1}{2}$ in eye, width about $1\frac{3}{4}$. Other suborbitals all much narrower, postorbitals scarcely evident. Posterior margin of preopercle concave to curve posteriorly below. External conspicuous mucous chambers along each side of head below eye and along mandible surface below. Upper series about 7 cells and mandibular series about 9, on each side of head.

Gill-opening forward to upper hind preopercle margin, about last third in head. Rakers 1 + 4 short firm robust processes, thick set, about 4 in filaments, latter $1\frac{1}{2}$ in eye. Pseudobranchiæ small, less than half of filaments. Least isthmus width $1\frac{1}{2}$ in eye, lower surface broadly depressed. Teeth 1, 4–4, 1, hooked strongly at tips, without grinding surfaces but edges entire.

Scales in series parallel with l. l., mostly uniform except little smaller on breast and median dorsal and ventral body-edges, striæ radiating, all rather broadly exposed. Caudal base scales not smaller than

[8] Cope includes *Phenacobius teretulus* Cope as probably occurring in western Pennsylvania, thus purely hypothetical.

others. Ventral axil without scaly flap, though broad scaly flap between bases of fins, its hind edge free. L. l. complete, only decurved at first till midway along body side and caudal peduncle. Tubes simple, well exposed over each scale nearly to edge.

Dorsal origin about midway between snout tip and caudal base, third simple ray highest though first branched subequal, fin $2\frac{1}{5}$ to caudal base. Anal origin trifle after dorsal base, third simple ray longest though first branched subequal, fin 2 to caudal base. Caudal deeply forked, lobes pointed, equal. Pectoral rather broad, upper rays longest, $\frac{9}{10}$ to ventral. Ventral inserted trifle before dorsal, broadly expanded, reaches vent close before anal.

Color in alcohol dull brownish, lower surface scarcely paler, side of head and streak down middle of side of trunk dull leaden-silvery. Fins plain pale brownish. Iris dull brassy-brown.

Length $2\frac{7}{16}$ inches.

No. 6,003, A. N. S. P., cotype (type) of *E. buccata* Cope. Kiskiminitas River, western Pennsylvania (Cope).

Also No. 6,004, same data, showing: Head $3\frac{1}{2}$; depth $4\frac{2}{3}$; D. iii, 7, I; A. iii, 7, I; scales 31 + 2; scales above l. l. 5; scales below l. l. 4; predorsal scales 14; snout 3 in head; eye $3\frac{2}{5}$; maxillary $3\frac{3}{7}$; interorbital $3\frac{1}{3}$; third simple dorsal ray $1\frac{1}{5}$; anal ray $1\frac{3}{7}$; caudal 1; least depth caudal peduncle 3; pectoral $1\frac{2}{5}$; ventral $1\frac{7}{8}$; teeth 1, 4–4, 1; length $1\frac{3}{4}$ inches.

Cope says "a narrow space from vent to opposite middle of pectorals scaleless," which is not true in the above examples.

This little fish is said to reach 5 inches in length, and occurs in clear streams and ponds west of the Alleghanies. Its color is olivaceous above with silvery sides, and spring males are said to be without tubercles or bright colors. There is a dark line down the middle of the back and a streak of dusky dots along the side.

Rhinichthys cataractæ (Valenciennes).

Head $3\frac{1}{3}$ to 4; depth 4 to $5\frac{1}{4}$; D. iii, 7, I; A. iii, 6, I; scales variable, 41 to 68, mostly from 53 to 66 + usually 3, occasionally 4, rarely 2; scales above l. l. usually 13, frequently 12 or 14, often 15, sometimes 11; scales below l. l. usually 11, frequently 10, often 9, seldom 12, rarely 8; predorsal scales usually 27 to 31, occasionally 24 to 26 and 32 to 35, rarely 22, 36 or 37; snout $2\frac{1}{5}$ to $3\frac{1}{10}$ in head; eye $3\frac{1}{4}$ to $5\frac{1}{3}$; maxillary $2\frac{1}{3}$ to $3\frac{1}{5}$; interorbital $2\frac{3}{7}$ to $4\frac{1}{3}$; teeth 2, 4–4, 2. Body moderately slender, compressed, rather robust forward. Head elongate, rather conic. Snout long as broad, convex, protruding beyond mandible about 1 eye-diameter. Eye small in adult, large in young, high, midway in head. Mouth small, broad. Maxillary to hind nostril, small barbel at end. Slightly convex interorbital broad. Rakers 2 + 5 robust firm short points. Scales smaller anteriorly on trunk. L. l. complete, slightly decurved, nearly midway. Dorsal origin about midway between front nostril and caudal base. Anal inserted little behind dorsal base. Caudal forked, lobes about equal. Pectoral $\frac{4}{5}$ to ventral, latter inserted little before dorsal, fin to vent. Color olivaceous above, sometimes nearly blackish with mottled appearance. No distinct dusky lateral shade in adult, more evident in young. Lower surface whitish. Sometimes blackish opercle blotch. Lips, cheeks and lower fins in spring males rosy-red. Iris silvery. Spring males also with entire upper head, pectoral fin and trunk finely tuberculate, jaws smooth. Length $1\frac{11}{16}$ to $3\frac{7}{16}$ inches. Many examples from the Delaware R. basin at Kennett Square, Mendenhall and Mill Run (Chester Co.), the Susquehanna R. basin at Paradise (Lancaster Co.) and Meadow Run in the Youghiogheny R. basin near Ohio Pyle (Fayette Co.).

This dace occurs in clear swift streams, usually about rapids and deep pools, in all the upland waters of the State. It is said to reach 5 inches in length and be good bait for bass, though rather difficult to secure. I have usually found it associated with *R. atronasus*, though it appears to be more active.

Rhinichthys atronasus (Mitchill).

Head 3 to $4\frac{1}{5}$; depth $3\frac{2}{3}$ to $5\frac{7}{8}$; D. iii, 7, I, rarely iii, 6, I or iii, 8, I; A. usually iii, 6, I, rarely iii, 7, I; scales usually 50 to 60, varying frequently 43 to 49 and 61 to 64, rarely varying 39 to 42 and 65 to 67 + usually 3, occasionally 2 or 4; scales above l. l. usually 12, frequently 11 or 13, seldom 10, rarely 14; scales below l. l. usually 8, frequently 9, seldom 7 or 10, rarely 11; predorsal scales usually 30 to 33, frequently 28, 29 or 34 to 38, seldom 25 to 27, rarely 23 and 39 to 42; snout $2\frac{1}{2}$ to $3\frac{1}{2}$ in head; eye 3 to $5\frac{1}{6}$; maxillary 3 to 4; interorbital $2\frac{1}{5}$ to $3\frac{2}{5}$; teeth 2, 4–4, 2 usually, rarely 2, 5–4, 2 or 2, 4, 1–4, 2 or 2, 4–3, 2 or 1, 3–4, 2. Body compressed, moderately long. Head moderate, robust, broad. Snout convex, depressed, length $\frac{7}{8}$ its width. Eye small in adult, large in young, circular, high, slightly anterior. Mouth small, inferior, snout projecting about $\frac{1}{3}$ of eye beyond mandible. Maxillary little inclined, to front nostril, ending in short barbel. Interorbital broadly depressed. Rakers 3 + 4 short firm points. Scales small, well exposed. L. l. complete in adult, absent in young. Dorsal origin midway between hind eye margin and caudal base. Anal origin just after dorsal base. Caudal forked, lobes rounded. Pectoral $\frac{3}{4}$ to ventral, latter inserted little before dorsal origin, fin to anal. Color very variable, usually olivaceous-brown above mottled with dusky. Black lateral band from snout to caudal, always pronounced in young. Below white. Lower fins whitish to pale yellowish. In spring males sometimes whole body blushed crimson or golden, lateral blackish band vermilion or orange, also lower fins. Later in season dark lateral band turns blackish. Spring males also with head above behind nostrils minutely tuberculate. Length 1¼ to 3½ inches. Very many examples: from the Delaware R. basin at Kennett Square, Mendenhall, Black Horse Run, second tributary below latter, run near Stock Grange, Willistown Barrens (Chester Co.); Chadd's Ford, Wawa, Whetstone Run, north branch of Langford's Run, Lewis's Run, Hunter's Run, Collar Brook, Collingdale (Delaware Co.); Wissahickon Creek, Holmesburg, Torresdale (Philadelphia Co.); Abrams, Hatboro (Montgomery Co.); Cornwells, Neshaminy Falls, Little Neshaminy Creek, Newtown, near Langhorne, Tullytown (Bucks Co.); Dingman's Ferry (Pike Co.): Susquehanna R. basin at Brooklyn (Potter Co.); Loyalsock Creek near Lopez (Sullivan Co.); Octoraro Creek at Nottingham (Chester Co.); Paradise, Akron and Trout Runs near Ephrata, Witmer's Mills and run near Blainsport (Lancaster Co.): Allegheny R., Port Allegany and Cole Grove (McKean Co.); Warren (Warren Co.); Youghiogheny R. and Meadow Run near Ohio Pyle (Fayette Co.); Beaver R.[9]; Kiskiminitas R.: Genesee R. at Gold and Raymonds (Potter Co.): Potomac R. basin in Cove Creek (Fulton Co.).

This beautiful little fish is very abundant in most all clear swift cold brooks in the State, especially in the mountainous regions. It is variable in the extreme, and many quite striking varieties may be found, even in the same brook. The so-called brown-nosed dace, from our western streams, does not appear to differ in having a paler color and deeper body, so far as I have examined. In fact many western examples are very dark or dusky. The snout is also variable. The fish is often found greatly parasitized with tape-worms, the abdomen then being greatly swollen. It is said to be good as bait. It spawns in the late spring and early summer, though bright-colored examples are found throughout the latter season.

Hybopsis dissimilis (Kirtland).[10]

Head 3⅞ to 4¼; depth 5 to 6⅔; D. iii, 7, I; A. iii, 6, I; scales usually about 47, varying 32 to 50 + 3; scales above l. l. usually 6, rarely 7;

---

[9] Recorded wrongly by me in *Am. Nat.*, XLI, 1907, p. 11, as *R. cataractæ*.
[10] Bean records *H. amblops* (Rafinesque) from the Ohio valley hypothetically.

scales below l. l. usually 5, rarely 6; predorsal scales usually 19 or 20, rarely 17, 18, 21 or 23; snout $2\frac{1}{2}$ to 3 in head; eye $2\frac{3}{4}$ to $3\frac{1}{3}$; maxillary $3\frac{1}{5}$ to $3\frac{1}{2}$; interorbital 3 to 4; teeth 4–4. Body elongate, slender, compressed. Caudal peduncle long, slender. Head long, robust, little deeper than broad. Snout convex, long as broad. Eye large, high, midway in head. Mouth small, inferior, upper jaw protruding slightly. Maxillary well short of eye, ending in short barbel. Interorbital flattened. Rakers 2 + 5 short points. Scales smaller on predorsal, well exposed. L. l. complete, nearly straight. Dorsal origin midway between snout tip and caudal base. Anal origin little behind depressed dorsal tip. Caudal forked. Pectoral $\frac{5}{6}$ to ventral, latter inserted little behind dorsal origin, fin $\frac{3}{4}$ to anal. Color olivaceous, back rather mottled, below white. Sides bright silvery-white. Fins pale, plain. Lateral bluish stripe around snout, overlaid with several dusky spots. Length $2\frac{9}{16}$ to 4 inches. Twelve examples from the Youghiogheny R.

Found in the channels of the larger streams, creeks and lakes, west of the Alleghanies. It does not appear to enter the small brooks. Said to reach 6 inches in length, and though a good biter most too small as food. Taken largely for bait.

Hybopsis storerianus (Kirtland).

Recorded by Evermann and Bollman from the Monongahela R.

Hybopsis kentuckiensis (Rafinesque).

Ceratichthys micropogon Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 277. Conestoga Creek in Lancaster County.

Head $3\frac{2}{3}$; depth 4; D. iii, 7, I; A. iii, 6, I; scales 34 + 3; scales above l. l. 6; scales below l. l. 5; predorsal scales 18; head width 2 its length; head depth at occiput $1\frac{2}{5}$; snout $3\frac{1}{8}$; eye 3; maxillary 3; interorbital $3\frac{4}{5}$; first branched dorsal ray $1\frac{1}{4}$; anal ray $1\frac{1}{2}$; least depth caudal peduncle $2\frac{1}{2}$; lower caudal lobe 1; pectoral $1\frac{2}{7}$; ventral $1\frac{2}{3}$. Body moderately long, compressed, profiles similar, deepest at dorsal origin. Caudal peduncle compressed, least depth $1\frac{3}{4}$ its length. Head compressed, profiles similarly convex, flattened sides not convergent below. Snout convex, width $\frac{3}{4}$ its length. Eye elongate, rounded, high, center about first $\frac{4}{9}$ in head. Mouth low, nearly horizontal, large. Jaws even. Premaxillaries protractile down. Maxillary little inclined, trifle beyond eye front, not quite to pupil. Lips thin, little fleshy. Small barbel at lower maxillary corner distally. Jaw edges rather thin, trenchant. Mandible heavy, convex, rami little elevated inside mouth. Tongue thick, fleshy, adnate. Nostrils together, posterior larger, near eye front. Interorbital broadly depressed. Preorbital broad, width $\frac{3}{5}$ its length, latter $1\frac{1}{4}$ in eye. Other suborbitals narrow. Gill-opening last $\frac{2}{5}$ in head, nearly to hind eye margin. Rakers 2 + 5 points, about 3 in filaments, latter $1\frac{3}{4}$ in eye. Pseudobranchiæ large, little less than filaments. Isthmus level, least width nearly 2 in eye. Teeth 1?, 4–4, 1?, hooked, compressed, grinding surfaces narrow. Scales rather large, crowded on predorsal and breast, more exposed along sides medianly. Pointed scaly axillary ventral flap 5 in fin. L. l. complete, first decurved till about midway along side. Tubes simple, over first $\frac{3}{5}$ of exposed scales. Dorsal origin midway between eye front and caudal base, first branched ray longest, fin 2 to caudal base. Anal origin little behind dorsal base, first branched ray longest, fin $1\frac{2}{5}$ to caudal base. Caudal forked, lobes pointed, tips (damaged) about equal. Pectoral pointed, upper rays longest, fin $\frac{1}{5}$ to ventral. Latter inserted about opposite dorsal origin, reaches anal. Vent close before anal. Color in alcohol dull brownish, below paler. Head and trunk below with pale silvery reflections. Iris pale silvery. Fins pale brownish. Length $3\frac{1}{4}$ inches (caudal damaged). No. 5,061, A. N. S. P., type of *C. micropogon* Cope. Conestoga Creek in Lancaster County (Stauffer).

Head $3\frac{1}{3}$ to 4; depth $3\frac{1}{5}$ to $4\frac{3}{4}$; D. iii, 7, I; A. iii, 6, I usually, rarely iii, 7, I; scales usually 35 to 40, sometimes 33 or 34, rarely 32 or 41 + usually 3, rarely 2; scales above l. l. usually 7, frequently 6; scales below l. l. usually 5, frequently 6, rarely 4; predorsal scales usually 16 to 19, occasionally 20, rarely 14 or 24; snout $2\frac{1}{10}$ to 3 in head; eye $3\frac{1}{5}$ to 7; maxillary $2\frac{1}{2}$ 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, 0 or 1, 4–4, 1, rarely 1, 4–4, 2. Body compressed, robust. Head large, broadly rounded above. Snout convex, blunt, rather long. Eye small, high, round, larger in young. Mouth large, little inclined, mandible slightly shorter. Maxillary not quite to eye, ending in barbel. Interorbital broadly convex. Rakers 2 + 5 short bony points. Scales well exposed. L. l. complete, little decurved. Dorsal origin midway between snout tip and caudal base. Anal inserted behind dorsal base. Caudal emarginate, broad lobes rounded. Pectoral $1\frac{1}{2}$ to ventral, latter inserted opposite dorsal origin, reaches vent. Color olivaceous above with bluish tints. Sides with pale greenish on white and silvery. Below white. Fins pale orange. Spring males with head and belly blushed rosy, crimson spot on side of former, high adipose-like crest on forehead, and snout with large tubercles. Silvery iris, then orange and greenish. Young olivaceous above, silvery below, and dusky band along side medianly. Length $1\frac{9}{10}$ to $9\frac{3}{8}$ inches. Many examples: from the Susquehanna R. basin in

Elk Creek (Chester Co.); Conestoga Creek and near Denver (Lancaster Co.); Emporium (Cameron Co.): Youghiogheny R. and Meadow Run near Ohio Pyle (Fayette Co.); Beaver R.; Kiskiminitas R.; Newcastle (Lawrence Co.); Allegheny R. basin (Warren Co.).

This beautiful fish occurs in all streams west of the Alleghanies, and I have only met with it in the Susquehanna, in the Atlantic basin of our limits. It is said to reach 10 inches in length and be a fair table fish. Most frequently it is found in the larger creeks and rivers, seldom occurring in small brooks. It will take the hook readily and is a good bait as it is hardy. It shows considerable variation, the young being quite unlike the adult, and the latter also differing in the spawning season, which takes place in late spring and early summer.

Exoglossum maxillingua (Le Sueur).

Head $3\frac{2}{3}$ to $4\frac{2}{5}$; depth $3\frac{3}{4}$ to $4\frac{4}{5}$; D. usually iii, 7, I, rarely iii, 8, I; A. usually iii, 6, I, rarely iii, 7, I; scales usually about 48 to 51, rarely 39, 43, 44, 45, 47, 52, 53, 54, 56, 57 + usually 3, frequently 2, rarely 4; scales above l. l. usually 10, frequently 9, seldom 11, rarely 12; scales below l. l. usually 6, frequently 7; predorsal scales usually 25 to 28, sometimes 29, rarely 30; snout $2\frac{2}{5}$ to $3\frac{1}{2}$ in head; eye $2\frac{2}{3}$ to $4\frac{3}{4}$; maxillary $2\frac{3}{4}$ to $3\frac{3}{4}$; interorbital $2\frac{1}{10}$ to $3\frac{1}{4}$; teeth usually 2, 4–4, 2, rarely 1, 4–4, 2 or 0, 4–4, 2. Body compressed, robust. Head compressed, broad. Snout convex, width $\frac{3}{4}$ its length. Eye small in adult, large in young, high. Mouth small. Maxillary to eye. Upper jaw projecting. Mandible small, dentaries closely wedged together, incurved, producing trilobed appearance. Interorbital broadly flattened. Rakers 1 + 3 small rounded tubercles. Scales crowded anteriorly on trunk. L. l. continuous in adult, midway along side, incomplete or absent in young. Dorsal origin midway between front pupil margin and caudal base. Anal inserted just behind dorsal base. Caudal emarginate. Pectoral $\frac{5}{7}$ to ventral, latter inserted trifle before dorsal origin, reaches vent. Color olivaceous above, below whitish. Diffuse dusky blotch at caudal base, most distinct in young. Fins otherwise plain. Iris whitish. Length $1\frac{3}{8}$ to $4\frac{7}{8}$ inches. Many examples: from the Delaware R. basin at Mendenhall, Black Horse Run and first tributary below, Mill Run (Chester Co.): Susquehanna R. basin at York Furnace (York Co.); Paradise, near Denver and Witmer's Mills (Lancaster Co.); Emporium (Cameron Co.): Allegheny R. basin at Cole Grove (McKean Co.).

This peculiar and strikingly characterized species occurs in all our river basins, but seems to be most abundant in the Susquehanna. It is, however, by no means rare in the Delaware. It reaches a length of 6 inches and though rather small is sometimes said to be used as a pan fish. It is usually to be found in clear running water with other small fishes, and readily takes a hook.

PLATE XXVII—NOTROPIS KEIMI Fowler.

A NEW SPECIES OF CYMATOPLEURA.

BY CHARLES S. BOYER.

Since the publication of Greville's papers on the Diatomaceæ but few new forms from the deposit of Barbadoes have been described with the exception of those named by the late Prof. J. Brun in the last number of *Le Diatomiste.* The deposit, however, is very rich, and Mr. John A. Shulze, of Philadelphia, has not only prepared and mounted the greater number of Greville's rare species, but has discovered several new ones. Among these may be mentioned a *Cymatopleura* the diagnosis of which follows:

Cymatopleura shulzei n. sp.

Valve elliptical-lanceolate, with produced, subcapitate ends; border with moniliform markings. Surface with ten quite definite undulations; striæ punctate in quincunx. L. of V. 170 μ, puncta 14 in 10 μ.

Barbadoes deposit. Rare. Coll. J. A. Shulze.

I take pleasure in naming this species after Mr. John A. Shulze, whose preparations of selected diatoms is unexcelled. *Cymatopleura* is a well-defined genus, but limited in the number of species. Those known as *elliptica, solea, regula, hibernica, angulata, cochlea* and the three new ones of Pantocsek, *kinkeri, gigantea* and *gracilis,* resemble each other in outline, more or less. Lewis' small form, *C. marina,* differs chiefly in its lanceolate outline. The present species is distinguished by its produced ends and by the fact that it is the only one of the genus thus far found in the miocene deposits (Plate XXVIII).

I am indebted to Dr. T. S. Stewart for the photographs from which the figures were taken.

Explanation of Plate XXVIII.

Fig. 1.—Valve view. × 650.
Fig. 2.—Same. × 350.
Fig. 3.—Zonal view, somewhat inclined, showing moniliform markings and the undulations. × 460.

NOTES ON POLINICES DIDYMA, WITH DESCRIPTION OF A NEW AUSTRALIAN SPECIES.

BY H. A. PILSBRY AND E. G. VANATTA.

An Indo-Pacific group of species or forms of the Naticoid genus *Polinices* is characterized by having a transverse sulcus dividing the convex surface of the dark-brown umbilical callous lobe. Numerous supposed species were based on shells of this character, but modern authors have united all under one species, called *Natica ampla* by Tryon (*Manual of Conchology*, VIII, 1886) and *Natica didyma* by Watson and E. A. Smith (*Challenger Report*, XV, Gastropoda, 1886, p. 450), and by Pritchard and Gatliff (*Proc. Roy. Soc. Victoria*, XII, 1900, p. 191).

The names which have been applied to the forms in question follow in chronological order.

1798. *Albula didyma* Bolten, Museum Boltenianum, p. 20. Based upon *Nerita umbilicata livida* Chemnitz, Systematisches Conchylien Cabinet, V, p. 246, pl. 186, figs. 1856–57 (Tranquebar).

1845. *Natica papyracea* "Busch," Philippi, Abbildungen und Beschreibungen neuer oder wenig bekannter Conchylien, Vol. II (October), p. 45, pl. 2, fig. 12 (Hab. ———?); Conchylien Cabinet, p. 87, pl. 13, fig. 4; p. 43, pl. 5, fig. 4.

1848. *Natica ampla* Philippi, Zeitschrift für Malakozoologie, p. 156, spec. 16 (Hab. ———?); Conchylien Cabinet (*Natica*), p. 41, pl. 6, fig. 2.

1848. *Natica bicolor* Philippi, Zeitschrift für Malakozoologie, p. 156, species 17 (China Sea); Conchylien Cabinet, p. 43, pl. 6, fig. 4.

1848. *Natica vesicalis* Philippi, Zeitschrift für Malakozoologie, p. 159 (China); Conchylien Cabinet, p. 40, pl. 6, fig. 1.

1846–1858. *Natica lamarckii* Recluz, in Chenu, Illustrations Conchyliologiques, Vol. III, pl. 2, figs. 1–4.

1846–1858. *Natica petiveriana* Recluz, in Chenu, Illustrations Conchyliologiques, Vol. III, pl. 2, figs. 5–9; Reeve, Conchologia Iconica, IX, 1855, pl. 5, fig. 17.

1846–1858. *Natica intermedia* Recluz, in Chenu, Illustrations Conchyliologiques, Vol. III, pl. 2, fig. 10; pl. 3, figs. 1, 2, 3 (not of Philippi, 1836).

1846–1858. *Natica chemnitzii* Recluz, in Chenu, Illustrations Conchyliologiques, Vol. III, pl. 3, fig. 4. Reeve, Conchologia Iconica, IX, 1855, pl. 2, fig. 7 (not of Pfeiffer, 1840).

1852. *Natica incisa* "Dunker," Philippi, Conchylien Cabinet, *Natica*, p. 81, pl. 12, fig. 8 (China).

1852. *Natica papyracea* Busch, var. *major* Philippi, Conchylien Cabinet, p. 157, pl. 5, fig. 4.

1855. *Natica lamarckiana* "Recluz," Reeve, Conchologia Iconica, IX, pl. 2, fig. 6.

1855. *Natica problematica* Reeve, Conchologia Iconica, IX, pl. 6, fig. 21.

1860. *Natica robusta* Dunker, Malakozoologische Blätter, Vol. VI, p. 232; Mollusca Japonica, 1861, pl. 2, fig. 24 (Deshima).

1876. *Natica tasmanica* Tenison-Woods, Papers and Proceedings and Report of the Royal Society of Tasmania, 1875 (1876), pp. 148, 149; 1877 (1878), p. 32; 1890 (1891), p. 134, species 173. Proceedings Royal Society of Victoria, Vol. XII, 1900, p. 192. *Polinices tasmanica* T. Woods, Tate and May, Proceedings Linnean Society of New South Wales, Vol. XXVI, No. 103, 1901, p. 375, pl. 25, fig. 49.

The study of a series of 53 specimens in 23 lots, from localities in Japan, China, India, the East Indies and Australia, shows that several species and races can be distinguished, as follows:

Polinices didyma Bolten. Pl. XXIX, fig. 9.

Size rather large, up to 59 mm. diam. Coloration as in *didyma ampla* Phil., from which it differs by the *subtriangular* shape of the umbilical callus, which has a long adnate upper border and less projecting outer edge than *P. didyma ampla* Phil.

Type locality, Tranquebar. Bolten's species was based on Chemnitz's figures. We have seen no examples from Tranquebar, but the figures seem to show no tangible difference between *didyma* and the common Japanese species described as *N. robusta* Dkr., which we consider a synonym, pending the comparison of topotypes. We have *robusta* from Tashima, Awaji (Hirase), and Hayama, near Kamakura, Sagami (Miss Hartshorne). It seems to be confined to Japan and India.

Fig. 9 of plate XXIX represents a Japanese shell.

Polinices didyma ampla Phil. Pl. XXIX, fig. 8.

A large form, ordinarily attaining the diameter of 63 mm. The umbilicus is very ample, the excavation not half covered by the callus, which projects as a free lobe, the middle or lower part projecting beyond the adnate upper border; hence the general outline of the callus is *semicircular.* The lower lobe of the callus is ordinarily larger than the upper. The inner part of the umbilical excavation is covered with yellowish cuticle except in old or worn shells, as it is in all the related forms; and while there may be two or three narrow radial purplish streaks, the umbilicus is mainly white within. The exterior is more or less deeply tinted with chestnut or livid brown above, paler or white on the base; the early whorls are dull blue with a pale subsutural band, apex dark red. The inside of the aperture is chestnut above, white at the base.

Most of the specimens before us are from China. One lot is labelled Madras. The type locality was not known. Absolute synonyms of this form are *Natica lamarckii* Recluz, and *N. lamarckiana* "Recluz," Rve.

Polinices didyma bicolor (Phil.). Pl. XXIX, figs. 4, 5.

A form of *didyma* which may perhaps be segregated, as a subspecies was described as *N. bicolor* Philippi. It is smaller than *P. didyma ampla*, the maximum diameter 35 to 39 mm. Umbilicus and umbilical callus similar, but the lobes of the latter are often more convex, and darker, very dark chestnut or chocolate colored. Upper surface darker than in *didyma* or *didyma ampla*, generally bluish or somewhat plum colored, with darker and paler streaks; base and interior of umbilicus pale or pure white. Interior of the aperture very dark chestnut or chocolate with a white area at the base.

This form differs from *didyma* and *didyma ampla* chiefly by the more strongly contrasted colors and smaller size. While not strongly differentiated, it seems to be recognizable, and not uncommon.

Type locality China Sea. Specimens are before us from "China," Singapore and Queensland.

Natica petiveriana Recluz is identical with *bicolor.*

Polinices didyma vesicalis (Phil.). Pl. XXIX, figs. 6, 7.

Similar to *P. didyma*, but the base and interior of the umbilicus are generally conspicuously *streaked radially with brown;* upper surface light brownish, as in *didyma;* there is a more or less definite white band or paler area between the basal and the upper tinted tracts. This band is usually more distinct inside. Upper adnate edge of the callous lobe generally longer than in *P. didyma ampla* Phil., more as in *didyma*, but the *callus is smaller.* The whole parietal wall and adjacent root of the callous lobe are covered with a heavy pure white callus, whereas in *didyma ampla* Phil. this white area is much less extended. General form is generally rather more elevated than *didyma ampla.* The largest example in the Academy's collection has a diameter of 47 mm.

Type locality, China. Specimens from three sources before us are from China, with one tray labelled Madras.

Natica intermedia Reclus (not of Philippi, 1836), *N. problematica* Reeve and *N. incisa* Dkr. are identical with *vesicalis.*

Polinices papyracea ("Busch," Philippi).

We have not seen this form, which according to Philippi differs from *didyma* by its depressed shape and very thin shell. It was known to Philippi by one specimen measuring about 18 x 20 mm. *Natica papyracea major* Philippi is a larger form or specimen.

Polinices aulacoglossa n. sp. Pl. XXIX, figs. 1, 2, 3.

Shell globose, the contour higher and less broad than in *P. didyma* and its varieties, solid; light brown or slightly bluish, with an ill-defined white band at the base. *Umbilicus much smaller* than in *P. didyma,* very narrow within, half or more covered by the callus, which is dark brown, divided by a submedian transverse sulcus, subtriangular in shape, *the upper margin adnate to the end,* which projects farther than the free edge of the lobe. Parietal callus heavy, white. Other characters substantially as in *P. didyma.*

Alt. 30½, diam. 31 mm.

Type locality, Altona Bay, Williamstown, near Melbourne, Victoria. Types No. 94229 A. N. S P., collected by Mr. F. H. Baker.

Some specimens received from Dr. J. C. Cox are larger, alt. 41½, diam. 42 mm., otherwise similar. This is apparently the form listed by Messrs. Pritchard and Gatliff as *Natica didyma* Chemn. It is certainly distinct specifically from *P. didyma,* or any of its subspecies.

Natica chemnitzii Recluz (not *N. chemnitzii* Pfr., 1840) seems to be identical with this species, though if so it attains a larger size than any examples we have seen. In any case the name is a homonym and cannot stand.

Natica tasmanica Tenison-Woods has been placed in the synonymy of *P. didyma* by Messrs. Pritchard and Gatliff, but Tate and May in their *Census of Marine Mollusca of Tasmania* (1901) have r tained it distinct, a decision supported by the figure published by them. It is a far smaller species than *P. aulacoglossa,* alt. 13, diam. 16 mm.; and as Tenison-Woods mentions seeing a number of examples in several collections, it is not likely that he was dealing with young specimens. See also the remarks by Tenison-Woods in *Proceedings of the Royal Society of Tasmania*, 1877, p. 32 (1878).

Natica secunda Mab. et Rocheb., as figured and described by Ortmann,[1] is evidently closely related to *P. aulacoglossa* and its allies. It is not surprising to find that the nearest relatives of *N. secunda* are austral forms.

Explanation of Plate XXIX.

The figures are slightly reduced in size.

Figs. 1, 2, 3—*Polinices aulacoglossa* Pils. and Van., n. sp. No. 94229 A. N. S. P.
Figs. 4, 5—*Polinices didyma bicolor* Phil., No. 59200 A. N. S. P.
Figs. 6, 7—*Polinices didyma vesicalis* Phil., No. 59190 A. N. S. P.
Fig. 8—*Polinices didyma ampla* Phil., No. 59198 A. N. S. P.
Fig. 9—*Polinices didyma* Bolt. (*robusta* Dkr.), No. 80440 A. N. S. P.

---

[1] *Rep. Princeton Univ. Exped. to Patagonia*, IV, p. 188, pl. 33, fig. 3*a*, *b*.

ON THE TEETH OF HAWAIIAN SPECIES OF HELICINA.

BY HENRY A. PILSBRY AND C. MONTAGUE COOKE.

The dentition has been examined in four Hawaiian species of Helicina: *H. baldwini* Anc., *H. uberta* Gld., *H. laciniosa* Migh. and *H. rotelloidea* Migh. The chief divergence is in the denticulation of the fourth or major lateral tooth, which is armed with several large and small denticles in some species, and with more numerous equal denticles in others.

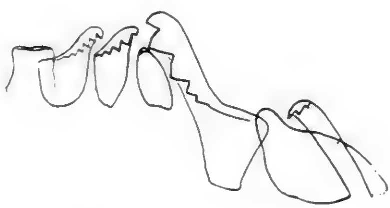


Fig. 1.—*Helicina baldwini.*

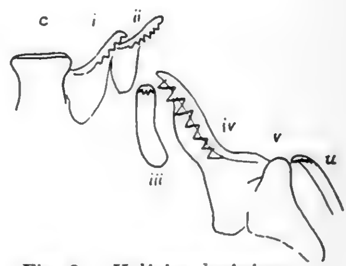


Fig. 2.—*Helicina laciniosa.*

In all the species, the central tooth has a very short smooth cusp or ledge at its summit.

In *H. baldwini* (fig. 1) the denticle formula of the laterals is 6, 5, 4, 5, 0; that is, the innermost lateral tooth has 6 points or denticles on its recurved cusp, the next tooth has 5, and so on. The inner uncini have three or four rather large denticles. Lateral iv has very unequal conic denticles, two of them much larger than the others.

H. uberta is like *baldwini*, except that the inner lateral has only 4 denticles.

H. laciniosa (fig. 2) has the denticle formula 5, 6, 4, 7, 0. The major lateral (iv) has an even series of subequal denticles. The inner uncini have about 7 very minute, subequal denticles.

The radula of *H. rotelloidea* resembles that of *H. laciniosa*, the major lateral having 6 subequal denticles, but the inner uncini are more like the *H. baldwini* type, having about 4 large denticles. What systematic value attaches to the differences observed is uncertain until many more species can be examined; but it would seem that two groups are indicated, characterized by the mode of denticulation of the cusp of the fourth lateral tooth.

The figures represent the central (*c*) and lateral teeth (*i*-*v*), with a single uncinus (*u*).

CLAUSILIIDÆ OF THE JAPANESE EMPIRE, XII.

BY HENRY A. PILSBRY.

Clausilias discovered by Mr. Y. Hirase, his correspondents and assistants, during the last year or two are described below. Unusual interest attaches to certain Euphædusoid species (*C. echo, C. nakadæ*) showing stages in a degeneration series leading to *Reinia*. Further minor phyla of the Zaptychoid series have also been found.

Section **EUPHÆDUSA** Boettger.

I have elsewhere given reasons for including the group *Reinia* in *Euphædusa*. *C. eastlakeana*, *C. echo* and *C. nakadæ* are connecting links between the typical members of these groups.

Clausilia eastlakeana vaga n. subsp.

The shell is like *C. eastlakeana* Mlldff. The clausilium is slightly wider, and distinctly more curved.

Length 12.0,	diam. 3.0 mm.;	whorls 7	} Nakanoshima.
" 10.3,	" 3.0	" " $6\frac{1}{2}$	
" 10.7,	" 2.8	" " 7	} Akusekijima.
" 9.0,	" 2.7	" " $6\frac{1}{2}$	

Nakanoshima, Ōsumi. Types No. 95691 A. N. S. P. from No. 1513 of Mr. Hirase's collection; also Akusekijima, Ōsumi.

In general appearance this shell resembles *C. variegata* A. Ad., from which it differs in having a clausilium and two palatal plicæ. It is profusely streaked with buff-white on a corneous-brown ground, the lighter tint usually predominating. The peristome is incomplete, the aperture being shaped like that of *Ena* (*Buliminus*). The short superior lamella curves toward the left termination of the lip, and is separated from the thin, low spiral lamella. The inferior lamella forms a high plate within the back. The subcolumeller lamella is very deeply immersed. The principal plica is rather short and lateral, and there are two short palatal plicæ, one above, the other near the base.

Clausilia eastlakeana Moellendorff was described from Fu-chow, on the island Nan-tai, province Fu-dshien, in southern China. So far as the shell is concerned, a comparison of specimens shows scarcely any difference from the variety defined above from the northeastern Ryukyu Islands, but the clausilium is perceptibly different. It must be admitted that such small differences as exist would not be thought of much significance were it not for the wide geographic separation.

Clausilia echo n. sp. Pl. XXX, fig. 7.

The shell is very small, thin, yellow or corneous, sometimes with a few yellow flecks; finely striate, becoming more coarsely so on the back of the last whorl, and under a lens showing faint spiral striæ. Penultimate whorl widest, those above tapering to the small, slightly obtuse apex. Whorls 6½ to 7, convex, the last compressed laterally, convex below. Aperture squarish ovate. Peristome continuous, expanded and reflexed, the upper margin notched over the superior lamella; sinulus retracted. The superior lamella is thin, marginal, separated from the spiral lamella, which is short and lateral. The inferior lamella is deeply placed, forming a prominent fold deep in the throat, strongly gyrate within the last whorl, penetrating as deep as the spiral lamella. The subcolumellar lamella is very deeply immersed. The principal plica is very short, lateral. There are small upper and lower palatal plicæ.


Fig. 1.

Length 7 to 8, diam. 2 mm.

The clausilium is rather broad, oval, tapering toward both ends, and very strongly curved.

Akusekijima, Ōsumi, Types No. 95688 A. N. S. P., from No. 1585 of Mr. Hirase's collection.

Clausilia echo is a connecting link between *Reinia* and *Euphædusa.* It resembles *C. eastlakeana* except in having the peristome complete, the aperture being shaped much as in *C. euholostoma* Pils., but that species has no superior lamella. *C. echo* is a less evolved form than *C. eastlakeana*, in the same phylum.

Clausilia variegata (A. Adams).

Pilsbry, Proc. A. N. S. Phila., 1901, p. 473, pl. 25, figs. 11, 12.

The type locality for this species is Tago, Izu (not in western Shikoku, as stated in a former communication). Other localities are Tokyo and its environs, Takasaki, Kōzuke; Kashima, near Tanabe, Kii, and Hirado, Hizen. Specimens have been received also from Chichijima, Ogasawara. They belong to the typical form of the species, not to the variety *nesiotica*.

The presence of this species in the Bonin Islands may perhaps be due to accidental introduction, with plants or otherwise. There has doubtless been abundant opportunity and time for such introduction since 1593, the date of first discovery of the Bonins, and occupation by the Daimio Ogasawara Sadayori.

Clausilia nakadæ Pilsbry. Pl. XXX, fig. 10.

Clausilia variegata var. *nakadai* Pils., Proc. A. N. S. Phila., 1902, p. 328.

The shell is rimate, fusiform, thin, dark brown, uniform or marked with buff on the upper whorls; upper half tapering and attenuate; lower two whorls subequal in width. Surface glossy finely and closely striate, the striation coarser on the latter part of the last whorl. Whorls 6½, convex, the last somewhat tapering downward, rather full and convex basally. The aperture is ovate; peristome thin, reflexed, the ends separated, joined across the parietal wall by a rather thin, transparent callus. Superior lamella very thin, subvertical, not continuous with the lateral and dorsal spiral lamella. Inferior lamella prominent, subhorizontal, ascending in a broad spiral within. Subcolumellar lamella very deeply immersed. Principal plica short, dorsal, penetrating to a lateral position. There are no other palatal plicæ (Fig. 2).

Fig. 2.

Length 7 to 7.3, diam. 2 mm.

The clausilium is very strongly curved, so that the distal part is at a right angle with the upper part. It is rather wide, parallel-sided, the end obtuse, slightly angular. The columellar side is only very slightly excised near the filament.

Hachijo-jima, Izu. Types No. 83299, topotypes No. 96984 A. N. S. P., from No. 942 of Mr. Hirase's collection, collected by Mr. Nakada.

This form was first described from two specimens, neither of which contained the clausilium. On subsequent examination Mr. Hirase discovered that it has a well-developed clausilium, and sent additional examples, one of which is described above, and illustrated on the plate.

Compared with *C. variegata* A. Ad., this species is much smaller and much more attenuate above; it is less variegated or uniform brown; and finally it has a clausilium. *C. echo*, of Akusekijima, Ōsumi, in the northeastern Ryukyu chain, is perhaps the most closely related species, but it differs from *C. nakadæ* by having the peristome continued as a raised cord across the parietal margin, and by possessing two small palatal plicæ, whereas *C. nakadæ* has only the principal plica. *C. nakadæ* is a perfect connecting link between *C. eastlakeana* and *echo* and *C. variegata*.

Group of Clausilia aculus.

Clausilia tripleuroptyx n. sp. Pl. XXXI, figs. 1, 2.

The shell is fusiform, the lower three whorls rather large, those above tapering to the attenuate summit; brown or chocolate colored, moderately glossy, the last 3 or 4 whorls sharply, finely striate, the

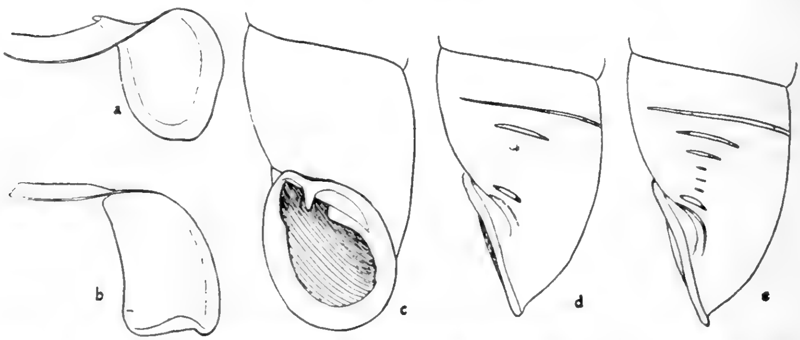


Fig. 3.—*Clausilia tripleuroptyx, a, b,* two views of clausilium; *c,* last whorl and aperture; *d, e,* diagrams of palatal armature of two individuals.

striæ a little coarser on the back of the last whorl. Whorls about 9, convex, the last flattened laterally, tapering downward. The aperture is squarish-ovate; peristome pale, well reflexed, continuous. Superior lamella marginal, of moderate size, compressed, *continuous with the spiral lamella,* penetrating to the middle of the ventral side. The inferior lamella approaches the superior, ascends in a broad spiral curve, and penetrates as deeply as the spiral lamella. The subcolumellar lamella is deeply immersed. The principal plica is rather short, lateral. There are usually three palatal plicæ below the principal, the upper well developed, a very short plica below it. There is no lunella, but a lower palatal plica about as long as the upper is present (fig. 3*d*).

Length 14.5, diam. 3.4 mm.
" 13.8, " 3.0 "

The clausilium is strongly curved, oblique and subangular at the apex, a little excised at the columellar side of the filament (fig. 3*a, b*).

Kuroshima, Satsuma. Types No. 95710 A. N. S. P., from No. 1589 of Mr. Hirase's collection.

This species is related to *C. digonoptyx* Bttg., but differs by its palatal plicæ and the more curved, differently shaped clausilium. It differs from *C. subaculus* by the better developed superior lamella and the different palatal armature. *C. aculus* Bens. of China and Korea is the most closely related species, but it differs in sculpture; it has not the fine, thread-like striation of *C. tripleuroptyx*, being more glossy, paler colored and less opaque.

As in *C. aculus*, the palatal armature varies. In most examples seen there are three palatal plicæ below the principal plica, the second either pliciform or punctiform (as in fig. 3*d*). Sometimes there are six plicæ, the 3d, 4th and 5th very small, scarcely visible inside by reflected light (fig. 3*e*).

Section **STEREOPHÆDUSA** Boettger.

Clausilia japonica Crosse.

The typical form of this species is found around Tokyo. The exact locality of the types was not known, but the Tokyo shells agree so fully with them that this place may be considered the type locality.

The shells are *coarsely rib-striate*, the striæ simple (not split), and on the last whorl there are about five striæ in one millimeter. The spiral lamella penetrates inward to the middle of the ventral side; the inferior lamella is much longer. There are two palatal plicæ, an upper and lower, below the principal, and in some examples there is the weak rudiment of a lunella near the lower palatal plica, and a second low nodule or plica just below the upper palatal plica. The size of Tokyo specimens is rather variable.

Length	29.0,	diam.	6.5	mm.;	whorls	11½.
"	25.5,	"	6.5	"	"	11.
"	26.5,	"	6.2	"	"	11.

The forms I described as var. *perstriata* and var. *perobscura* are close to typical *japonica* in sculpture. It is hard to decide what forms of so variable a species call for special names. Besides those now recognized, there seem to be several races, which may for the present remain undescribed.

The largest form of *C. japonica* I have seen was sent from Yakuenji, Izumo, by Mr. Hirase (No. 1594). The shell is rich chestnut colored when unworn, about as finely striate as *C. j. nipponensis*, and, like that, it has upper and lower palatal plicæ only, the lower one quite small. The spiral lamella runs inward to the middle of the ventral side, the inferior lamella being longer. Except in having no sutural plica, this form agrees with *C. hilgendorfi* Martens. No other *Stereophædusa* is known to have a sutural plica, so that it is possible that its recorded presence in *C. hilgendorfi* may be an abnormal development, in which case, this form is evidently *C. hilgendorfi*. Specimens from Yakuenji, Izumo, measure:

Length	42.5,	diam.	9	mm.;	whorls	12½.
"	40.0,	"	9	"	"	11.

This Clausilia is surpassed in size only by certain forms of *C. martensi.*

Clausilia japonica kobensis (Smith).

Clausilia kobensis E. A. Smith, Quart. Journ. of Conch., I, No. 8, p. 122 (Feb., 1876).
Clausilia nipponensis Kobelt, Jahrb. D. M. Ges., III, 1876, p. 275, pl. 8, figs. 3, 4.
Clausilia loxospira Martens in coll., Kobelt, *l.c.*, p. 277.
Clausilia japonica var. *nipponensis* Kob., Bttg. Jahrb. D. M. Ges., V, 1878, p. 50 (Clausilium).

In western Hondo there is a rather weakly defined race described as *kobensis* Smith and *nipponensis* Kobelt, these two names being synonymous, and based on specimens from Kobe, Setsu. The striation is noticeably finer than in typical *C. japonica.* The last whorl is frequently much compressed, and the preceding whorl bulges, giving a peculiar contour to the shell in dorsal view; but this feature is variable. There are always two palatal plicæ below the principal one, an upper and a lower. There is often a whorl more than in typical *C. japonica.*

Clausilia japonica vespertina n. subsp. Pl. XXX, figs. 11, 12.

The shell is glossy, chestnut colored, large, swollen in the lower half, attenuated as usual above, finely striate, the striæ often split or interrupted near the suture; penultimate whorl inflated, the last whorl compressed, tapering downward. The superior lamella is usually small, short, not reaching to the margin of the peristome, and generally separated from the spiral lamella. Palatal plicæ two, upper and lower; principal plica usually shorter than in *japonica.*

Length	33.0,	diam.	7.7	mm.;	whorls	11½	Takuhisan.
"	31.2,	"	7.7	"	"	10½	Takuhisan.
"	32.2,	"	8.2	"	"	10½	Takazakiyama.
"	33.0,	"	8.8	"	"	11	Takazakiyama.

Nishinoshima, Oki, at Takazakiyama (type loc.) and Takuhisan. Types No. 95711 A. N. S. P., from No. 198*b* of Mr. Hirase's collection.

This race differs from *C. j. interplicata* by the absence of intermediate palatal plicæ between the upper and lower; but it should be noted that some individuals of *interplicata* from Takeya, Izumo, also lack the intermediate plicæ, and then scarcely differ from this insular race from Oki. It is also related to var. *kobensis.*

Clausilia japonica ultima n. subsp. Pl. XXX, figs. 8, 9.

The shell is much more slender and lengthened than *C. japonica,* chestnut colored, paler just below the suture, very glossy, finely and regularly rib-striate, about four striæ in one mm. on the last whorl, the interstices of the striæ minutely, finely striate transversely. Three or four early whorls are of about equal diameter; the penultimate whorl is largest, the last whorl compressed and tapering downward. The spiral and inferior lamellæ are very long, extending inward past the front to the left side; other lamellæ as in *japonica;* two palatal plicæ, an upper and a lower, below the principal plica.

Length	29.3,	diam.	5.5 mm.;	whorls $13\frac{1}{2}$.
"	27,	"	5.2 "	" 13.

Nakamura, Oki. Types No. 95714 A. N. S. P., from No. 1566 of Mr. Hirase's collection.

This is a very distinct race, quite unlike any of the many forms of *C. japonica* known from the main island and Shikoku. Like the preceding subspecies it is probably confined to the Oki Islands.

Clausilia hickonis "Kobelt" Bttg.

Clausilia hickonis Kobelt, Boettger, Jahrb. d. D. Malak. Ges., V, 1878, p. 55, pl. 3, fig. 7; with var. *binodifera* Bttg., *l.c.*, fig. 7*b* (interior of Nippon).
C. hickonis Kobelt, Fauna Japonica, p. 86.
Clausilia subjaponica Pilsbry, Proc. A. N. S. Phila., 1900, p. 679 (Jan. 28, 1901) (Ibuki, Omi).
Clausilia fultoni subsp. *clavula* von Moellendorff, Nachrbl. d. D. Malak. Ges., April, 1901, p. 41 (Ibuki, Omi).

This fine *Stereophædusa* has some resemblance to *C.* (*Megalophædusa*) *vasta.* It is now known from Hakusan, Kaga; Kurozu and Tomisato, Kii; Ibuki, Omi; and on Shikoku from Nagaomura, Sanuki.

The variety *C. hickonis saucia* Pils. differs chiefly by its much coarser striation. It was described from Sodayama, Tosa, and smaller examples have been taken at Naarimura, Tosa, No. 1010 of Mr. Hirase's collection, 83901 A. N. S. P.

Clausilia jacobiana jacobiella n. subsp. Pl. XXXI, figs. 3, 4, 5, 6.

The shell is more slender than *C. jacobiana*; and the last half of the last whorl is less coarsely striate. There are short upper and lower palatal plicæ, but no lunella (pl. XXXI, figs. 3, 4, 5).

Length	14.8,	diam.	3.0 mm.;	whorls $9\frac{1}{2}$.
"	13.0,	"	3.0 "	" 9.
"	12.7,	"	2.9 "	" $8\frac{1}{2}$.

Akusekijima, Ōsumi. Types No. 95682 A. N. S. P., from No. 1547 of Mr. Hirase's collection. Also Nakanoshima and Suwanosejima.

Specimens from Nakano-shima are a little larger:

Length	15.2,	diam.	3.4 mm.,	whorls 9.
"	14.9,	"	3.6 "	
"	14.3,	"	3.25 "	

Shells from Suwanosejima are much smaller:

Length 12, diam. 2.9 to 3 mm.; whorls 8½ (pl. XXXI, fig. 6).

Clausilia nishinoshimana n. sp. Pl. XXXI, fig. 7.

A *Stereophædusa* of the group of *C. brevior*. The shell is fusiform, tapering from the penultimate whorl, considerably attenuated near the apex; dull dark brown; rather finely and sharply striate except the earlier whorls, which are worn. Whorls 11½, moderately convex, the second, third and fourth of about equal diameter, the last compressed and tapering downward. Aperture ovate, the sinulus a little retracted. Peristome brown tinted, rather broadly reflexed, recurved at the edge, thick. Superior lamella a little oblique, marginal, continuous with the spiral lamella, which is high and lamellar in the middle, low toward both ends, and penetrates inward to a point above the outer lip. The inferior lamella forms a rather strong fold in the throat, and ascends in a broad spiral curve in the back, where it is very wide. It penetrates as deeply as the spiral lamella. The subcolumellar lamella emerges to the lip edge. The principal plica is weak, short and lateral. There are short upper and lower palatal plicæ, but no lunella (fig. 4).

Fig. 4.

Length 18, diam. 3.9 mm.

The clausilium is strongly curved, somewhat angular at the apex, a little excised on the columellar side of the filament. It is similar to the clausilium of *C. brevior*.[1]

Nishinoshima, Oki. Types No. 95689 A. N. S. P., from No. 1576 of Mr. Hirase's collection.

This species is closely related to *C. brevior*, differing in the following respects: There are but two palatal plicæ below the principal one, which is much shorter than in *C. brevior;* the spire tapers for a longer distance, and it is composed of more whorls.

Some individuals lose the early whorls, closing the breach with a convex plug, as in some Urocoptids. The number of whorls retained may be reduced to six. Among some hundreds of *C. brevior* seen from six localities, none were similarly truncate. It is a rather unusual condition in Japanese *Clausiliidæ*.

[1] See Proc. A. N. S. Phila., 1901, pl. 38, figs. 52, 53.

Section LUCHUPHÆDUSA Pilsbry.

Clausilia degenerata Pils.

Clausilia nakadai degenerata Pils., Proc. A. N. S. Phila., 1904, p. 818, pl. 52, fig. 12; pl. 53, fig. 22.

The inadvertent use of Mr. Nakada's name twice in *Clausilia* makes it necessary to modify the later application as above. The former subspecific name will become the name of the species, while what was formerly described as typical *C. nakadai* requires a new name, which, being later, becomes subspecific. I am indebted to Mr. Hirase for calling my attention to the duplication.

The type of *C. degenerata* is No. 87593 A. N. S. P., from No. 1205 of Mr. Hirase's collection.

C. degenerata nakadiana n. n.

Clausilia nakadai Pils., Proc. A. N. S. Phila., 1904, p. 818, pl. 52, figs. 9, 10, 11; pl. 53, figs. 18, 19. Not *C. variegata* var. *nakadai* Pils., Proc. A. N. S. Phila., 1902, p. 328.

The type of *C. d. nakadiana* is No. 87594 A. N. S. P., from No. 1205*a* of Hirase's catalogue.

Section FORMOSANA Bttg.

This section has much affinity with *Hemiphædusa* and the closely related *Megalophædusa*, having the same long and narrow type of clausilium, which, however, is slightly thickened at the end. The palatal structure is primitive—a series of well-developed, subequal plicæ.

Three Formosan species known may be distinguished as follows:

a.—Shell rather obesely fusiform, the diameter contained 3½ to 4½ times in the length; whorls 9 to 11, the later ones closely and finely striate.
- *b.*—Whorls convex; later whorls with waved striæ; southern Formosa.
  - *c.*—Color pale yellowish or very pale brownish (pl. XXXII, figs. 4, 8, 9); . . . . *C. formosensis* A. Ad.
  - *c*¹.—Color dark reddish or purplish brown (pl. XXXII, figs. 1, 2, 3), ... *C. f. hotawana* Pils.
- *b*¹.—Whorls flattened; striæ fine, close and straight; dark colored, northern Formosa (pl. XXXII, figs. 7, 10, 11), *C. swinhoei* H. Ad.

*a*¹.—Shell long and narrow, the diam. contained 5 or 6 times in the length; whorls 11 to 14, the later ones flattened, with interrupted striæ (pl. XXXII, figs. 5, 6), . . . *C. taiwanica* Pils.

Clausilia formosensis H. Ad. Pl. XXXII, figs. 4, 8, 9.

This species belongs to southern Formosa, while *C. swinhoei* has been found only in the northern end of the island. In color it varies from pale yellow to a pale reddish-brown tint. Schmacker and Boettger have already described the close, peculiarly waved or "vermiculate" striation of the later whorls. Figs. 8, 9 are from Hotawa examples; fig. 4 is a smaller, eroded form from Arikawa.

C. formosensis hotawana subsp. nov. Pl. XXXII, figs. 1, 2, 3.

The shell resembles *C. formosensis* in its rather obesely fusiform shape, convex whorls, close and sharp wavy striation, and in the characters of aperture and interior; but it differs by being dark reddish-brown or purplish-brown in color, the apical whorls yellowish-white, lip white, interior of the mouth purple-brown. Old examples usually lose the apical whorls.

Length 28.0, diam. 7.8 mm.; whorls $8\frac{1}{2}$ (apex entire).
" 29.7, " 7.5 " " 8 remaining (decollate).

Hotawa, Formosa. Types No. 90032 A. N. S P., from No. 1397 of Mr. Hirase's collection.

The locality *Hotawa*, given by us for *C. swinhoei* (Proc. A. N. S. Phila., 1905, p. 738), should be cancelled. The record was based upon the specimens described above as *C. f. hotawana*. So far as we know, the true *C. swinhoei* has not been found at that place, but only in the extreme north of the island.

Clausilia taiwanica n. sp. Pl. XXXII, figs. 5, 6.

The shell is cylindric-turrite, very long and slender, dark purple-brown, very glossy; sculpture of rather fine, low oblique striæ, cut into long granules by spiral impressions which cut the striæ only, and are noticeable only on the later 3 or 4 whorls; striation not coarser on the back of the last whorl. Whorls 11 to 14, the earlier ones convex, more or less worn in adult shells; the last 3 or 4 whorls less convex, last whorl compressed, narrower than the preceding, nearly straight-sided, rounded basally. The aperture is ovate, vertical, very dark in-

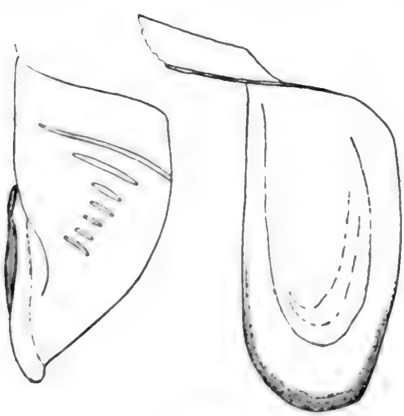


Fig. 5.

side; peristome pure white, broadly reflexed. Superior lamella high, very oblique, marginal, continuous within with the spiral lamella, which penetrates to a point above the upper angle of the aperture.

Inferior lamella forming a moderately prominent fold on the columella, straightened and obliquely ascending in the back, and as long within as the superior lamella. Subcolumellar lamella barely emerging, not extending upon the lip. Principal plica about a half whorl long. Palatal plicæ 6, the lower five nearly equal, lateral, showing as a whitish streak outside (fig. 5).

Length	36.2,	diam.	6.0	mm.;	length of aperture	7.5	mm.
"	31.0,	"	5.8	"	"	7	"

Clausilium narrow with nearly parallel sides, the lower end rounded and somewhat thickened.

Taiwan (Formosa), at Taitō (or Hinan). Types No. 94756 A. N. S. P. from No. 1492 of Mr. Hirase's collection.

This species has the dark color of *C. swinhoei*, and agrees with that in the general structure of the aperture and internal plicæ, but it differs from that species by its long, narrow shape, greater number of whorls, and the much more obsolete striation, that of *C. swinhoei* being comparatively close, fine and sharp, and not interrupted into long granules, as it is in *C. taiwanica*.

Section **HEMIPHÆDUSA** Boettger.

The type of this group is *Clausilia pluviatilis* Bens. of China, a form closely related to species of the Japanese group of *C. platyauchen*. An arrangement of the Japanese species was given in these PROCEEDINGS for 1901, p. 623, and pp. 648–651. Subsequent studies have added many species and caused the removal of some originally included in *Hemiphædusa* to form new sections—*Nesiophædusa*, *Luchuphædusa* and *Zaptyx*. Moreover, it appears that the species with several palatal plicæ are not separable from those with an I-shaped lunella (cf. *C. tosana*, etc.). A new classification of the species is therefore in order:

Groups of Japanese Hemiphædusæ.

a.—Lunella well developed, curving inward above, and below united to the middle of a straight or arched lower palatal plica. Clausilium scarcely or not excised at the palatal side of the filament, *Group of C. platyauchen.*

a[1].—Clausilium deeply excised at the palatal side of the filament. A lower palatal plica present, or represented by an inward curve of the lower end of the lunella.

b.—Lunella well developed, *J*-shaped, the lower palatal plica represented only by the inward curve of its lower end. Apical end of clausilium simple.

c.—Principal plica very small or wanting; no upper palatal plica. . . . . *Group of C. hyperolia.*

c^1.—Principal plica well developed; a short upper palatal plica, or the lunella bent inward in its place, *Group of C. awajiensis.*

b^1.—Lunella, etc., as in the group of *C. awajiensis*, but there is a lower palatal nodule at its lower end; clausilium in apical view appearing deeply notched, . *Group of C. aulacopoma.*

b^2.—Lunella either I-shaped, or replaced by a series of palatal plicæ, ... *Group of C. validiuscula.*

a^2.—A short, straight, or nodule-like, or rudimentary lunella, not curving inward at the lower end, below one or two palatal plicæ; *no lower palatal plica. Clausilium not excised* at the palatal side of the filament, . . . *Group of C. sublunellata.*

Clausilia tosana Pils. Pl. XXXI, figs. 14–20.

Proc. A. N. S Phila., 1900, p. 680, pl. 25, figs. 22–25, 41.

This species is now before us from five localities, all on Shikoku Island. It shows remarkable variation. All have the last whorl

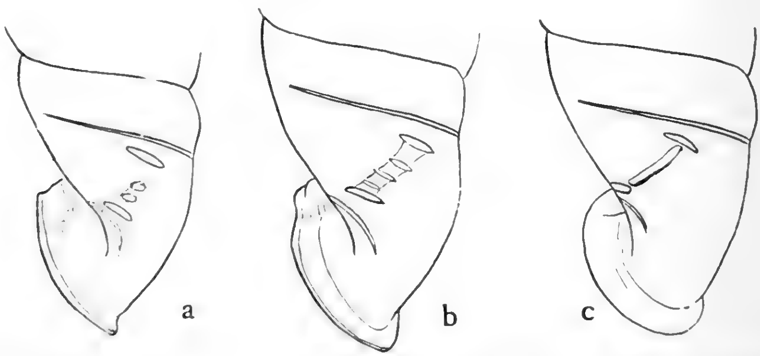


Fig. 6.—*Clausilia tosana.* *a*, typical form from Ushirohawa, Tosa; *b*, variety from Shimohanyama, Tosa; *c*, variety from Irazuyama, Tosa.

built forward, Cylindrella-like, with a furrow outside above the principal plica, and the subcolumellar lamella is always very deeply immersed. Internally the spiral and subcolumellar lamellæ are usually of equal length, reaching inward to the middle of the ventral side, and the inferior lamella between them is shorter.

1. The types from Ushirokawa, Tosa (pl. 31, figs. 16, 17), have several palatal plicæ standing upon a ridge (fig. 6*a*) and measure:

Length	12.2,	diam.	2.6	mm.;	whorls	10½.
"	11.0,	"	2.5	"	"	9½.
"	11.0,	"	2.3	"	"	9½.
"	10.5,	"	2.5	"		

2. A lot from Shimohanyama, Tosa (pl. 31, figs. 18, 19), also have

several tubercular plicæ on a distinct, curved ridge (fig. 6*b*), but are larger:

Length 15.0, diam. 3.5 mm.; whorls 9½.
" 12.3, " 3.0 " " 9⅓.

3. Those from Irazuyama, Tosa (pl. 31, fig. 20), have a well developed arcuate lunella between the upper and lower palatal plicæ, but hardly joined to either (fig. 6*c*), specimens measure:

Length 13.8, diam. 3 mm.; whorls 10¼.
" 14.0, " 3 " " 10.

4. A lot from Nametoko, Iyo (pl. 31, figs. 14, 15), has a similar curved lunella, and consists of specimens of two sizes, obviously from two diverse stations. The larger shells are more or less worn, the cuticle mainly lost, and measure 11.8 to 13.2 mm. long. The smaller shells are glossy with the cuticle perfect, the lip is narrower, and the subcolumellar lamella is not so long inside as the spiral. They measure:

Length 9.4, diam. 2.2 mm.; whorls 8¾.
" 8.9, " 2.1 " " 8½.

5. At Kotsuzan, Awa, the curved lunella is also perfect, as in (3) and (4). The lip is better developed than in the smaller specimens from Nametoko, Iyo. Specimens measure:

Length 10, diam. 2.3 mm.; whorls 9½.
" 9, " 2.0 " " 8½.

These lots show that multifarious differentiation with consequent formation of local races is in progress; but in the present condition of our knowledge it would probably be inexpedient to recognize these races by name.

Clausilia pigra Pils.

Proc. A. N. S. Phila., 1902, p. 368 (Kashima, Harima).

Specimens received from Nagami, Iwami and Yakuenji, Izumo, differ slightly from the types. The aperture is built forward a little less, and the lunella differs somewhat, being shaped more as in the group of *C. platyauchen*, there being a very short lower palatal plica, and the upper palatal plica is represented only by an inward bend of the lunella, whereas in the types of *pigra* the upper plica stands almost free of the lunella, and the whole structure is somewhat J-shaped (rather than I-shaped, as originally described).

Clausilia ikiensis tsushimana n. subsp. Pl. XXXI, figs. 8, 9, 10.

Shell somewhat larger and more robust than *C. ikiensis*, the subcolumellar lamella wholly immersed; outer end of the lower palatal plica joining the lunella.

Length 14.5,	diam. 3.2	mm.;	whorls 11.		
" 13.5,	" 3.5	"	" 9.	Izuhara.	
" 12.2,	" 3.0	"			
Length 15.0,	diam. 3.4	mm.;	whorls 10.		
" 15.0,	" 3.4	"	" 11.	Tsutsu.	
" 12.7,	" 3.25	"	" 9.		

Izuhara, Tsushima. Types No. 95701 A. N. S. P., from No. 1550 of Mr. Hirase's collection. Also Tsutsu and Kashitake, Tsushima.

The specimens vary remarkably in contour. Three examples from Tsutsu are figured.

Clausilia hemileuca n. sp. Pl. XXX, fig. 6; Pl. XXXI, fig. 11.

The shell is long and rather slender, the upper half tapering and attenuate; glossy; finely and distinctly striate, the earliest whorls worn; *lower half of each whorl dark reddish-brown, upper half white,* the base of the last whorl and a streak over the lunella also white. Whorls about 10½, moderately convex, the second, third and fourth of about equal diameter, last whorl flattened laterally. Aperture

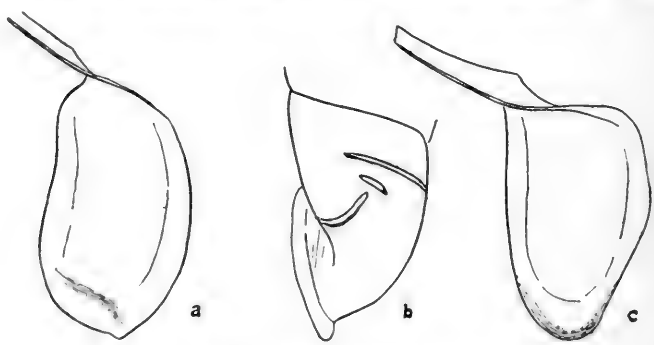


Fig. 7, *Clausilia hemileuca.*

ovate, the sinulus slightly retracted. Peristome expanded and reflexed, thick, white, notched over the superior lamella, which is compressed, vertical and marginal, continuous with the spiral lamella, which is rather high and penetrates inward to a point above the outer lip. The inferior lamella recedes deeply, but in oblique view is visible as a fold within the throat; in the back it ascends obliquely, being slightly sigmoid, and it is thickened below. It penetrates less deeply than the superior lamella. The subcolumellar lamella is deeply immersed, not visible in the mouth. The principal plica is about a half whorl long, approaching the aperture. Upper palatal plica short and curved, not connected with the oblique, curved lunella (fig. 7*b*).

Length	18.5,	diam.	3.7	mm.
"	17.0,	"	3.8	"

The clausilium (figs. 7*a*, *c*) is narrow and tapers rather strongly toward the rounded apex, the palatal margin being decidedly convex. It is excised on the columellar side of the filament, and is rather strongly curved throughout.

Ōetakayama, Iwami. Types No. 95705 A. N. S. P., from No. 1600 of Mr. Hirase's collection.

Only six specimens of this handsome *Hemiphædusa* were taken. In coloration it resembles *C. holotrema*. No other Japanese *Hemiphædusa* is similarly colored. The separation of the upper palatal plica from the lunella and the shape of the clausilium are further distinguishing features.

Section HEMIZAPTYX Pilsbry.

Clausilia ptychocyma Pils.

In specimens from Kuroshima the subcolumellar lamella emerges on the lip but is rather weak, and the spiral and inferior lamellæ are longer than in the types, running inward to a point above the termination of the outer lip. They measure 11.2 to 12.5 mm.

Clausilia agna spicata n. subsp. Pl. XXXI, figs. 12, 13.

The shell resembles *C. agna* in its smooth surface and translucent texture, and in having the subcolumellar lamella weakly emerging, or at least visible in an oblique view in the mouth; but it differs by being longer and more slender, similar in shape to *C. purissima*. It may be either clear greenish-corneous (like *C. purissima*), chestnut brown, or very pale brown. *C. agna spicata* differs from *C. purissima* by its emerging subcolumellar lamella. The shell is also stronger when adult.

Length	12.0,	diam.	2.3	mm.;	whorls	9½	Akuseki.
"	12.2,	"	2.7	"	"	9½	Akuseki.
"	10.7,	"	2.2	"	"	8½	Akuseki.
"	9.7,	"	2.0	"	"	8½	Akuseki.
"	11.0,	"	2.3	"	"	9	Kuchinoerabu.
"	9.3	"	2.3	"	"	7½	Kuchinoerabu.

Akusekijima, Ōsumi. Types No. 95709 A. N. S. P., from No. 663*c* of Mr. Hirase's collection. Also taken at Kuchinoerabushima, Ōsumi. No. 90023 A. N. S. P., from No. 663*d* of Mr. Hirase's collection.

This race stands between *C. agna*, described from Yaku-shima, and *C. purissima*, from Miyake-jima, Izu, and shows that these two species, widely separated geographically, are in reality very closely related. The Miyake-jima form has a very deeply immersed subcolumellar lamella, but otherwise hardly differs from pale, long specimens of *C. a. spicata*.

In *C. agna* the lunella only weakly joins the upper palatal plica. This is not well shown in the original figure.

Section HETEROZAPTYX Pils.

Clausilia oxypomatica Pils.

Specimens received from Ōgachi, Ōshima, are smoother than the type of this species, the striation rather indistinct except on the last whorl, and the clausilium is quite perceptibly broader.

Length 12, diam. 2.8 mm.; whorls 9½.
" 11, " 2.6 " " 6.

Section ZAPTYX Pilsbry.

In this section we group numerous closely related forms distributed throughout the Ryukyu chain, from the Southwestern Group to Kagoshima Bay.

Key to Species of Zaptyx, s. str.

a.—Upper palatal plica very long; spiral lamella reduced to a short lamella in the region of the lunella.
  b.—10.5 to 12.5 mm. long, with 9½ to 10 whorls; striatulate. Ryukyu, ... *C. dolichoptyx.*
  *b*¹.—8.5 to 9.5 mm. long, with 8 to 8½ whorls; last half whorl sharply and finely striate. Ryukyu, ... *C. d. micra.*
*a*¹.—Upper palatal plica moderate or short, much shorter than the lunella.
  b.—Subcolumellar lamella wholly immersed; whorls quite *convex*, smoothish, but finely and sharply striate behind the lip.
    c.—9 to 10 mm. long, 2.2 to 2.3 wide. Okinoerabushima, *C. sarissa.*
    *c*¹.—8 to 9 mm. long, 2 to 2.1 wide; last two whorls less convex. Nakanoshima, ... *C. nakanoshimana.*
  *b*¹.—Subcolumellar lamella emerging; whorls less convex.
    c.—Upper palatal plica very short; inferior lamella not continuous within with the lamella inserta.
      d.—Last 3 or 4 whorls finely and sharply striate; superior and spiral lamellæ weakly continuous. Yaeyama, *C. yaeyamensis.*
      *d*¹.—Smoothish throughout, or only the last whorl striate; superior and spiral lamellæ widely separated.
        e.—Smoothish, early whorls not attenuate. Satsuma, *C. hirasei.*
        *e*¹.—Back of last whorl striate; spire attenuate above, Kikai, Tokuno, ... *C. kikaiensis.*
    *c*¹.—Upper palatal plica moderate; inferior lamella continuous with the lamella inserta, penetrating inward as far as the spiral lamella; fulcrum and parallel lamella well developed, apex larger than the preceding species.

d.—Shell smoothish, last whorl more or less striate. Ryukyu, Yoronjima, ... *C. hyperoptyx.*
d[1].—Last 3 or 4 whorls sharply striate. Sezokojima, Ryukyu. . . . . *C. h. sezokoensis.*

Clausilia nakanoshimana n. sp. Pl. XXX, fig. 2.

The shell is small and slender, the lower half cylindric, upper half tapering slowly to the rather large and obtuse apex; pale brown, somewhat transparent, thin, glossy, faintly striatulate, becoming distinctly striate behind the outer lip. Whorls 7½ to 7¾, the earlier ones quite convex, the last two much less so; last whorl convex below but not saccate. The aperture is broadly oval; peristome white, reflexed and rather thick, continuous. The superior lamella is marginal, subvertical, not continuous with the spiral lamella. Spiral lamella is very low and thread-like, and extends inward only slightly beyond the lateral line. The inferior lamella recedes deeply, being visible as a prominent fold in an oblique view in the aperture; inside it ascends nearly vertically, is very broad and a little curved, rather abruptly terminating above, not continued on the parietal wall, but reappearing as a minute lamella near the inner end of the spiral lamella. The subcolumellar lamella is rather deeply immersed. The principal plica is dorsal and lateral. Upper palatal plica short, connected to the oblique, nearly straight lunella. There are two delicate sutural plicæ, and a minute parallel lamella (fig. 8).


Fig. 8.

Length	9,	diam.	2.1 mm.;	whorls	7¾.
"	8,	"	2.0	"	"	7¾.
"	8,	"	2.0	"	"	7½.

The clausilium is narrow, rather long, rounded at the apex, rather straight except near the filament where it bends abruptly. It is deeply excised at the columellar side of the filament, and broadly dilated at the palatal side.

Nakanoshima, Ōsumi. Types No. 95687 A. N. S. P., from No. 1517 of Mr. Hirase's collection.

This species is closely related to *C. sarissa* Pils. of Okinoerabushima. It differs by the more slender shell with the last two whorls less convex, and the clausilium a little more slender and slightly twisted near the apex.

Clausilia yaeyamensis Pils.

Pilsbry, Proc. A. N. S. Phila., 1904, p. 831.

Previously reported from Yaeyama, now sent from Yonakuni-jima the westernmost of the Sakishima or Southwestern Group of islands, and the nearest one to Formosa. The specimens measure 8.5 to 9.7 mm.

While very closely related to *C. hyperoptyx sezokoensis* of Sezokojima, Kunchan (Loochoo), this form is separable by the inferior lamella which is short inside, its inner end being separated as a *lamella inserta*, while in *C. hyperoptyx* the inferior lamella is continued within parallel to the spiral lamella. This rather minute distinction is constant in the specimens I have opened, and, in connection with the geographic isolation, may be held of specific significance.

Clausilia hyperoptyx sezokoensis n. subsp.

The shell differs from *C. hyperoptyx* by having the last 4 or 5 whorls densely striate, as in *C. yaeyamensis*. Internally it is like *C. hyperoptyx*, the inferior lamella being continued inward parallel with the spiral lamella.

Sezokojima, an islet on the west side of Kunchan, Loochoo. Types No. 89884 A. N. S. P., from No. 457*d* of Mr. Hirase's collection. Sezokojima or Sesokojima is similar to the adjacent peninsula of Okinawa geologically, being formed of raised reefs around a center of palæozoic limestone.

Section STEREOZAPTYX Pilsbry.

Clausilia exodonta n. sp. Figs. 9, 10.

The shell is slender, fusiform, solid and strong, dull yellow, smoothish, the last third of the last whorl strongly striate. Whorls 8, moderately convex, the last compressed at the sides, tapering toward the base, built forward free of the preceding whorl. Apex rather acute. Aperture oblique, small, piriform, the peristome broadly expanded and reflexed. Sinulus slightly retracted, oval, nearly separated from the aperture by a strong conical tooth within the outer lip, which approaches the lower end of the superior lamella. Superior lamella oblique, high, but not penetrating far inward, separated from the spiral lamella, which is a low plate in a lateral position, penetrating inward to a point above the columellar lip. Inferior lamella receding, visible as a strong fold in the aperture, strong, high and strongly spiral within the back, much shorter within than the spiral lamella. Subcolumellar lamella

Fig. 9.

Fig. 10.

very deeply immersed. Principal plica very short, weak and lateral. Lunella low above, becoming very strong toward its lower end, which is thickened and curves inward (fig. 10). There is a short, tubercular fulcrum, but no sutural plicæ.

Length 9.8, diam. 2 mm.

The clausilium is broad above, tapering to the apex, which projects somewhat. It is strongly curved throughout, V-shaped in section near the apical end, dilated on the palatal side near both ends, and deeply excised on the columellar side of the filament, as usual.

Sumiyohō, Ōshima, Ōsumi. Types No. 95690 A. N. S. P., from No. 1504 of Mr. Hirase's collection.

This very distinct little species is more slender than *C. entospira* or *C. exulans*, and differs from all known Japanese species by having a conical tooth at the upper third of the outer lip, forming, with the superior lamella, an oval sinulus.

Section PARAZAPTYX Pils.

Clausilia thaumatopoma Pils.

Originally described from Kumejima, this species has also been found on the island of Kerama (Keramajima). in several places—Tokashiki, Zamami and Tokashikijima. Most of the specimens from this island are more slender than the types, with more whorls; yet some agree with typical *thaumatopoma* in these respects, so that a subspecific separation seems impracticable.

The measurements of several specimens follow:

Length	11.0,	diam.	2.4 mm.;	whorls	9	}	Kumejima.
"	10.5,	"	2.3 "	"	8½		
"	11.3,	"	2.0 "	"	10	}	Tokshiki, Keramajima.
"	9.7,	"	2.0 "	"	7¾		
"	10.8,	"	2.4 "	"	8½	}	Zamami, Keramajima.
"	10.8,	"	2.2 "	"	9½		
"	9.2,	"	2.2 "	"	8		
"	10.0,	"	2.0 "	"	9½	}	Tokashikijima, Keramajima.
"	8.8,	"	1.9 "	"	8¼		

The sculpture and the internal structure seem to be practically the same throughout the series of 23 examples examined.

Section METAZAPTYX Pilsbry.

The shell is similar to *Zaptyx* in having sutural plicæ, fulcum and parallel lamella. The inferior lamella is *very broad within, ascends* *spirally,* and is visible in oblique view in the mouth as a strong fold approaching the superior lamella. Spiral lamella *very low* throughout. Base of the shell *conspicuously full and sack-like,* the latter part of the last whorl sharply striate. Clausilium broad throughout, rounded at the apex, *strongly bent near the middle.* Type *C. pattalus.*

This group differs from *Zaptyx* by the shape of the inferior lamella and the saccate base of the shell, and by the shape of the clausilium, which is strongly bent near the middle, while in *Zaptyx* it is nearly flat except close to the filament. It differs from *Stereozaptyx* by the shape of the clausilium, which is broad at the distal or lower end in *Metazaptyx,* tapering in *Stereozaptyx.* Also by the base of the shell, which is not saccate in *Stereozaptyx.*

The inferior lamella sometimes continues on the base of the penultimate whorl as a slender thread parallel to the spiral lamella, occasionally penetrating deeper than the latter, but this thread-like continuation may be absent or interrupted. The spiral lamella is remarkably low throughout. As in *Zaptyx,* the species are closely related and rather difficult. The shape of the clausilium is often characteristic. Both *Zaptyx* and *Metazaptyx* are widely ranging groups in the islands between Kyushu and Formosa.

The following species belong to *Metazaptyx:*

Southwestern Group of the Ryukyu Islands.

C. pattalus Pils. Tarama-jima.
C. p. miyakoensis Pils. Miyako-jima.

Ōshima Group (Ōsumi).

C. dæmonorum Pils. Kikaiga-shima.
C. d. viva Pils. Tokuno-shima.

Tokara Group (Ōsumi).

C. tokarana Pils. Suwanose-jima to Tokara-jima.
C. t. saccatibasis Pils. Nakano-shima, Kuchino-shima.

Izushichito-jima (Izu).

C. hachijoensis Pils. Hachijo-jima and Nii-jima.

Clausilia tokarana n. sp. Pl. XXX, fig. 3.

The shell is cylindric below, above tapering to the small but obtuse apex; light brown; weakly striatulate, nearly smooth, the last third of the last whorl finely and rather sharply striate. Whorls 7½ to 9, slightly convex, the last flattened at the sides, very convex and somewhat sack-like at the base. The aperture is rhombic, peristome thin, *very narrowly reflexed,* continuous. Superior lamella is small, thin and vertical, continuous with the spiral lamella, which is low and thread-like throughout, and continues inward to a point above the columella. The inferior lamella recedes deeply, and is visible as a prominent fold in an oblique view in the mouth. Inside it is broad and ascends in a spiral curve; it is continued low and thread-like parallel to the spiral lamella, and penetrates more deeply than that. The subcolumellar lamella emerges weakly. The principal plica is short, dorso-lateral. The very short or subobsolete upper palatal plica joins the very oblique, slightly curved lunella. Sutural plicæ, fulcrum and parallel plica are well developed (fig. 11,*a*).

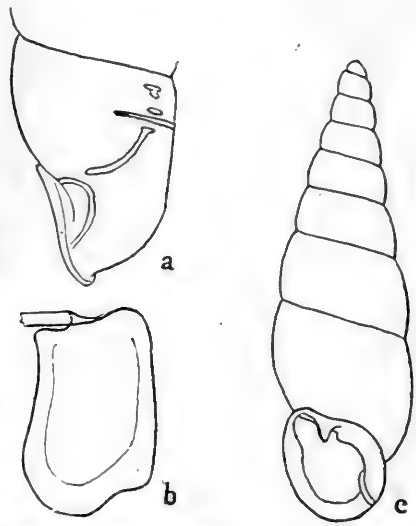


Fig. 11.—*a, b, C. tokarana; c, C. t. saccatibasis,* short form.

Length 11, diam. 2.8 mm.; whorls 8¾.
" 9, " 2.25 " " 7½.

The clausilium (fig. 11,*b*) is broad, parallel-sided, rounded at the apex, strongly curved in the middle, dilated on the palatal side of the filament.

Suwanose-jima, Ōsumi. Types No. 95678 A. N. S. P., from No. 1592*a* of Mr. Hirase's collection. Also Tokara-jima, No. 1592 of Mr. Hirase's collection, and Akuseki-jima, No. 1548 of Mr. Hirase's collection.

This species is related to *C. t. saccatibasis*, but the apical whorls are smaller, the penultimate whorl is much less swollen, in a dorsal view; the shell is less distinctly striate, and is paler. The principal plica is shorter in *C. tokarana*.

In the specimens from Tokara-jima the superior and spiral lamellæ are separated, and the inward continuation of the inferior lamella parallel to the spiral lamella, is only very weakly developed, scarcely noticeable. They constitute a weakly differentiated race.

In those from the intermediate island Akuseki-jima, the superior and spiral lamellæ are weakly continuous—being, therefore, intermediate in structure, as well as in geographic position, between the forms from Suwanose and Tokara islands. Several specimens measure as follows:

Length	11.9,	diam.	2.8 mm.;	whorls	$8\frac{1}{2}$.
"	10.0,	"	2.9	"	8.
"	11.0,	"	2.5	"	9.

Clausilia tokarana and its variety *saccatibasis* were taken in some profusion, and probably inhabit the whole "Tokara group" of islets, being known from Kuchino-shima, Nakano-shima, Suwanose-jima, Akuseki-jima, and Tokara-jima. All of these islands are of volcanic origin, the country rock being andesite. Nakano and Suwanose have active volcanoes, while the others have extinct craters or traces of them.

Clausilia tokarana saccatibasis n. subsp. Pl. XXX, figs. 4, 5.

The shell is somewhat fusiform, the upper half tapering and attenuate, the last two whorls of about equal diameter, strong and solid, glossy, *rich purplish-brown with a paler or light band along the suture*, indistinct in some specimens, but especially conspicuous in the earlier whorls, which are *corneous with a median dark band*. Whorls 9 to $9\frac{1}{2}$, quite convex, the second disproportionately large, the *penultimate whorl swollen* (in a view from the back), the last very convex below, sack-like, its last half much compressed laterally. Aperture ovate. Peristome white, reflexed, more or less thickened, continuous, the upper margin notched over the superior lamella. The superior lamella is small, compressed and vertical, continuous with the spiral lamella, which is very low throughout and penetrates inward but little past a lateral position. The inferior lamella is deeply immersed, but visible (in an oblique view in the mouth) as a high lamella. It is a strongly spiral wide plate within the back of the last whorl, but decreases suddenly above where it joins the parietal wall, then becoming a low cord parallel to the spiral lamella, and of the same length inside. The subcolumellar lamella emerges to the lip-edge. It does not extend upon the parietal wall inside. The principal plica is short, mainly dorsal, extending to the lateral line. The upper palatal plica is very short, connected with the lateral lunella, which is strong, long, its lower and curving far inward. There are two small sutural plicæ, a moderately long parallel lamella and a short fulcrum.

Length 12.5 to 13.5, diam. 3.0 mm.
" 11, " 2.9 "

The clausilium is quite broad, rounded at the apex, deeply excised on the columellar side of the filament. Its curvature is chiefly in the part near the filament.

Nakanoshima, Ōsumi. Types No. 95679 A. N. S. P., from No. 1515 of Mr. Hirase's collection. Also Kuchinoshima.

The type lot consists of very handsome, glossy, dark colored shells, but there are some gray, corroded specimens among them, apparently from a different situation. The smallest measures, length 11.5, diam. 3 mm., and has the penultimate whorl strongly swollen, the last whorl compressed (fig. 11,*c*).

This form is closely related to *C. tokarana*, but differs by its darker color, swollen penultimate whorl, etc. It also resembles *C. pattalus* of Tarama-jima and Miyako-shima, but it differs by having the penultimate whorl more swollen, the principal plica shorter, and the subcolumellar lamella emerges. In both species the second whorl appears disproportionately large.

Examples from Kuchinoshima are corroded and dull, and have the superior lamella *separated rather broadly* from the spiral lamella; otherwise they do not differ from the types.

The subspecies *saccatibasis* is confined to the two northern islands of the Tokara group.

Section IDIOZAPTYX n. sect.

The shell is Zaptychoid externally. Superior lamella small, separated from the much reduced spiral lamella. Inferior lamella receding, massive, almost straightly ascending within. Upper palatal plica long, the lunella descending from near its inner end, and joining the inner end of the lower palatal plica; fulcrum and parallel lamella short but distinct; sutural plicæ developed. Clausilium excised and bent near the filament, parallel-sided, rounded at the apex. Type *C. idioptyx*.

This section is related to *Diceratoptyx*,[2] but it differs in having a well-developed lunella, joining the lower palatal plica, in the straightly ascending inferior lamella, and the very different clausilium, which is like that of *Zaptyx*.

[2] Proc. A. N. S. Phila., 1904, p. 836. To the diagnosis of *Diceratoptyx* should be added, a small lower palatal plica is developed; the inferior lamella ascends in a broad, sigmoid curve.

Clausilia idioptyx n. sp. Pl. XXX, fig. 1.

The shell is quite small, fusiform, brownish-yellow, somewhat translucent; surface glossy, weakly striatulate, nearly smooth, becoming strongly and coarsely striate behind the outer lip. The spire tapers regularly from the penultimate whorl to the obtuse apex. Whorls $8\frac{1}{3}$ to $8\frac{1}{2}$, convex, the last one compressed, tapering to the base. Aperture ovate, with distinct, somewhat retracted sinulus. Peristome reflexed, continuous. Superior lamella very low, obtuse, short, very widely separated from the spiral lamella, which is minute, and lateral in position. Inferior lamella deeply receding, its base visible as a low fold in an oblique view in the aperture. Within the back it is straight, massive, and ascends obliquely, terminating abruptly on reaching the parietal partition. The subcolumellar lamella emerges very weakly, and in a lateral position it forms an ascending angle, visible by transparence from the outside. Fulcrum and parallel lamella are visible as two equal, short white folds about as far inward as the lunella. The principal plica runs from near the mouth to a little beyond the lateral line. The upper palatal plica is long, diverging forwardly from the principal plica, its lower end visible in the aperture. The lower palatal plica

Fig. 12.

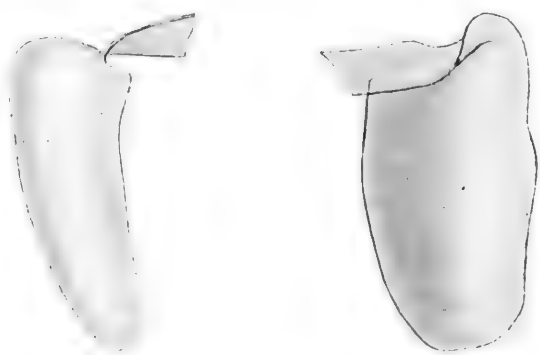


Fig. 13.—Clausilium of *C. idioptyx.*

is short, parallel to the upper. Its inner end abuts against the lunella, which joins the upper palatal plica near its inner end. There are two distinct sutural plicæ and a very weak one between them, as usual (fig. 12).

Length 9.0, diam. 1.9 mm.
" 7.8, " 1.8 "

The clausilium (fig. 13) is bent rather abruptly near the filament; parallel-sided, the apex rounded; the external face is somewhat swollen, inside concave. It is excised on the columellar side near the filament.

Nase, Ōshima (Ōsumi). Types No. 95681 A. N. S. P., from No. 1505 of Mr. Hirase's collection.

With a general resemblance to *Clausilia cladoptyx*, this species is entirely distinct from all known forms in the structure of the closing apparatus.

Explanation of Plates XXX, XXXI, XXXII.

Plate XXX—Fig. 1—*Clausilia idioptyx* Pils.
Fig. 2—*Clausilia nakanoshimana* Pils.
Fig. 3— " *tokarana* Pils.
Figs. 4, 5— " *tokarana saccatibasis* Pils.
Fig. 6— " *hemileuca* Pils.
Fig. 7— " *echo* Pils.
Figs, 8, 9— " *japonica ultima* Pils.
Fig. 10— " *nakadæ* Pils.
Figs, 11, 12— " *japonica vespertina* Pils.

Plate XXXI—Figs. 1, 2—*Clausilia tripleuroptyx* Pils.
Figs. 3–5—*Clausilia jacobiana jacobiella* Pils. Akusekijima.
Fig. 6— " " " Pils. Suwanosejima.
Fig. 7— " *nishinoshimana* Pils.
Figs. 8–10— " *ikiensis tsushimana* Pils.
Fig. 11— " *hemileuca* Pils.
Figs. 12, 13— " *agna spicata* Pils.
Figs, 14, 15— " *tosana* Pils. Nametoko; Iyo.
Figs, 16, 17— " " " Ushirohawa, Tosa.
Figs, 18, 19— " " " Shimohanyama, Tosa.
Fig. 20— " " " Irazuyama, Tosa.

Plate XXXII—Figs. 1, 2, 3—*Clausilia formosensis hotawana* Pils.
Fig. 4—*Clausilia formosensis* H. Ad. Arikawa.
Figs, 5, 6— " *taiwanica* Pils.
Fig. 7— " *swinhoei* H. Ad. Kiirun.
Figs. 8, 9— " *formosensis* H. Ad. Hotawa.
Figs. 10, 11— " *swinhoei* H. Ad. Suganiikei.

NEW LAND MOLLUSCA OF THE JAPANESE EMPIRE.

BY H. A. PILSBRY AND Y. HIRASE.

The present contribution includes species from the main island of Japan, the Bonin Islands, Ryukyu Islands and Formosa. Recent explorations in the Tokara Group (small volcanic islets between Ōshima and Yakushima) have filled a gap in our knowledge of the land snails of the northeastern islands of the Ryukyu Curve, the *Clausiliidæ* and operculate shells being especially interesting.

Spiropoma japonicum tsushimanum n. subsp.

The spire is slightly higher than in *japonicum* and the last whorl descends more to the aperture. The cuticle is *extremely finely and densely striate,* duller and darker than in *japonicum;* finally, the columellar margin of the peristome is retracted more.

Alt. 8, diam. 14.2 mm.
" 6.1, " 11.7 "

Izuhara, Tsushima. Types No. 95762 A. N. S. P., from No. 1447*a* of Mr. Hirase's collection.

The several species and local forms of *Spiropoma* are only very slightly differentiated, and while the races of Tsushima, Quelpart, etc., have a certain individuality appreciable to the eye, their differences are of no great importance. The generic type seems to be very conservative and inflexible.

Alycæus tsushimanus n. sp.

The shell is quite depressed, otherwise shaped as usual in the subgenus *Chamalycæus;* very pale reddish-brown or whitish. Spire low, convex, the apex projecting a little, brown. Whorls 3½, the first 1½ smooth, the rest sculptured with extremely delicate, close thread-striæ; just before the constriction of the neck the striation is distinctly stronger, and on the neck it is more or less obsolete. Later part of the last whorl is moderately swollen, then contracted. Beyond the contraction the neck is swollen in the middle, then descends a little to the aperture. The sutural "tube" is rather long, and very closely appressed, as if partially melted into the suture. The aperture is very oblique, circular. The peristome is strongly expanded and reflexed, its face thickened and convex, the outer edge somewhat recurved. It is appressed for a short distance to the preceding whorl. The rather wide umbilicus is elliptical.

Alt. 3, diam. 5.8 mm.

The operculum is somewhat concave externally, and its whorls bear elevated cuticular appendages or raised cord-like spirals, wanting in the depressed central part, which is generally filled with dirt.

Tsutsu, Tsushima. Types No. 95737 A. N. S. P., from No. 1553 of Mr. Hirase's collection.

This is larger than other known Japanese species, with a more broadly expanded peristome. It is related to the Korean *A. cyclophoroides* Pils. and Hir., but differs by having a distinct swelling in the middle of the neck and in some minor details of sculpture and shape. By the characters of the operculum it belongs to the subgenus *Metalycæus.*

In a race of the same species found at Sasuna, Tsushima, the shell is smaller, the diameter varying from 4 to 5 mm. This small form is No. 95738 A. N. S. P., No. 1553*a* of Mr. Hirase's collection.

Alycæus tokunoshimanus principialis n. subsp.

The shell is much larger than *A. tokunoshimanus*, more or less deeply reddish-yellow tinted above, nearly white beneath, the embryonic whorls golden. Whorls 3½, the last half of the last whorl very much inflated, then contracted into a rather small neck, beyond which the whorl is strongly deflexed. Very closely and finely thread-striate, more closely so on the inflated portion. Neck strongly bent downward. Peristome strongly reflexed, thickened and bevelled on the face; columellar border much narrower, its outer edge more or less straightened. Alt. 3.3, diam. 5 mm.

Ōgachi, Ōshima (Ōsumi). Types No. 95830 A. N. S. P., from No. 1330*b* of Mr. Hirase's collection.

This is the finest development of the *tokunoshimanus* series. That species was originally described from the smallest of the several forms now known.

Alycæus tokunoshimanus mediocris n. subsp.

The shell is decidedly larger than *A. tokunoshimanus*, with the neck bent downward more, and more coarsely striate in front of the contraction. The sculpture of the neck is also coarser than *A. t. principialis.* Alt. 2.9, diam. 4.5 mm.

Yorojima (Ōsumi). Types No. 89926 A. N. S. P., from No. 1330 of Mr. Hirase's collection. Also found on Ikejijima (No. 89927 A. N. S. P., and 1330*a* coll. Hirase).

Alycæus lævis n. sp.

A *Chamalycæus* resembling *A. tokunoshimanus* in general form; openly umbilicate; spire low, conoidal, the first whorl projecting. Whorls $3\frac{1}{2}$, regularly increasing to the middle of the last whorl, where it rapidly enlarges, becoming much inflated. The inflation is terminated by a moderately contracted neck which curves down to the aperture. There is a prominent swelling around the neck in the middle. The "tube" is rather long and pressed into the suture. The surface is smooth, lightly marked with growth-lines, but on the inflation there are distinct fine and close striæ. The neck is smooth and glossy. The aperture is very oblique; peristome expanded, usually dilated to form a short lobe at the posterior angle. In fully mature individuals an inner rim is built out shortly beyond the expansion. Alt. 3, diam. 4 mm.

Nakanoshima (Ōsumi). Types No. 95831 A. N. S. P., from No. 1514 of Mr. Hirase's collection. It occurs also on Suwanosejima.

In having a smooth surface, marked with slight growth-lines only, becoming striate on the inflation, this species is very distinct from other Japanese and Ryukyuan forms. The rounded swelling on the neck is a further distinguishing character.

Diplommatina paxillus ultima n. subsp.

The shell is somewhat more robust than *D. paxillus* from Shanghai or Cheju, Quelpart. *The peristome is less angular at the foot of the columella,*—only very indistinctly so. The peristome is doubled, or there is a wrinkle or two behind the outer lip. Adults vary from reddish-brown to nearly white.

Kashitake, Tsushima. Types No. 95662 A. N. S. P., from No. 1554*a* of Mr. Hirase's collection. Also taken at Kojeto (Island of Koje), Korea, No. 95660 A. N. S. P., from No. 1531 of Mr. Hirase's collection.

D. paxillus (Gredler) is a very widely distributed species, ranging from Hunan to the Korean Archipelago, with closely related forms in Formosa and Tsushima. In the present state of our collections it is not easy to define subspecies. A form from Mokpo, Korea (No. 1531*a* of Mr. Hirase's collection), is similar to the shells from Koje Island, except that there is a distinct angle at the foot of the columella. The form from Quelpart is very close to typical Chinese *D. paxillus*.

Diplommatina yonakunijimana n. sp.

The shell is narrow, the penultimate whorl much the largest, those above tapering in a rather long cone with straight sides; pale brown; sculpture of delicate thread-like striæ, wanting in the region of the constriction and on the last half or more of the last whorl. There are

8 whorls, the first 5½ convex, regularly and slowly increasing; the next enlarges more rapidly and is the widest, most convex whorl. It contracts suddenly to the constriction, which lies one-fourth of a whorl back of the peristome. The front of the last whorl has very widely spaced striæ when unworn, but the last half is smooth and glossy. It ascends very little. The palatal plica is short. It is faintly visible above the suture in the thinnest shells, but most adults are too opaque to show it externally. The aperture is subcircular, somewhat oblique. Parietal callus thin, its edge scarcely thickened, ascending about half way to the suture. Columellar lamella thin and small, its spiral continuation inward being thin and rather low.

Length 3.1, diam. 1.4 mm.

Yonakunijima, Ōsumi. Types No. 95675 A. N. S. P., from No. 1510 of Mr. Hirase's collection.

In this species the last fourth of the penultimate whorl, in front of the constriction, is very narrow. It is related to *D. kumejimana* P. and H., but differs by its far more widely spaced riblets.

Diplommatina okiensis tsushimana n. subsp.

The shell is like *D. collarifera* S. and B. in shape, but differs as follows: The delicate thread-like striæ of the last two whorls are more widely spaced, and on the next earlier two whorls they are still more spaced. The palatal plica is very short and lies under the parietal callus. The spiral columellar lamella within the last whorl is thin and much lower than in *collarifera*. *D. okiensis* is very similar, but *tsushimana* differs by having the striæ more widely spaced throughout. The shell is pale brown, and resembles *okiensis* in the aperture and collar.

Length 3.9, diam. 1.9 mm.; whorls 6½.

Tsutsu, Tsushima. Types No. 95664 A. N. S. P., from No. 1554 of Mr. Hirase's collection.

Diplommatina nesiotica n. sp.

A species of the subgenus *Sinica*. The lower two whorls form a cylindric portion, those above taper rapidly in a straight-sided cone about one-third the total length of the shell. It is pale red or grayish-white, with sculpture of very delicate hair-like striæ, which are rather closely placed on the last two whorls, more spaced on the two preceding. Whorls slightly exceeding 6, quite convex, regularly and slowly widening to the penultimate, which enlarges rapidly and is more swollen. It contracts rather strongly to the constriction, which varies in position from submedian in front to nearly over the inner edge of the columella.

The last whorl ascends moderately to the lip, and is usually worn nearly smooth. The palatal plica is short, and either wholly to the left of the parietal callus, or its inner half may be under the callus. The aperture is rounded, a little longer than wide. Peristome thin, rather narrowly reflexed, sometimes very indistinctly subangular at the base of the columella. The parietal callus spreads rather extensively upward, and has a thin, raised edge. The columellar tooth is so deeply immersed that it is not visible in a front view.

Length 3, diam. 1.8 mm.

Suwanosejima, Ōsumi. Types No. 95668 A. N. S. P., from No. 1587 of Mr. Hirase's collection. Also found on the adjacent islands Akusekijima and Nakanoshima, of the Tokara group.

This species is related to *D. saginata* of Ōshima and *D. tanegashimæ* of Tanegashima, both of them much smaller species. *D. tanegashimæ* is also more slender. *D. saginata* is a common and characteristic species of Ōshima. It is very similar to *D. nesiotica* but always much smaller, so far as present collections show.

Specimens from Akusekijima and Nakanoshima are a trifle smaller than the types from the intermediate island Suwanosejima, measuring 2.5 to 2.8 mm. long. The palatal plica is slightly longer, and in some specimens the columellar tooth is visible in a front view.

Diplommatina hirasei Pilsbry n. sp.

The shell is large for a *Sinica*; the last two whorls, form more than half the total length, are cylindric, upper portion conic with straight sides. Whorls fully 6½, moderately convex, the last strongly ascending in front, having a very strong, narrow ridge or collar a short distance behind the lip, the back of the collar opaque whitish. Constriction very slight, median in front. Color dull red. Sculpture of very delicate hair-like striæ, closer and finer on the last two whorls than on the preceding two, and usually worn from fully adult shells. The aperture is circular, orange colored within; peristome reflexed and somewhat thickened, continued in a raised ledge across the parietal wall, reaching to or almost to the suture. Palatal plica rather long and wholly covered by the parietal callus. Columellar tooth strong, the lamella within moderately high but thin. Internal parietal lamella low.

Length 4.75, diam. 2.5 mm.

Gakuenji, Izumo. Types No. 95670 A. N. S. P., from No. 1596 of Mr. Hirase's collection. Also Makuragisan, Izumo, No. 95669 A. N. S. P.

This largest of the Japanese Diplommatinas is in every way more robust than *D. collarifera* S. and B. or *D. okiensis* P. and H. It further differs by having the parietal callus extended nearly to the suture, and the palatal plica lies wholly or almost wholly under the parietal callus.

Eulota (Euhadra) contraria n. sp.

The shell is depressed, biconvex, umbilicate, angular at the periphery, thin, greenish-yellow with a narrow dark red-brown band on the peripheral angle and narrowly visible above the suture on the last 1½ whorls; inner whorls suffused with reddish-brown. Surface but slightly shining. First 1¾ whorls, forming the embryonic shell, are convex, with a close sculpture of low granules arranged in obliquely descending series. The next 1½ whorls have weak growth-lines and minute, rather closely arranged papillæ scarcely noticeable in some specimens. The last two whorls have irregular growth-lines, and some shallow, irregular spiral sulci, most obvious on the base; there are also minute papillæ visible in places. Whorls 5½, the first 1½ convex, the rest convex below the suture, then flattened. The last whorl scarcely descends in front, and is convex below. The aperture is oblique, wide, lunate. Peristome white, the upper margin expanded, the outer and basal margins rather narrowly reflexed. The parietal callus is extremely thin.

Alt. 15, diam. 26 mm.
" 14.3, " 25 "

Kōshun, South Formosa. Types No. 95838 A. N. S. P., from No. 1581 of Mr. Hirase's collection.

This is a species of the *E. succincta* group. *E. formosensis* differs by being more elevated, with the lip sinuous above and in having very minute spiral striation on the last whorl. *E. succincta* is more compact, with the last whorl narrower (viewed from above), and the umbilicus is much smaller. The sculpture also differs in various details.

A specimen of *E. contraria* a little less mature than the type has the last whorl reddish-brown, the spire paler. It is banded like the type specimen. Only 10 examples of this fine snail were taken.

Eulota (Euhadra) picta n. sp.

The shell is rather narrowly umbilicate, somewhat depressed, with conic spire; rather solid; pale yellow, with two broad dark reddish-brown bands, the upper band extending from just below the periphery half way to the suture, and ascending the spire above the suture, the last 2 or 2½ whorls are therefore bicolored above; on earlier whorls the band becomes light reddish-brown and spreads over the surface of the whorls. The basal band is wider than the other, fading out on its inner edge. There is also a small umbilical patch of the same dark color. The surface is somewhat glossy, the first 4 whorls having a microscopic sculpture of minute raised points, regularly arranged (as in *Chloritis*); last whorl marked with growth-lines, not punctate. Whorls 5½, moderately convex, very slowly widening, the last rounded peripherally but showing the faint trace of a peripheral angle; not descending in front; base somewhat flattened. The aperture is but little oblique, wide, banded inside. Peristome narrowly reflexed, colored by the bands, dilated at the columellar insertion, half concealing the umbilicus.

Alt. 22, diam. 30.2 mm.
" 20.7, " 29.0 "

Yonakuni-jima, Ryukyu. Cotypes No. 95837 A. N. S. P., from No. 1507 of Mr. Hirase's collection.

A very handsome species of the *caliginosa* group, closely resembling *E. okinoerabuensis* in shape, but the last whorl, viewed from above, is narrower, and the minute sculpture of the spire is different. The somewhat flattened base and the shape of the basal lip are features like *E. caliginosa.*

Eulota luhuana latispira n. subsp.

The shell is large, bright greenish-yellow, with three brown bands, coarsely striate, with the usual fine spiral lines. *The spire is very wide,* whorls more slowly and more regularly increasing than in *luhuana* or *senckenbergiana*, the last whorl narrower. Umbilicus ample, regularly tapering within.

Alt. 30, diam. 48 mm.; whorls 6½.

Hakusan, Kaga. Types No. 83913 A. N. S. P., from No. 562*a* of Mr. Hirase's collection.

The spiral bands may be dark and conspicuous or very pale. The lip is flesh colored, varying in shade in different shells.

Eulota (Ægista) perangulata n. sp.

The shell is umbilicate (width of umbilicus contained 4½ times in the diameter of the shell), conic above, convex below, strongly angular at the periphery; light brown, dull, finely striate, sometimes with some very delicate, short, thread-like cuticular appendages on some of the striæ in places. Under the cuticle there are very fine spiral lines, visible just in front of the parietal callus. Whorls 6¼, moderately convex, slowly increasing, the last strongly angular peripherally, the angle disappearing immediately behind the peristome. The whorl scarcely descends in front, not angular around the umbilicus. The aperture is rounded-lunate; peristome thin, forming three-fourths of a circle; the upper margin is slightly expanded, outer and basal margins reflexed. Parietal callus merely a thin film.

Alt. 8.5, diam. 13.7 mm.
" 9, " 13 "

Izuhara, Tsushima. Cotypes No. 95859 A. N. S. P., from No. 1551 of Mr. Hirase's collection.

This is a strongly angular species of the *E. aperta* group. The peristome is like that of *E. aperta tumida*. Neither *E. aperta* or *E. mimula* is known from the island of Kyushu.

Trishoplita cretacea hypozona n. subsp.

The shell is conic, white with a broad purplish-brown or rich reddish-brown zone on the base. The surface is rather finely striate, the striæ elegantly granulose, especially on the base.

Alt. 14, diam. 17.8 mm.; whorls 6½.
" 12, " 16.8 " " 6.

Mikuriya, Hoki. Types No. 95862 A. N. S. P., from No. 387*a* of Mr. Hirase's collection. It also occurs at Mihonoseki and Gakuenji, Izumo, and at Itsukushima, Aki.

The shell is generally in large part denuded of cuticle, as in *T. cretacea*. The granules on the striæ of the base are irregular, not arranged in spiral lines. Some specimens from Izumo are smaller:

Alt. 12.2, diam. 16 mm.; whorls 6½.
" 10, " 14.5 " " 6.

A single example seen from the province Aki resembles *hypozona* in shape and color, but differs in minute sculpture, the striæ being superficially cut by fine spiral lines, chiefly evident on the base, in place of the irregular granulation of typical *hypozona*. This form (No. 87678 A. N. S. P., No. 1190 of Mr. Hirase's collection) may be found separable from *hypozona*, yet we prefer to refer it to that race until more material can be brought together.

T. c. hypozona inhabits the provinces along the northern shore of the western end of the main island of Japan.

Ganesella albida mollicula n. subsp.

The shell is larger than *G. albida*, thinner, more transparent, bluish-milky above the keel, transparent yellowish below, sculptured quite distinctly with close microscopic spiral lines; base decidedly more convex than in *albida*, the mouth and columella being longer; whorls more numerous.

Length 21, diam. 14.5 mm.; whorls 6½.

Tōshun, South Cape of Formosa. Type No. 95753 A. N. S. P., from No. 1584 of Mr. Hirase's collection.

The typical measurements of *G. albida* (H. Ad.) are alt. 15, diam. 14 mm. An example of the typical form from Sammaipo before us measures, alt. 14.5, diam. 12 mm., whorls 5½. Only three examples of *G. a. mollicula* were taken.

Ennea iwakawa yonakunijimana n. subsp.

Closely related to *E. i. miyakojimana* P. and H., but the aperture is more contracted by the large teeth, and the spire tapers more, being widest below the middle, at the penultimate whorl. Whorls 6¾ to 7½.

Length 4, diam. 1.9 mm.

Yonakunijima, Loochoo. Types No. 95715 A. N. S. P., from No. 1511 of Mr. Hirase's collection.

Petalochlamys rejecta (Pfr.).

> *Helix rejecta* Pfr., P. Z. S., 1859, p. 25, No. 9, pl. 43, fig. 1; Monographia Hel. Viv., V, 142.
> *Microcystis? rejecta* Mlldff., Jahrb. D. M. Ges., X, p. 365.
> *Hyalina mamillaris* Heude, Moll. Terr. Fleuve Bleu, 1882, p. 15, pl. 19, fig. 8.

This species was described from a specimen taken by Robert Fortune in "northern China." Dr. von Moellendorff has pointed out that most of the shells discovered by Fortune are from places inland from Shanghai, toward the tea district of Wu-yuan in the Province An-hui. Hangchow, where several of Fortune's species occur, such as *Plectotropis brevibarbis*, is between Shanghai and Wu-yuan. A *Petalochlamys* from Hangchow, taken by Mr. Nakada, agrees with Pfeiffer's description of *H. rejecta*.

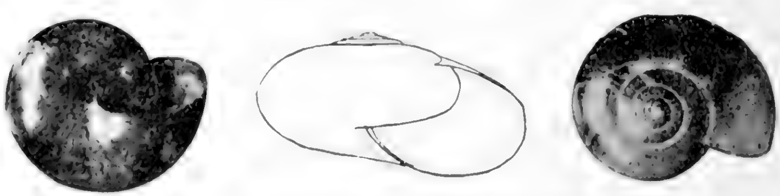


Fig. 1.—*P. rejecta* Pfr., Hangchow, China.

The shell is strongly depressed, with very low-conic spire; of the usual thin substance and of a greenish-yellow color above, subtransparent, the base perceptibly paler. The umbilicus is extremely narrow, its width contained about 12 times in that of the shell. The surface is polished, and shows under a compound microscope very close, engraved spiral lines, chiefly below the suture, wanting on the first whorl, and becoming weak on the last whorl and the base. Large specimens have just 5 whorls; these increase rather slowly to the last which is very wide—wider than in related species. Seen from above the spire is small, its diameter hardly 46 per cent. of the total diameter of the shell. The last whorl is equally rounded at the periphery. The aperture is broadly lunate.

Alt. 7, greater diam. 13.5, lesser 11.3 mm.

The specimens described and figured are from Hangchow, Chekiang Province, China; No. 95800 A. N. S. P., from No. 1476 of Mr. Hirase's collection.

P. rejecta is related to *P. planula* and *P. planata* of Heude, but viewed from above the last whorl is wider than in either of these species, both of which moreover are smaller. Dr. O. von Moellendorf found *rejecta* in Lü-shan, near Kiukiang. P. Fuchs collected it in southern Hunan and northern Guangdung, and Father Heude described specimens from the former locality as *H. mamillaris,* a species which von Moellendorff referred to *rejecta* as a synonym. The first published record of *rejecta,* after the original reference, was by A. Adams, who identified it from Tsushima (*Annals and Magazine of Natural History,* 4th series, I, 1868, p. 467). Among difficult and critical species an identification by Adams has slight value. Von Martens, Reinhardt and Kobelt have repeated Adams' record, but without further confirmation. I do not know the locality of the specimen figured by Dr. Reinhardt. Kobelt has copied these figures. On the whole, it seems hazardous to admit *P. rejecta* to the fauna of Japan or Korea without better evidence than we now have. It will probably prove to be peculiar to China, especially in the district below the mouth of the Yangtze, in An-hui and Chekiang Provinces. At all events, the somewhat similar *Petalochlamys* known to us from Tsushima is certainly a species distinct from *P. rejecta.*

Petalochlamys subrejecta n. sp.

Macrochlamys rejecta Pfr., Hirase, The Conch. Magazine, II, p. 5, pl. 13, fig. 13, not *Helix rejecta* Pfr.
Macrochlamys subrejecta Pils. and Hir., Conch. Mag., II, p. 76 (no description).

Shell depressed, very narrowly umbilicate, very thin and fragile, glossy, of a pale brown tint, or very pale greenish-yellow. The surface is weakly marked with growth-lines, and under the compound microscope shows very fine, close, superficial spiral striæ, wanting on the first whorl, becoming weak on the last whorl. The spire is low-conoidal, wide; its diameter, viewed from above, is 58 per cent. the total diameter of the shell. Whorls $5\frac{3}{4}$, slowly increasing, the last much wider, rounded at the periphery. The suture is narrowly transparent-margined. Umbilicus very small, its diameter contained about 20 times in that of the shell. Aperture lunate.

Alt. 7.6, greater diam. 13.2, lesser 12 mm.

Sasuna, Tsushima. Types No. 95802 A. N. S. P., from No. 1549*a* of Mr. Hirase's collection. Also found at Fusan, Korea.

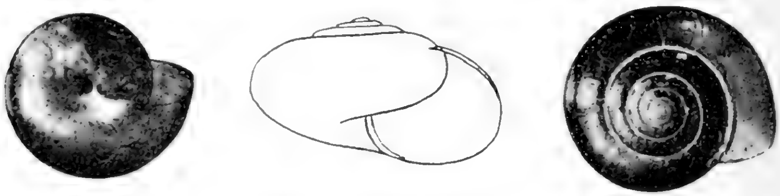


Fig. 2.—*P. subrejecta.*

Compared with the Chinese *P. rejecta,* this species is less depressed and has, viewed from above, a much wider spire and narrower last whorl. The aperture is consequently higher and less dilated laterally. The spiral sculpture is not quite so deeply engraved, and the umbilicus is wider than in *P. rejecta*, though still very narrow. *P. subrejecta* is probably the shell A. Adams reported from Tsushima as *Macrochlamys rejecta* Pfr.

Petalochlamys serenus n. sp.

The shell is depressed, very narrowly umbilicate, amber colored, subtransparent, very fragile. The surface has delicate, close microscopic engraved spirals both above and below. Spire slightly convex; whorls 4, but slightly convex, slowly increasing to the last, which is much wider, rounded peripherally. The suture is narrowly transparent-margined. Aperture lunate, columellar lip triangularly dilated at the insertion, thin; columella vertical.

Alt. 2.8, greater diam. 4.7, lesser 4 mm.

Kaminoyama, Kunchan, Okinawa. Types No. 95809 A. N. S. P., from No. 1441 of Mr. Hirase's collection.

This small, very fragile shell is related to *P. doenitzi* (Reinh.), but the last whorl is wider in a view from above, and is somewhat more ample.

Petalochlamys perfragilis sakui subsp. n.

The shell is more depressed than *P. perfragilis* and *P. p. shikokuensis*, and is a little more openly umbilicate. Surface brilliantly polished, almost smooth, but under a compound microscope very faint traces of spiral striæ may be seen in some places, and on the base of the last whorl these incised spirals sometimes become distinct. The suture is white-edged.

Alt. 8.7, greater diam. 15, lesser 13.2 mm.

Yaku-shima (Ōsumi), types No. 85729 A. N. S. P., from No. 1081 of Mr. Hirase's collection. It also occurs on Kuchinoerabu-shima (Ōsumi).

Kaliella gudei mutsuensis n. subsp.

The shell is perforate, conic, having an acute peripheral keel, visible on the spire as a thread in the suture; irregularly striatulate and glossy. Whorls $4\frac{3}{4}$ to 5, convex. Aperture lunate, truncate at the ends. Columellar margin vertical, slightly thickened, reflexed at the insertion.

Alt. 3.3, diam. 4.7 mm.

Osoreyama, Mutsu. Types No. 96178 A. N. S. P., from No. 1445 of Mr. Hirase's collection.

This form differs from *K. gudei* by the number of whorls and much smaller size. The whorls are more convex than in *K. ceratodes* (Gude), and the columella is less calloused. In *K. koshinoshimana* the whorls are more closely coiled. *K. g. mutsuensis* differs from *K. sororcula* by its *vertical columella*, that of *K. sororcula* being oblique to the shell-axis.

Kaliella subcrenulata satsumana n. subsp. Fig. 3.

A form decidedly larger than *K. subcrenulata*. Under the compound microscope there are seen to be fine thread-like vertical striæ on the upper surface and on a band below the periphery. The rest of the base is glossy, but shows a few fine spiral lines.

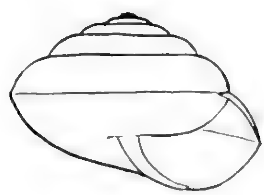


Fig. 3.

Alt. 2.3, diam. 3.25 mm.

Yamakawa, Satsuma. Types No. 96176 A. N. S. P., from No. 1593 of Mr. Hirase's collection.

Kaliella longissima n. sp. Fig. 4.

The shell is minutely perforate, conic-turrite, with nearly straight lateral outlines and obtuse summit; pale yellowish, subtransparent. Surface glossy, almost smooth. Whorls $9\frac{1}{2}$, very slowly increasing, moderately convex, the last rounded peripherally, though there is a very delicate thread-like keel. Base convex. Aperture semilunar, the columella vertical, with reflexed edge.

Alt. 4.25, diam. 2.3 mm.

Sasuna, Tsushima. Types No. 96177 A. N. S. P., from No. 1556 of Mr. Hirase's collection.

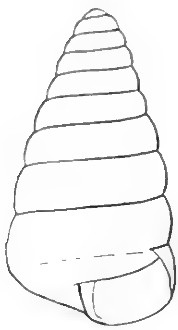


Fig. 4.

This is the most lengthened Japanese *Kaliella* known to us, being much longer than *K. prœalta*. The Indian *K. elongata* G.–A. has about the same proportions, but differs by its strongly keeled last whorl, the convex outlines of the spire, etc.

Kaliella boninensis n. sp.

The shell is perforate, depressed, the spire convexly conoidal, with obtuse, rounded summit, base convex, the periphery angular; brown. Surface rather dull above, more glossy beneath; first half whorl smooth, next whorl sharply striate and decussated with fine spiral lines; following whorls are densely, finely and sharply striate, with very faint traces of spiral lines in places; the base is smoothish, but not much polished; showing faint traces of spiral lines in places. Whorls 3¾, moderately convex.

Alt. 1.75, diam. 2.66 mm.

Anijima, Ogasawara (Bonin Islands). Types No. 95867 A. N. S. P., from No. 1500 of Mr. Hirase's collection.

This small species is not closely related to any known Ogasawaran or Japanese form. Whether it really belongs to *Kaliella* is perhaps doubtful.

Sitala ultima n. sp.

The shell is perforate, conic, with the last whorl large; very fragile, amber colored, rather shining, with a silky luster above, more glossy below. Sculpture of excessively fine, close vertical striæ decussated by very delicate spirals, the base having engraved spiral lines. The spire is straightly conic. Whorls 4½, convex, the last angular at the periphery in front, becoming inflated and rounded in the last half. Base rather convex.

Alt. 2.3, diam. 2.9 mm.

Kaminoyama, Uzen. Types No. 95908 A. N. S. P., from No. 1443 of Mr. Hirase's collection.

This delicate snail is smaller than the related *S. reinhardti*, and has much more distinct microscopic sculpture. It lives farther north than any other known *Sitala*.

Ena luchuana nesiotica n. subsp.

The shell is rimate, very thin, *purplish-brown*, more or less flecked with yellow on the upper whorls, by incipient disintegration of the cuticle. The spire tapers regularly to the small but obtuse apex. Whorls 7½. The earliest whorls are worn but seem to be smooth. On the third whorl very fine, close spiral striæ appear, and by the decussation of growth-lines the surface becomes minutely granular. The last whorl or two are more coarsely closely granulose. The aperture is slightly oblique, dark inside; peristome expanded, slightly thickened within, white. Columella dilated and forked above. Parietal callus very thin and transparent.

Length	17,	diam.	7.0 mm.
"	17.2,	"	6.9 "
"	16,	"	7.0 "

Kuroshima, Ōsumi. Types No. 95768 A. N. S. P., from No. 1546*a* of Mr. Hirase's collection. Also Yakushima, No. 1546 of Mr. Hirase's collection, 95769 A. N. S. P.

This form differs from *Ena luchuana* and *E. l. oshimana* by the dark coloration, without light streaks, and the more pronounced granulation. The specimens from Yakushima seem to be identical in all respects with those from Kuroshima.

ON THE MELOÏDÆ OF ANGOLA.

BY F. CREIGHTON WELLMAN, M.D.

While determining a collection of Angolan specimens of Coleoptera of the family Meloïdæ recently collected by myself, I have had occasion to go somewhat thoroughly into the literature of the subject and also to compare the material in the British Museum, the Hope Department of Oxford University, the Königliches and the National Museums in Berlin, the National Museum at Washington, and several private collections; so it seems that the results, together with my collecting notes, may be of sufficient interest to publish along with the descriptions of the new forms that have come to light.

Our present knowledge of the Meloïdæ of Angola, it may be said, is due principally to three collections, viz., the Schönlein-Grossbendtner collection described by Erichson, the Welwitsch collection, the Meloïd material of which was described by Marseul, and the collection made by von Hohmeyer and Pogge and described by Harold. My own collection—described in the present paper—is now added. Besides these there are a few single descriptions by various authors, which will be found in their places in the present list. It is possible that some of the more recent records have escaped my attention. Of the four collections named above, by far the most complete is that of Welwitsch, which, like all the collections of this gifted naturalist, is of the highest scientific value.

I have recently, in collaboration with Dr. Walther Horn of Berlin, published a memoir containing a short description of the region under consideration and some account of its zoogeographical features and shall content myself with referring to that paper,[1] only observing here that with the exception of two new species, viz., *Mylabris* (*Actenodia*) *deserticola* Wellman (from the littoral region) and *Mylabris chisambensis* Wellman (from the high inland plateau), all the Angolan Meloïdæ collected by me are from the mountain slopes intermediate between the interior alpine region and the low-lying coastlands.

Some of the habits of the beetles are most interesting. I shall not

[1] On the Cicindelinæ of Angola, by F. Creighton Wellman, M.D., F.E.S., and Walther Horn, M.D., *Proc. Acad. Nat. Sci. Phila.*, November, 1908, pp. 504–512.

speak here of the remarkable illustrations of mimicry and warning colors afforded by the Angolan species, as I have already in preparation a paper on these questions, in collaboration with Prof. E. B. Poulton, F.R.S., of Oxford University, England. I may perhaps with advantage, however, refer at this time to the most important food plant of the Angolan Meloïdæ. This is a small Roseaceous annual which Prof. Engler kindly informed me in Berlin last summer was a species of *Tribulus* (*T. zegheri*) which is widely distributed in tropical Africa. Throughout the desert belt of Angola (which extends from the sea to a point 30 to 100 miles inland according to the configuration of the country) this plant occurs in enormous masses and is the most important and indeed almost the only food supply of the Meloïdæ of the region. Most of the genera represented eat it—*Mylabris* (*Ceroctis, Actenodia, Coryna, Decapotoma*), *Lytta*, etc. There are great patches of the yellow blooms and these reveal thousands of beetles; sometimes almost every plant has one or more beetles. Some of the more common species like *Mylabris dentata* Olivier, *Mylabris* (*Actenodia*) *chrysomelina* Erichson, *Mylabris pluvialis* Wellman, *Mylabris* (*Decapotoma*) *regis* Thomas and *Mylabris* (*Coryna*) 12-*punctata* Chevrolat can be obtained in almost endless numbers, and the yellow fæces of the beetles may be seen over the ground like numerous small dots. It is interesting to note that insects like these, which are during their larvæ stages all parasitic on other insects, should have such an intimate relation in their imaginal stage to certain plants. Lyttini in their early stages feed on the eggs of Orthoptera and Mylabrini on the young of the same order of insects. In Angola these beetles occur shortly before or about the time when the young Locustidæ and Acrididæ become numerous, the first rains doubtless having something to do with the hatching of them all. The appearance of the adult Meloïdæ is almost exactly synchronous with the flowering of the *Tribulus*, which lasts only a few weeks, and should the beetles be too early or too late in their appearance they (being flower feeders) must inevitably perish from want of food in this desert region where only this one species of *Tribulus*[2] (which is apparently fertilized by the beetles themselves) is abundant enough to support such vast numbers of insects. We see here another illustration of how in the economy of nature the interdependence of several organisms may be very close

[2] I have remarked on the relation of this flower to Angolan Meloidæ before the Deutsch. Entomol. Gesellschaft, *vid.* report in *Deutsch. Ent. Zeitschrift*, 1908 p. 647.

and the adjustment of life to environment very delicate. Other notes on the habits of the various species need not be discussed here, but will be found with the mention of the various species.

Following is a list of the species occurring in Angola, so far as I have been able to verify the records. When I have had occasion to compare material with original types I have usually indicated where such types are to be found. It may be mentioned that in the records and synonymy all names from Dejean's Catalogue have been ignored, as have MS. names, since the recognition of such serves only to perpetuate confusion. A set of cotypes (with the exception of three uniques) of the new forms described in this paper has been deposited in the collection of the United States National Museum. Probably a few of the species now included under *Mylabris* (sens. str.), and of which I have been unable to trace the types, will later have to be distributed among the various subgenera which I have recognized.

Fam. MELOÏDÆ.

Subfam. LYTTINÆ.

Tribe MYLABRINI.

Genus **MYLABRIS** Fabr., Syst. Ent., 1775, p. 261.

Subgenus 1. ACTENODIA Cast., Hist. des Ins., II, 1840, p. 268.

Syn. *Actenoda* Erichs., Wiegm. Arch., IX, 3, 1843, p. 257 (? *ex error*).
Syn. *Arithmema* Chevr., Ic. Régn. anim., III, p. 384.

Subgenus 2. CORYNA Billb., Mon. Mylabr., 1813, p. 73, nota.

Syn. *Hycleus* Latr., Régn. anim., Ed. I., 1817, p. 314.

Subgenus 3. DECAPOTOMA Voigts, Wien. Ent. Zeit., XXI, p. 177.

Syn. *Decatoma* Cast., Hist. des Ins., II, 1840, p. 268 (nec Spinola).

Subgenus 4. MYLABRIS Fabr., Syst. Ent., 1775, p. 261 (sens. strict.).

Subgenus 5. CEROCTIS Mars., Abeille, VII, 2, 1870, p. 168.

Syn. *Mimesthes* Mars., Mem. Soc. Sci. Liège, 1872, p. 566.

Subgenus 6. LYDOCERAS Mars., Abeille, VII, 2, 1870, p. 12.

The following artificial table based on the antennal characters may be useful in separating these subgenera of *Mylabris:*

A.—Antennæ with from eight to eleven joints, last joints inflated into a club-shaped mass.

a.—Antennæ moniliform.

Antennæ eight-jointed, ... ACTENODIA.
Antennæ nine-jointed, ... CORYNA.
Antennæ ten-jointed, ... DECAPOTOMA.
Antennæ eleven-jointed, ... MYLABRIS (s. str.).

aa.—Antennæ serrate.

Antennæ eleven-jointed, ... CEROCTIS.

AA. Antennæ with eleven joints, last joints not inflated.

Antennæ somewhat flattened, ... LYDOCERAS

Subgenus ACTENODIA Cast.

1. **Mylabris (A.) chrysomelina** Erichs. Wiegm. Arch. f. Naturg., 1843, p. 258.

Angola (ERICHSON), Loanda, Bengo (WELWITSCH), Mossamedes (ANCHIETA), Gamba, March, 1908, 341 specimens (WELLMAN). All the specimens were taken on the flowers of *Tribulus zegheri*. Type in Berlin Königliches Museum, marked on locality label "Angola, Schönh."

2. **Mylabris (A.) deserticola** Wellm. spec. nov.

Nigra, elongata, pallido-pubescens; elytris nigris, punctulatis, pone basin et humerale flavo-maculatis undulatimque bifasciatis, fascia anteriore flava, posteriore fulva; prothorace et capite fortiter punctatis, illo medio breviter foveolato; antennarum articulis 1, 2, 6, 7, 8 *nigris*, 3, 4, 5 *testaceis; pedes testacei, geniculis tarisque nigris.*

Long. corp. 8 mm.

Lat. elytr. 3½ mm.

Hab. Benguella (Africa) *ab auctore collecta.*

Typ. in coll. mea.

Small, graceful species; *head* black, rather strongly punctured and with a few scattered minute pale hairs; labrum emarginate, rather hairy; mandibles fuscous, maxillary palpi with apical joint obliquely truncate and nearly twice as long as penultimate, labial palpi short, *eyes* large, *antennæ* with first two joints black, 2d to 5th testaceous, 6th to 8th black, rather sparsely covered with short fine white hairs and a few larger black ones, the last joint more closely covered with short fine white hairs; *thorax* black rather sparsely and strongly punctured, clothed with pallid hairs, in the center at the basal third is an elongate fovea about ⅕ the length of the thorax; *scutellum* small, with a few short pallid hairs; *elytra* black irregularly punctulate, pallidly villose, with a large yellow or pale orange spot at the base of each elytron, and two transverse irregular bands, one of a yellow color a little in front of the middle and the other of an orange red color about half way between the middle band and the apex of the elytron; at the humeral margin of the elytron is a spot smaller and narrower than the basal spot, this is connected by a narrow marginal band to the middle transverse fascia; *legs* testaceous with a rather broad apical black band to the femora, a much narrower, occasionally nearly obsolete black apical band on the tibiæ and tarsi, the last tarsus being sometimes almost entirely black; the under side of the body is black.

Type in my collection; cotype (paratype) Cat. No. 12119, U. S. N. M.

Five specimens of this pretty little species were taken in the desert just outside of the city of Benguella in March, 1908. They were all on a leafless shrub and their food plant is unknown. It seemed problematical what they could find to feed on in that dried-up region. There is a series of specimens without name in the Königliches Museum in Berlin.

3. **Mylabris (A.) jucunda** Erichs., Wiegm., Arch. f. Naturg., I, 1843, p. 257.

Angola (Erichson), Angola, Benguella (Marseul).

Type in Berlin, Königliches Museum, marked "Angola, Schönh."

Subgenus CORYNA Billb.

4. **Mylabris (C.) ambigua** Gerst., Wiegm. Arch. f. Naturg., XXXVII, p. 68.

Gamba, March, 1908, 2 specimens (Wellman).

This species was originally described from Zanzibar and placed by its author as a *Mylabris*.

Type in Berlin, Königliches Museum.

5. **Mylabris (C.) chevrolati** Beaur., Les Ins. Vés., 1890, p. 523.

Hyclæus duodecimpunctata Chevr., Guér. Ic. règn. anim., p. 132, tab. 35, fig. 3 (nec Oliv.).

Hycleus decimguttatus Cast., Hist. Nat. des Ins., II, p. 268.

Gamba, March, 1908, 72 specimens (Wellman).

Originally described from Senegal.

6. **Mylabris (C.) hermanniæ** Fabr., Ent. Syst., I, 2, p. 89.

Mylabris affinis Oliv., Ent., III, 47, p. 8, tab. 2, fig. 16.

Angola—"aus dem inneren"—(Pogge).

Described from Guinea.

7. **Mylabris (C.) mylabroides** Cast., Hist. Nat. des Ins., II, p. 208.

Mylabris lanuginosa Gerst., Monatsb. Berl. Acad., 1854, p. 695.

Angola (Marseul).

The type of *lanuginosa* is in Berlin, Königliches Museum.

8. **Mylabris (C.) posthuma** Mars., Mem. Soc. roy. Sci. Liége, 1872, p. 603. Pl. VI, fig. 6.

Angola, Bengale = ? Bangala (Marseul), Loanda, Bengo (Welwitsch), Humbe, Huilla (Anchieta), Gamba, March, 1908, 308 specimens (Wellman).

On the flowers of *Tribulus zegheri*.

It is possible that *mixta* Mars. from "Caffraria" is a variety of *posthuma*.

9. **Mylabris (C.) tergemina** Mars., Mem. Soc. roy. Sci. Liége, 1872, p. 613.

Angola (Marseul).

Subgenus DECAPOTOMA Voigts.

10. **Mylabris (D.) decorata** Erichs., Wiegm. Arch. f. Naturg., 1843, p. 256.

Angola (Erichson), Benguella (Marseul), Loanda (Welwitsch), Loanda (Hohmeyer), Huilla (Anchieta).

Type in Berlin, Königliches Museum.

11. **Mylabris (D.) chiyakensis** Wellm. spec. nov.

Nigra, argenteo-villosa, caput et thorax obscure viridi-cœrulescentia, subtiliter punctata, pallido-villosa; elytra nigra, argenteo-villosa; vittis duabus (altera dorsali, altera marginali; illa medium attingente ad apicem valde dilatata, hac medium subattingente minus dilatata) maculisque duabus (altera dorsali, altera marginali) inter medium et apicem positis: corpus infra pedesque nigra (femora pallido-hirsuta, tibiæ flavo-sericeae) pedes postici elongati.

Long. corp. 12 mm.

Lat. elytr. 4 mm.

Hab. Chiyaka, Angola (Africa) *ab auctore collecta.*

Typ. in coll. mea.

Medium sized species; *head* and *thorax* dark greenish-blue, finely punctured and clothed with long pale hairs; *eyes* large, very convex; *antennæ* with first two joints shining, the rest dull; *scutellum* almost semicircular; *elytra* black, finely punctured, clothed with pale, silvery hairs; on each elytron a dorsal and marginal broad yellow line, both dilated at the posterior termination, the former reaching past the middle of the elytron and strongly dilated into a large transverse spot; the latter not reaching to the middle of the elytron and less strongly dilated. In some specimens the dorsal vitta is interrupted, the terminal dilatation then becoming an isolated spot and the vitta remaining shorter than the marginal one. Half way between the terminal inflation of the dorsal vitta and the apex of the elytra a large, somewhat transverse spot; a smaller transverse spot oppostе it at the margin. The legs and abdomen are clothed with rather long, pale hairs, the tibiæ being closely covered with shorter and yellower hairs. The hind legs are very long.

Type in my collection; cotype Cat. No. 12120, U. S. N. M.

There also occurs a variety of this species which may be briefly characterized as follows:

Mylabris (D.) chiyakensis var. **tekama** Wellm. var. nov

Vittis dorsalibus nullis maculisque minoribus.

Typ. in coll. mea.

The very striking reduction of the yellow markings gives at first glance the impression of a different species. The name is a local Bantu word referring to the dull color.

Eighty-one specimens of this interesting species were taken in February, 1908, chiefly on flowers of Compositæ. In life the antennæ are held farther forward than in most Mylabrini, giving the insect a somewhat peculiar aspect.

12. **Mylabris (D.) elendensis** Wellm. spec. nov.

Nigra, elongata, argenteo-subpubescens, capite prothoraceque crebre punctatis, hoc subimpresso; antennis nigris; elytra nigra, vittis duabus flavis (vitta dorsali ad apicem subiter, vitta marginali non, dilatata) maculisque 2 posticis, oblique positis, ornatis; pedes nigri, argenteo-sericei; abdomen nigrum.

Long. corp. 12 mm.

Lat. elytr. 3¼ mm.

Hab. Chiyaka (Mt. Elende), Angola, Africa; *ab auctore collecta.*

Typ. in coll. mea.

Slender species; *head* (including antennæ and mouth parts) black, closely punctured with pale villosity, *eyes* large, hemispherical; *antennæ* black, *thorax* black, punctured like head, pubescence pale, feebly impressed in the median line at its posterior third; *scutellum* large; *elytra* black, more coarsely punctured than the head and thorax, palely villose, with yellow markings disposed as follows: two dorsal vittæ, one on each elytron, not reaching to the posterior third of elytron; here it is angularly deflexed externally, forming the vitta into an obtuse angled hook; midway between this hook-like deflexion and the apex of the elytron is a large blotch longer than wide and lying at the same angle as the bent end of the vitta; a marginal vitta on each elytron distinctly shorter than the dorsal, and a small marginal spot just opposite the ante apical dorsal blotch; *legs* and under side of body black both clothed with pale hairs, the former closely beset with shorter hairs, the latter more sparsely set with long hairs.

Two specimens taken at Mt. Elende, Chiyaka, November, 1907, in a large orchid.

13. **Mylabris (D.) omega** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 585, pl. VI, fig. 11.

Loanda (Welwitsch), Huilla (Anchieta).

14. **Mylabris (D.) regis** Thos., Ann. Mag. Nat. Hist., 6, XIX, 1897, p. 1897.

Angola (Welwitsch), Gamba, March, 1908, 102 specimens (Wellman).

On the flowers of *Tribulus zegheri.*

Type in London, British Museum.

15. **Mylabris (D.) temporalis** Wellm. spec. nov.

Nigra, elongata subcylindrica, pilis argenteis hirta; capite prothoraceque nigris subtiliter punctulatis, argenteo-villosis, illo lato (tempora inflata et rotundata), hoc medio fortiter foveolato; antennis articulis 2 primis nigris, reliquis obscure brunneis; elytris nigris, fortiter punctulatis argenteo-villosis; vitta lata dorsali medium subattingente, altera *marginali angusta medium attingente, macula media dorsali et fascia irregulare inter medium et apicem (suturam et marginem attingens); corpus infra et pedes nigra, nigro-sericea.*

Long. corp. 15 mm.

Lat. elytr. 4⅓ mm.

Hab. Chiyaka, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

Medium-sized species, black, rather densely clothed with longish silvery hairs, which are longer on the head and thorax than on the elytra. The *head* is very wide, being much wider than the thorax, and in some specimens as wide as the elytra at their base, and with the tempora much inflated making the head above the eyes as wide as it is across the eyes themselves. *Eyes* not prominent. The head and *thorax* are finely punctulate, the latter with a median fovea situate somewhat in front of its posterior third. *Antennæ* with first two joints black, the remainder being a very dark brown. *Scutellum* long and narrow. *Elytra* black with yellow markings arranged as follows: on each elytron a broad dorsal vitta (one-fourth as wide as the elytron) not reaching to the middle of the elytron; another narrower marginal vitta reaching fully to, or rather beyond, the middle; behind the apex of the dorsal vitta and occasionally coalescing with it a large dorsal spot, irregular in outline but always transverse; behind this spot, midway between it and the apex of the elytron, an irregular yellow band. The *legs* and abdomen are densely clothed with long silvery hairs which are more abundant on the femora and tibiæ.

Type in my collection; cotype Cat. No. 12121, U. S. N. M.

One hundred and two specimens taken in January, 1907 on Malvaceæ (*Hibiscus* and *Malache* spp.). The pattern of this species is wonderfully stable showing almost no variation.

Subgenus MYLABRIS Fabr. (*sens. strict.*).

16. **Mylabris (M.) andongoana** Har., Col. Hefte, XVI, 1879, p. 138.

Pungo Andongo, July (HOHMEYER).

Type in Berlin, Königlisches Museum. The pubescence of the legs is in the type somewhat different from ordinary specimens.

17. **Mylabris (M.) atrochalybea** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VI, No. XXV, 1879, p. 57.

Loanda (WELWITSCH), Huilla (LOBO D'AVILA).

18. **Mylabris (M.) benguelana** Mars., *ibid.*, p. 57.

Angola (WELWITSCH), Benguella (ANCHIETA).

19. **Mylabris (M.) bicincta** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 161, pl. V, fig. 60.

Loanda (WELWITSCH).

This species was described from Lake N'gami.

20. **Mylabris (M.) bifurcata** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV., 1879, p. 48.
Capangombe (ANCHIETA).

21. **Mylabris (M.) bilineata** Mars., *ibid.*, p. 56.
Angola (WELWITSCH).

22. **Mylabris (M.) bissexguttata** Mars., *ibid.*, p. 50.
Humbe (ANCHIETA).

23. **Mylabris (M.) carinifrons** Mars., *ibid.*, p. 47.
Angola (WELWITSCH).

24. **Mylabris (M.) chisambensis** Wellm., spec. nov.

Nigra, magna, elongata, convexa, nigro-villosula; capite, prothoraceque crebre punctulatis; antennis nigris; elytris nigris, punctulatis, macula magna juxtascutellare et altera minore humerali testaceis; medio undulatim lateque testaceo-bifasciatis; corpus infra et pedes intermedii posticique nigro-pubescentes; pedes antici dense argenteo-sericei.

Long. corp. 24 mm.

Lat. elytr. 10½ mm.

Hab. Chisamba, Bihé, Angola (Africa); *a Doctore L. Cammack collecta.*

Typ. in coll. mea.

Large species; *head* black, finely punctured, clothed with fine black hairs which are fewer on the vertex; labrum emarginate, the margin provided with a thick fringe of coarse testaceous hairs, its basal third smooth, the apical two-thirds very closely, finely and regularly punctured; *eyes* slightly reniform; *antennæ* black, with a tuft of coarse black hairs on the anterior surface of the basal joint and a few scattered black hairs on the next three joints; maxillary palpi large with apical joint inflated and squarely truncate, both maxillary and labial palpi with long black hairs on them; *thorax* with punctuation and pubescence like that of head, posterior margin elevated, two feeble impressions, one just in front of the posterior margin, and the other just in front of the posterior third of the thorax, both in the median line; *scutellum* small, triangular with the posterior angle truncate; *elytra* black, with a large juxta-scutellar straw-colored spot, not quite reaching the sutural margin, on each elytron; nearly opposite to this, but rather more in front, a smaller spot on the humeral margin; two wide, wavy bands of the same color dividing the elytra into three nearly equal parts, but placed nearer together than from the basal or apical borders of the elytra; *legs* black, densely clothed with short black hairs and some longer ones, the front legs very closely covered on their internal surface with short pale hairs and in the males provided with very long black hairs at the apex of the tibiæ and sides of the tarsi; under surface of body black with longish black pubescence.

Type in my collection; cotype Cat. No. 12122, U. S. N. M.

Eight specimens sent by Dr. Cammack, taken on "foliage." One of the individuals is a monstrosity, having the secondary bifurcation of the inner front claws reduced to a tiny spur.

This species in its coloration and facies presents a startling resemblance to an oriental species (*M. cichorii* Linn.), but the striking differences in the mouth parts readily separate it.

25. **Mylabris** (**M.**) **dentata** Oliv., Encyc. méth., VIII, p. 97.

Mylabris tortuosa Erichs., Wiegm. Arch. Naturg., I, 1843, p. 256.

Angola (Erichson), Loanda, Benguella (Marseul), Icolo, Loanda (Welwitsch), Loanda (Hohmeyer), Humbe, Cabinda (Anchieta), Gamba, March, 1908, 84 specimens (Wellman).

This species was first described from Sierra Leone.

26. **Mylabris** (**M.**) **dicincta** Bert., Nov. Act. Bonon., X., 1849, p. 419.

Mylabris bizonata Gerst., Monatsb. Berl. Acad., 1854, p. 694.
Mylabris dicincta var. *Buqueti* Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 408.
Zonabris dicincta var. *occidentalis* Har., Col. Hefte, XVI, 1879, p. 135.

Benguella (Marseul), Angola (Welwitsch), Capangombe (Anchieta), Gamba, 60 specimens, on flowers of *Tribulus zegheri*, March, 1908 (Wellman).

The typical form was first described from Mozambique. The Angolan form with juxta-scutellar and humero-marginal elytral spots seems to be a distinctively western race and is probably a true subspecies. In all my specimens the last three joints of the palpi are yellow.

A specimen of *dicincta* probably named by Bertolini and designated as a "type" is in Berlin, Königliches Museum.

27. **Mylabris** (**M.**) **discrepens** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, p. 46.

Loanda (Welwitsch).

28. **Mylabris** (**M.**) **dispar** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 435, pl. IV, fig. 22*a*.

Ambriz (Marseul).

29. **Mylabris** (**M.**) **erichsoni** Gemm., Col. Hefte, VI, 1870, p. 123.

Mylabris duodecimguttata Erichs., Wiegm. Arch. Naturg., I, 1843, p. 257 (nec Germar).

Angola (Erichson).

30. **Mylabris** (**M.**) **flavoguttata** Reiche, Galin. Voy. Abyss., 1850, p. 380, tab. 23, fig. 6.

Angola (Welwitsch).

A species described from Abyssinia.

31. **Mylabris** (**M.**) **gamicola** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 436, pl. IV., fig. 23*a*.

Humbe (Anchieta).

Described from Lake N'gami.

32. **Mylabris (M.) holosericea** Klug, Erm. Reise, 1835, p. 41.

Loanda (WELWITSCH).

Described from Guinea. It is suggested by Mr. Champion (*Mém. Soc. Ent. Belg.*, 1899, p. 165) that *villosa* Fåhr. (*Öfv. Vet.-Ak. Forh.*, XXVII, p. 345) from "Caffraria" is a variety of this species.

33. **Mylabris (M.) hybrida** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 418, pl. IV. fig 12.

Capangombe (ANCHIETA).

Described from Port Natal.

34. **Mylabris (M.) jacob** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., V, No. XXV, 1879 p. 53.

Loanda (WELWITSCH), Capangombe (ANCHIETA).

35. **Mylabris (M.) lactimala** Mars., *ibid.*, p. 44.

Humbe (LOBO D'AVILA).

36. **Mylabris (M.) lanigera** Mars., *ibid.*, p. 49.

Angola (WELWITSCH).

37. **Mylabris (M.) liquida** Erichs., Wiegm. Arch. Naturg., I, 1843, p. 255.

Angola (ERICHSON). Loanda, Pungo Andongo (HOHMEYER), Cabinda (ANCHIETA), Angola (WELWITSCH), Gamba, March, 1908, 7 specimens (WELLMAN).

On the flowers of *Tribulus zegheri*.

My specimens differ from typical examples in that the basal fascia of the elytra is not humerally subinterrupted.

38. **Mylabris (M.) muata** Har., Mitth. Munch. Ent. Ver., 1878, p. 109.

Angola—"aus dem inneren"—(POGGE).

This species was first described, probably from Kabébé, now in the Congo Free State, as a *Bruchus*, but was subsequently (*Col. Hefte*, 1879, p. 136) removed by its author from that genus and placed in *Mylabris*, where it conflicts with *Mylabris muata* Har., *Mitth. Munch. Ent. Ver.*, 1878, p. 109. I accordingly propose for this last species, which is not mentioned by Mr. Champion in his "List of the Cantharidæ Supplementary to the 'Munich' Catalogue" (*Mém. Soc. Ent. Belg.*, 1899, pp. 154–206), the following designation:

Mylabris (M.) haroldi Wellm. nom. nov.

The type of *muata* in the Berlin, Königliches Museum, has "Regn. Lunda" on the locality label.

39. **Mylabris (M.) myops** Chevr., Guér. Ic. régn. anim., p. 133, tab. 35, fig. 4.

Cabo Negro (WELWITSCH).

Described from the Cape of Good Hope.

Among my specimens (not collected by myself, but undoubtedly from Angola) and also among those of Welwitsch in the British Museum I find some individuals which differ considerably from the type, as was first pointed out by Marseul (*Jorn. Sci. Math. Phys. Nat. Lisb.*, 1879, p. 45) and which may be briefly described as follows:

Mylabris (M.) myops var. **welwitschi** Wellm. var. nov.

Macula flava basali elytrorum nulla. Typ. in coll. mea.

There are some other points of difference, among which may be mentioned the rather coarser and more irregular punctuation of the head and thorax in the case of the ♀♀, and the greater comparative length of the third joint of the antennæ.

40. **Mylabris (M.) oculata** Thunb., Diss. Nov. Ins. Spec., VI, 1791, p. 114.

Cantharis bifasciata Degeer., Ins., VII, p. 647, tab. 48, fig. 13.

Angola (WELWITSCH), Humbe (ANCHIETA).

First described from the Cape.

Mylabris (M.) oculata var. **moufleti** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 404.

Benguella (MARSEUL), Huilla (LOBO D'AVILA), Caconda (ANCHIETA), Bihé (CAPELLO and IVENS).

Mylabris (M.) oculata var. **ophthalmica** Mars., *ibid.*, p. 404.

Angola (WELWITSCH), Benguella, Capangombe, Humbe (ANCHIETA). Chiyaka, January, 1908, one specimen, Gamba, March, 1908, 3 specimens (WELLMAN).

Described from the Cape.

41. **Mylabris (M.) opacula** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 45.

Duque de Bragança (MARSEUL), Bihé (CAPELLO and IVENS).

42. **Mylabris (M.) palliata** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 432, pl. IV, fig. 21*a*.

Humbe (ANCHIETA).

Described from "Caffraria."

43. **Mylabris (M.) paulinoi** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 48.

Angola (WELWITSCH).

44. **Mylabris (M.) phelopsis** Mars. *ibid.*, p. 48.

Angola (WELWITSCH).

45. **Mylabris (M.) pluvialis** Wellm. spec. nov.

Nigra, oblongo-ovata, postice paulo latior, parum convexa, nigro-villosula; capite prothoraceque crebre punctulatis; antennis flavis, articulis duobus primis nigris; elytris nigris, punctulatis, macula magna juxtascutellare et altera parva humerali flavis; medio undulatim flavo-fasciatis, postico guttis duabus aurantiacis; corpus infra et pedes nigris.

Long. corp. 18 mm.

Lat. elytr. 8 mm.

Hab. Gamba, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

Medium-sized species; *head* black, rather closely punctured with shallow punctures, sparsely clothed with small black hairs; *eyes* large, almost hemispherical; *antennæ* with first two joints black, 3d to 11th light orange; *thorax* black, closely punctured, clothed with a few black hairs; *scutellum* very small, hardly visible, with a few fine black hairs; *elytra* black, punctured throughout not very closely with small, rather deep punctures; there are also some small, fine black hairs over the whole elytra which are marked with a median, yellow, transverse band and also spots anterior and posterior to it, these markings arranged as follows: on each elytron near the base is a large, almost circular bright yellow spot; behind this is the irregular, rather wide, median transverse yellow band which would lie in front of a transverse line which might be drawn to divide the elytron into two halves; about midway between this band and the posterior margin of the elytron are two orange-red spots, nearly round; the larger of these, which is smaller than the basal spots above mentioned, is near the sutural margin of the elytron, almost on a line with the basal spot; the other (hardly half as large) lies opposite at the outer margin of the elytron; basally at the extreme humeral margin of the elytron is a yellow spot, longer than wide, reaching to the margin of the elytron and narrowly connected with the median yellow band; *legs* black, blackly hairy, the front femora and tibiæ covered with short yellowish silky hairs on their inner surface.

Type in my collection; cotype Cat. No. 12123, U. S. N. M.

In some specimens the basal spots (both juxta-scutellar and humeral) show a tendency to become confluent with the median fascia.

This species is very prolific and appears in great numbers during the rains. In March, 1908, at Gamba, Angola, I collected 194 specimens in a few hours. Its principal food plant is *Tribulus zegheri.*

46. **Mylabris (M.) rufitarsis** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 52.

Loanda (Welwitsch), Huilla (Anchieta).

47. **Mylabris (M.) senegalensis** Voigts, Wien. Ent. Zeit., XXI, p. 178.

Mylabris bifasciata Oliv., Ent., III, 47, p. 5, tab. 1, fig. 10 (nec Degeer).

Angola (Welwitsch), Angola—"aus dem inneren"—(Pogge).

Described from Senegal, also a variety (var. *conjuncta* Voigts, *Wien. Ent. Zeit.*, XX, p. 217) from Dar-es-Salaam.

48. **Mylabris (M.) sibylæ** Wellm. spec. nov.

Nigra, statura magna sat robusta, nigro-pubescens; capite (antennæ articulis 1, 2 *nigris,* 2, 3 *fulvis, reliquis flavis; palpis brunneis) prothoraceque nigris subtiliter punctulatis, nigro-villosis, hoc longitudine paulo latior, medio leviter bi-impresso; elytris nigris, dense subtiliter* *punctatis, maculis 2 (juxta-scutellare et humerali) obscure aurantiacis, fascisque 2 (prima anteriore ad medium integra, secunda inter medium et apicem interrupta) obscure rufo-aurantiacis ornatis. Corpus infra et pedes nigra, nigro-pubescentia.*

Long. corp. 24 mm.

Lat. elytr. 13 mm.

Hab. Gamba, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

Large black species, rather robust, clothed with very short black pubescence, which is longer on the head, thorax and abdomen. The *head* and *thorax* are feebly punctulate, the latter doubly though feebly impressed. *Eyes* large, not very convex. *Antennæ* with the first two joints black, the second and third fulvous and the remainder light orange-yellow. The palpi are brownish. *Scutellum* very small, triangular. *Elytra* closely and finely punctate, each elytron with two spots, juxta-scutellar and humeral, and two fasciæ, the first in front of the middle, the second about midway between the median band and the apex of the elytron. The two spots and the median band are dark orange, the posterior band (which is sometimes interrupted) dark orange-red. *Legs* and body black, clothed with black hairs, the internal surface of the front legs covered with short pale silky hairs.

Type in my collection; cotype Cat. No. 12124, U. S. N. M.

Twenty-four specimens taken in March, 1908, on the flowers of *Tribulus zegheri.*

49. **Mylabris (M.) tincta** Erichs., Wiegm. Arch. Naturg., 1843, I, p. 256.

Angola (Erichson), Angola (Marseul), Angola (Welwitsch).

Type in Berlin, Königliches Museum.

50. **Mylabris (M.) tindila** Wellm. spec. nov.

Nigra, parva, nigro-pubescens; caput dense puntulatum, nigro-villosum, antennis flavis, articulis duobus primis nigris; thorax parvus, dense punctulatus, nigro-villosus, latitudine longior, postice longitudinaliter foveolatus; elytra dense subtiliter punctata, liniis dorsalibus 3 distinctis, nigro-pubescentia; fasciis tribus undulatis flavis suturam attingentibus; corpus infra et pedes nigra.

Long. corp. 12 mm.

Lat. elytr. 5 mm.

Hab. Gamba, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

A rather small species; *head* densely punctulate, blackly pubescent with a longish vertical smooth boss between the eyes. *Eyes* prominent. *Antennæ* with first two joints black, the next three dark yellow, the remainder light yellow. The palpi are black, hairy. *Thorax* small, narrow, longer than wide, conical in front, densely punctulate, with a small longitudinal median fovea at its posterior third. *Scutellum* small. *Elytra* black, finely and closely punctured, with three yellow bands placed much as in *M. liquida* Erichs. except that the basal fascia has no tendency to become interrupted. The three longitudinal veins or lines on the elytra are very distinct. *Legs* and under side of body black, blackly pubescent.

Type in my collection; cotype Cat. No. 12125, U. S. N. M.

Two specimens taken March, 1908, on the flowers of *Tribulus zegheri*. The specific name is a Bantu word meaning rare.

51 **Mylabris (M.) tricolor** Gerst., Peter's Reis. n. Mozamb., (1862), p. 297, pl. 17, fig. 11.

Humbe (ANCHIETA).

Described from Mozambique.

Type in Berlin, Königliches Museum.

52. **Mylabris (M.) trispila** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, p. 55, 1879.

Loanda (WELWITSCH), Huilla (ANCHIETA).

53. **Mylabris (M.) tristigma** Gerst., Monatsb. Berl. Acad., 1854, p. 694.

Described from Mozambique. The Angolan examples may be regarded as at least representing a distinct western geographical race which may be described as follows:

Mylabris (M.) tristigma tribuli Wellm. subsp. nov.

Nigra, angusta, valde elongata; capite crebre punctato, nigro-villoso; antennis articulis primis duobus fulvis, reliquis flavis. Labrum fulvum; palpis inflatis, truncatis, flavis; thorace crebre punctato, longitudine latiore medio impresso, postice elevato. Elytra flava, fortiter punctata, nigro-pubescentia; margine basali maculis duabus antemedium (altera pone suturam, altera majore laterali) fascia submediana apiceque nigris. Corpus infra et pedes (tarsi primi postici excepti) nigra, nigro-pubescentia.

Long. corp. 20 mm.

Lat. elytr. 5 mm.

Hab. Gamba, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

This insect, which quite possibly represents a new species, is described for the present as a subspecies of *tristigma* Gerst., from which it differs *inter alia* by the longer and narrower body, the shape of the head and eyes, the much larger black spots on the anterior part of the elytra, the different marking of the posterior portion, which shows a complete yellow band instead of the two yellow spots on a broad black apical band, etc.

Type in my collection; cotype Cat. No. 12126, U. S. N. M.

Three specimens taken at Gamba, on flowers of *Tribulus zegheri*, March, 1908.

The type of *tristigma* is in Berlin, Königliches Museum.

54. **Mylabris (M.) tristriguttata** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 55.

Mylabris "*ristriguttata*" Mars., Champion, Soc. Ent. Belg. Ann., XLIII, 1899, p. 165 (*ex error*).

Loanda (Welwitsch).

Subgenus CEROCTIS Mars.

55. **Mylabris (C.) amphibia** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 559, pl. V, fig. 70*a*.

Angola (Marseul).

56. **Mylabris (C.) angolensis** Gemm., Col. Hefte, VI, 1870, p. 123.

Mylabris phalerata Erichs., Wiegm. Arch. Naturg., I, 1843, p. 256.

Angola (Erichson), Angola (Welwitsch).

Type in Berlin, Königliches Museum, marked "Angola Schönh."

57. **Mylabris (C.) bohemanni** Mars., Mém. Soc. roy. Sci. Liége, 1872, p. 198, pl. V, fig. 69.

Capangombe (Anchieta).

Described from "Caffraria."

58. **Mylabris (C.) exclamationis** Mars., *ibid.*, p. 562, pl. V, fig. 72*a*.

"Amberix" (= ? Ambriz) (Marseul), Bengo (Welwitsch), Gamba, March, 1908, on flowers of *Tribulus zegheri*, 16 specimens (Wellman).

59. **Mylabris (C.) interna** Har., Mitth. Münch. Ent. Ver., 1878, p. 108.

Angola (Welwitsch) (a specimen in the British Museum labeled as *Coryna lata* Reiche), Angola (Mechow), Pungo Andongo, end of July (Pogge and Hohmeyer), Chiyaka, 1 specimen on grass December, 1906, 1 specimen on *Geigeria wellmani* September, 1907, 20 other specimens on Compositæ chiefly *Geigeria* and *Othonna* spp. (Wellman).

Described from the interior of "Guinea" and placed by its author in the genus *Bruchus*. *C. vespina* Thos. (*Ann. Mag. Nat. Hist.*, 6, XIX, p. 501) from east Africa has been sunk as a synonym of the species under discussion, but a series of 40 specimens from the Congo, now in the United States National Museum, together with my own examples, show that *vespina*, the type of which is in the British Museum, should be retained as a distinct and stable variety of *interna*, the front brown fascia of the latter being quite constantly reduced to two dots in the former. In the description *vespina* is not compared with *interna* but with *yerburyi* Gahan, from which it differs not especially (as is stated by Thomas) in the elytral banding, but in the color and structure of the antennæ (the type of *vespina* has no antennæ) which are very different.

The type of *interna* is in Berlin, Königliches Museum, and has "Regn. Lunda" on the locality label.

60. **Mylabris (C.) serricornis** Gerst., Peter's Reis., 1862, p. 300, pl. 18, fig. 1.

Loanda, Huilla (Welwitsch), Humbe (Anchieta).

This fine species was first described from Mozambique. In the type (in Berlin, Königliches Museum, marked "Mozamb. Peters") the legs are rather less hairy than in ordinary specimens.

61. **Mylabris (C.) trifurca** Gerst., Monatsb. Berl. Acad., 1854, p. 694.

Chiyaka, 1 specimen taken digging in native path, 1 specimen in large orchid, October, 1907, 2 other specimens, one on flowers of *Faroa wellmani* and one flying, December, 1907 (Wellman).

Described from Mozambique.

Type in Berlin, Königliches Museum marked "Sena, Peters."

Genus **ELETICA** Lacord., Gen. Col., V, p. 672.

62. **Eletica colorata** Har., Mitth. Munch. Ent. Ver., 1878, p. 108.

Angola—"aus dem inneren"—(Pogge), Chiyaka, November, 1907, taken flying in bright sunshine after a rain, 2 specimens (Wellman).

Described from the interior of Guinea. Kolbe (*Col. aus Afrika*, I, p. 178f.) considers *bicolor* Champ. (*Proc. Zool. Soc. Lond.*, 1890, p. 645, tab. 56, fig. 8) from Central Africa as a synonym of this species.

The type of *colorata* is in Berlin, Königliches Museum.

63. **Eletica læviceps** Kolbe, Ent. Nachr. XII, p. 299.

Chiyaka, November, 1907 (Wellman). A single specimen which lit on my hat in bright sunshine.

Described from the Congo. This species is very near *rufa* F., if indeed it can be separated from it.

The type of *læviceps* is in Berlin, Königliches Museum.

64. **Eletica ornatipennis** Luc., Bull. Soc. Ent. Fr., 1887, p. XXVII.

Huilla (Campana).

65. **Eletica rufa** Fabr., Syst. El., II, p. 78.

Lytta bipustulata Fabr., *loc. cit.*, p. 78.
Eletica cardinalis Pér., Trans. S. Afr. Phil. Soc., IV. p. 136.

Angola (Welwitsch), Angola (Monteiro), Angola (Anchieta), Chiyaka, January, 1908, twelve specimens (Wellman). Always taken about 9–11 A.M., flying, or rarely crawling, in bright sunshine after a rain. One specimen also lit on my hat.

First described from Senegal. This is an extraordinarily variable species, ranging from light red to coal black, some individuals even having the elytra pale yellow with black tips. I suspect that some of the black forms described under other names are nothing but variations of *rufa*, but as yet have been unable to examine the types.

66. **Eletica stuhlmanni** Kolbe, Stett. Ent. Zeit., LV, p. 183.

Chiyaka, November, 1907, three specimens (WELLMAN). Brought to me by my servant.

Described from Lake Albert Nyanza. It is probable that my specimens represent a new form, very closely allied to *stuhlmanni*, but the specimens are in such bad condition that I cannot separate them from Kolbe's species, without further material.

The type of *stuhlmanni*, is in Berlin, Königliches Museum.

Tribe **LYTTINI**.

Genus **LYTTA** Fabr., Syst. Ent., p. 260.

Cantharis Linn., Act. Ups., 1736, p. 19 (*pars*).
Lagorina Muls. et Rey., Ins. Canth., 1858, p. 150.

67. **Lytta amethystina** Mäkl., Act. Soc. Sci. Fenn., 1875, p. 602.

Chiyaka, running about on ground in company with *L. signifrons* Fåhr., 56 specimens (WELLMAN).

Described from Senegal.

68. **Lytta atrocœrulea** Har., Mitth. Münch. Ent. Ver., 1878, p. 108.

Angola—"aus dem inneren"—(POGGE).

Described from the interior of Guinea.

Type in Berlin, Königliches Museum.

69. **Lytta buqueti** Mäkl., Act. Soc. Sci. Fenn., 1875, p. 602.

Humbe (ANCHIETA).

Described from Senegal.

70. **Lytta chalybea** Erichs., Wiegm. Arch. Naturg., I, 1843, p. 258.

Cantharis seminitens Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 60.

Angola (ERICHSON), Angola (WELWITSCH), Loanda (HOHMEYER), Angola (MONTEIRO), Gamba, March, 1908, on flowers of *Tribulus zeyheri*, 146 specimens (WELLMAN).

A comparison of the material in Berlin and London with my series shows that Erichson's and Marseul's species are the same.

The type of *chalybea* is in Berlin, Königliches Museum.

71. **Lytta cinctifrons** Mars., *loc. cit.*, p. 61.

Humbe (ANCHIETA).

72. **Lytta episcopalis** Har., Mitth. Münch. Ent. Ver., 1878, p. 108

Angola—"aus dem inneren"—(POGGE).

Described from the interior of Guinea.

Type in Berlin, Königliches Museum.

73. **Lytta hemicrania** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 61.

Angola (Welwitsch).

74. **Lytta laminicornis** Fairm., Notes Leyd. Mus., X, p. 270.

Humpata (Kellen).

75. **Lytta maculifrons** Mäkl., Act. Soc. Sci. Fenn., 1878, p. 608.

Angola (Welwitsch), Angola (Monteiro), Humbe (Anchieta).

76. **Lytta melanocephala** Fabr., Syst. El., II, p. 77.

Lytta melanocephala var. *bilineata* Haag-Rut., Deutsch. Ent. Zeit., 1880, p. 68.

Angola (Welwitsch).

Described from Guinea. Hoag-Rutenberg's *Lytta bilineata* from Senegal is here treated as only a variation of *melanocephala* Fabr., but it is probable that the examination of more material would show it to be a constant and distinct geographical subspecies.

77. **Lytta metasternalis** Fairm., Notes Leyd. Mus., X, p. 269.

Humpata (Kellen).

78. **Lytta myrmido** Fairm., Pet. Nouv. Ent., II, p. 93.

Angola (Fairmaire).

79. **Lytta notifrons** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 59.

Humbe (Anchieta).

80. **Lytta pectoralis** Gerst., Monatsb. Berl. Acad., 1854, p. 695.

Gamba, March, 1908, 56 specimens (Wellman); never seen feeding but always running about restlessly on the ground like Carabidæ.

The type of *pectoralis* Gerst. is in Berlin, Königliches Museum.

Described from Mozambique. Fairmaire (*Faun. et Flor. Comal., Col.*, 1882, p. 84) has described another insect under the same name. For this last species I would propose

Lytta rubropectus Wellm. nom. nov.

81. **Lytta signifrons** Fåhr., Ofv. Vet.-Ak. Förh., XXVII, p. 352.

Lytta Cælestina Haag-Rut., Deutsch. Ent. Zeit., 1880, p. 61.

Angola (Welwitsch), Chiyaka, December, 1908, running on ground in company with *L. amethystina* Mäkl., 28 specimens (Wellman).

Described from "Caffraria."

82. **Lytta strigida** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 61.

Angola (Welwitsch).

83. **Lytta subrugulosa** Mäkl., Act. Soc. Sci. Fenn., X, p. 606.

Humbe (Anchieta).

84. **Lytta thoracica** Erichs., Wiegm. Arch. Naturg., I, 1843, p. 258.

Angola (Erichson), Gamba, March, 1908, on flowers of *Tribulus zegheri*, 10 specimens (Wellman).

My examples show that the puncturing of the thorax is variable and not always so reduced in the ♂♂ as Erichson thought.

85. **Lytta vellicata** Erichs., *ibid.*, p. 258.

Angola (ERICHSON).

Type in Berlin, Königliches Museum.

Genus **EPICAUTA** Redt. Faun. Aust., I, p. 631.

Isopentra Reitt., Wien. Ent. Zeit., XXXIV, p. 195.

86. **Epicauta canescens** Klug, Erman. Reis., 1835, p. 42.

Angola (WELWITSCH).

Described from Guinea.

87. **Epicauta prolifica** Wellm. spec. nov.

Nigra (caput rufum) lata, oblonga, pube densa depressa alba vestita; caput magnum, subpunctulatum, antennæ filiformes; thorax quadratus longitudine latior, medio leviter sulcatus, crebre punctatus; elytra crebre punctata, albo-marginata, medio lineaque dorsali longitudinali albis; corpus infra pedesque dense albo-vestita; pedes postici valde elongati.

Long. corp. 12 mm.

Lat. elytr. 6 mm.

Hab. Chiyaka, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

A very short robust species; black, clothed with a dense covering of closely lying white hairs, giving the insect a gray appearance. *Head* large, red (a frontal spot, the mouth parts and antennæ are black), feebly punctulate, clothed with short white hairs (very small and sparse on the vertex); *eyes* long, narrow and oblique; *antennæ* filiform, first joint long, second joint constricted before the base, third joint twice as long as second and much longer than fourth. *Thorax* quadrate, wider than long, with a very faint median longitudinal groove, closely and finely punctured. *Scutellum* small, triangular. *Elytra* also closely and finely punctured, with a white dorsal vitta (formed by a thicker arrangement of the hairs of the elytron) reaching from the base to almost the apex of the elytron; a white margin to the elytron formed in the same way. The *legs* and under surface of the body are closely covered with fine white hairs. There is a concave sericious spot on the inner surface of the front femora and tibiæ. The hind legs are very long.

Type in my collection; cotype Cat. No. 12127, U. S. N. M.

An interesting variety also occurs which may be briefly indicated as follows:

Epicauta canescens var. **elunda** Wellm. var. nov.

Vitta dorsali elytrorum nulla.

Typ. in coll. mea.

The absence of the most prominent marking gives the insect a strikingly different aspect. The name is a local word referring to the place in which the type of the variety was found.

Seventy-eight specimens of this species taken in November, 1907, and February, 1908. It is usually found wandering aimlessly about on the ground, but I have taken it eating potato tops and also bean leaves. It is often mentioned by the natives as destroying their crops. I once found them eating the young tender sprouts of a coarse branching grass (*Eragrostis* sp.).

Genus **ŒNAS** Latr., Hist. Nat. Crust. Ins., III, 1802, p. 186.

88. **Œnas bicolor** Cast., Hist. Nat. Ins., II, p. 271.

Angola (Bitta).

89. **Œnas melanura** Erichs., Wiegm. Arch. Naturg., I, 1843, p. 259.

Angola (Erichson).

Genus **SYBARIS** Steph., Ill. Brit. Ent., V, 1832, p. 70.

Prionotus Koll. et Redt., Hüg. Kasch., IV, p. 356.

Lacordaire (*Gen. Col.*, V, p. 683) suggests regarding the type (said to have been found in England) of this genus that it "pourrait bien être d'origine exotique." I have examined the insect (*S. immunis* Steph.) in the British Museum and believe that this must certainly have been the case.

90. **Sybaris flaveola** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 62.

Angola (Welwitsch).

91. **Sybaris picta** Mars., *ibid.*, p. 62.

Humbe (Anchieta).

Genus **SITARIS** Latr., Hist. Nat. Crust. Ins., III, 1802, p. 187.

Necydalis Fabr.
Criolis Muls.
Stenoria Muls.

92. **Sitaris hilaris** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 64.

Angola (Welwitsch).

Genus **ZONITIS** Fabr., Syst. Ent., 1775, p. 126.

Apalus Oliv., Encyc. méth., I, p. 165.
Megatrachelus Motsch., Bull. Mosc., 1845, p.
Stenodera Eschsch., Mém. Acad. Imp. Sci. Pet., VI, 1818, p. 469.
Zonitides Abeille de Per., Bull. Soc. Toul., XIV, 1880, p. 253.
Tmesidera Westw., Guér., Mag. Zool. Ins., 1841, tab. 85 (*pars*).
Euzonitis Sem., Hor. Soc. Ent. Ross., XXVII, 1893, p. 276.

Subgenus 1. ZONITIS Fabr., *loc. cit.*, p. 126 (*sens. str.*).

Subgenus 2. NEMOGNATHA Illig. Mag. Ins., VI, 1807, p. 333.

Leptopalpus Guér., Icon. Ins., p. 136.

Subgenus 3. GNATHIUM Kirby, Trans. Linn. Soc. Lond., XII, p. 425.

I propose to follow Casey (*Ann. N. Y. Acad. Sci.*, VI, 1891, p. 170) in treating *Nemognatha* and *Gnathium* under *Zonitis*. This will necessitate changes in synonymy (principally of the American species) which need not be entered into at this time. The elongated outer lobe of the maxillæ is the only real character separating the two first mentioned groups from *Zonitis* proper, and this character fails in several American species and also in the new species of *Nemognatha* described in the present paper. The differences between *Nemognatha* and *Gnathium* are even slighter, the antennal and thoracic characters often leaving one in doubt as to which group an insect should go. Nevertheless the divisions are useful to a certain extent and I do not follow Casey in sinking the names entirely, but suggest that they both be considered as subspecies of *Zonitis*.

The following artificial table shows how the main characters run through the three groups of the genus:

A.—Palpi not elongated.
Antennæ not thickened at tips, . . . ZONITIS (*sens. str.*).

AA.—Palpi elongated, the maxillary palpi often forming a sucking proboscis.
a.—Antennæ not thickened at tips, . . . NEMOGNATHA.
aa.—Antennæ thickened at tips, ... GNATHIUM.

Subgenus ZONITIS Fabr. (*sens. str.*).

93. **Zonitis (Z.) antennalis** Wellm. spec. nov.

Gracilis, lutea; antennæ, pectus et pedes (tibiis exceptis) nigra; capite prothoraceque valde elongatis, angustis, subtiliter punctulatis, hoc tri-impresso (impressionibus haud profundis); antennis fortiter serratis; palpis nigris, apice oblique truncatis. Elytra dense subtiliter punctata, submedio nigro-fasciata. Pectus, pedes et abdomen pallido-sericea.

Long. corp. 12 mm.

Lat. elytr. 4½ mm.

Hab. Chiyaka, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

A striking species both from its form and coloration. Luteous except the mouth parts, antennæ, breast and legs which are black, the tibiæ having the upper portion also luteous. *Head* and *thorax* long and narrow, finely punctulate, the latter with three shallow impressions. Labrum luteous provided with a fringe of strong yellow hairs. The *antennæ* are strongly serrate. *Eyes* strongly reniform. Palpi black with apices obliquely truncate. *Elytra* closely and finely punctured and ornamented with a broad black band somewhat in front of their middles. Breast, legs and abdomen with pale silky hairs.

One specimen, November, 1907.

94. **Zonitis (Z.) prionocera** Wellm. spec. nov.

Caput, prothorax, scutellum et abdomen lutea; antennæ, elytra, pectus et pedes nigra; capite prothoraceque elongatis, angustis, sparsim punctulatis; antennis nigris, serratis; articulis 1, 2 *nitidis; elytris dense subtiliter punctatis, albo-subpubescentibus. Pedes nigri; tibiis parte superiore luteis. Pedes et abdomen pallido-sericea.*

Long. corp. 10 mm.

Lat. elytr. 5 mm.

Hab. Chiyaka, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

Graceful species; head, thorax, scutellum and abdomen luteous; antennæ, elytra, breast and legs (except the upper portion of the tibiæ) black. *Head* and *thorax* long, narrow, rather finely punctured. *Eyes* strongly reniform, *antennæ* serrate, first 2 joints very shining, sparsely punctulate, rest dull and clothed with microscopic hairs; 3d joint shorter than 4th; *scutellum* very finely punctulate and with microscopic hairs. *Elytra* shining, irregularly and rather finely punctured. *Legs* black, closely punctulate, upper $\frac{2}{3}$ of tibiæ luteous. Breast and abdomen punctulate, sparsely covered with microscopic hairs.

One specimen taken in November, 1907.

Subgenus NEMOGNATHA Illig.

95. **Zonitis (N.) angolensis** Har., Col. Heft, XVI, 1879, p. 142.

"Wahrscheinlich von Loanda oder von Pungo Andongo (HOHMEYER)." (Harold.)

Type in Berlin, Königliches Museum.

96. **Zonitis (N.) annulicornis** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, p. 65.

Angola (WELWITSCH).

97. **Zonitis (N.) ciconia** Mars., *ibid.*, p. 66.

Mossamedes (ANCHIETA).

98. **Zonitis (N.) posoka** Wellm. spec. nov.

Parva; caput, pectus, scutellum et pedes nigra; thorax et abdomen lutea; elytra viridi-cærulea; capite subtiliter punctulato; antennis fili-

formibus; palpis plus minusve elongatis (sed palpis maxillaribus proboscidem non formantibus) totis nigris, albo-pubescentibus; labro albovilloso; thorace luteo, lato, sparsim punctulato; elytris dense punctulatis; nigro-subpubescentibus. Pectus et pubes nigra, albo-sericea; pedes postici valde elongati.

Long. corp. 9 mm.

Lat. elytr. 4 mm.

Hab. Chiyaka, Angola (Africa); *ab auctore collecta.*

Typ. in coll. mea.

Small, elegant species; *head* and *thorax* broad, rather coarsely and sparsely punctured, with pale microscopic hairs. *Antennæ* filiform, first three joints of about equal length. *Scutellum* very finely punctulate. *Elytra* more finely and closely punctured than head and thorax. Breast and abdomen very feebly punctulate, covered with short fine, pale hairs; femora with similar hairs; tibiæ and tarsi with coarse short black hairs, thickly set.

One specimen taken in November, 1907. The specific name is a local Bantu word meaning beautiful.

99. **Zonitis (N.) scapularis** Mars., Jorn. Sci. Math. Phys. Nat. Lisb., VII, No. XXV, 1879, p. 67.

Angola (WELWITSCH).

Genus **DERIDEA** Westw., Trans. Ent. Soc. Lond., 1875, p. 226.

? *Iselma* Haag.-Rut., Deutsch. Ent. Zeit., XXIII, 2, 1879, p. 401.

Westwood in founding this genus referred it with an interrogation to the Helopidæ, remarking in his diagnosis "*unguibus-simplicibus.*" Fairmaire also (*Ann. Soc. Ent. Fr.*, 1891, p. 265) says of "*Doridea* (*sic*) Westw." that while it "rappelle au premier bord, certaines especes du genre *Nemognatha*," still "il en differe par les crochets des tarses simples." Thomas (*Ann. Mag. Nat. Hist.*, 1897, p. 389) has pointed out that the claws are divided. The only properly generic character given by Haag-Rutenberg for his genus *Iselma* is that the claws are non-pectinated, and this character is shared by *Deridea.* The diagnoses of both genera come very near to *Zonitis*, with the exception of this important character, and I am inclined at present to sink *Iselma* as a synonym of *Deridea*, which (I am convinced by an examination of the type at Oxford and a series of specimens in the British Museum) should be regarded as a good genus belonging by virtue of most of its characters to the Zonitis group, but aberrant by reason of its nonpectinated claws.

100. **Deridea curculionides** Westw., Trans. Ent. Soc. Lond., 1875, p. 226

Angola (Rogers).

Type in Oxford, Hope Department.

SUBFAM. HORIINÆ.

Genus **HORIA** Fabr., Mant. Ins., I, 1787, p. 164.

Cissites Latr., Gen. Crust. et Ins., II, 1807, p. 211.

Gahan has recently worked out the vexed synonymy of this genus in a valuable paper which I have read, by the kindness of the author, in manuscript.[3] I here adopt his synonymy (which is the same as that of Aurivillius *ubi infra*) of the species reported from Angola.

101. **Horia africana** Auriv., Ent. Tidskr., XI, 1890, p. 203.

? *Horia senegalensis* ♀ (nec ♂) Cast., Hist. Nat. Ins., II, 1840, p. 280.
? *Horia (Cissites) testacea* Fab., De Borre, Ann. Soc. Ent. Belg. C.R., 1883, p. 136.

Angola (Welwitsch).

Described from the Congo and referred to the genus *Cissites*.

---

[3] Since this was written Mr. Gahan's paper has been published (*Ann. Mag. Nat. Hist.*, Ser. 8, Vol. II, 1908, p. 199f.) under the title, "Notes on the Coleopterous genera *Horia* Fab., and *Cissites* Latr., and a List of the Described Species."

The following reports were ordered to be printed:

REPORT OF THE RECORDING SECRETARY.

Since the last report of the Recording Secretary the meetings of the Academy have been held, as provided by the By-Laws, on the first and third Tuesdays of each month from December 3, 1907, to May 19, 1908, and from October 6 to November 17, 1908, with an average attendance of forty-eight. Verbal communications, most of them illustrated with lantern views, were made at these meetings by the late William S. Vaux, Jr., George Vaux, Jr., Stewardson Brown, Casey A. Wood, Witmer Stone, John W. Harshberger, Philip P. Calvert, Henry Skinner, Edwin G. Conklin, Henry W. Cattell, Harold Sellers Coulton, Spencer Trotter, Miss Walter, Charles S. Boyer, Thomas S. Stewart, Frank J. Keeley and Henry A. Pilsbry.

Thirty-one papers have been presented for publication by the following authors: Henry A. Fowler, 4; Henry A. Pilsbry, 3; Henry A. Pilsbry and Y. Hirase, 2; Witmer Stone, 2; Ralph V. Chamberlin, 2; Harold Sellers Coulton, 2; E. P. Van Duzee, 1; Frank M. Surface, 1; William S. Vaux, Jr., 1; Frederick W. True, 1; Chiyomatsu Ishikawas, 1; Arthur Erwin Brown, 1; Clarence B. Moore, 1; John Otterbein Snyder, 1; J. Percy Moore, 1; James A. G. Rehn and Morgan Hebard, 1; Robert T. Young, 1; John W. Harshberger, 1; Philip P. Calvert, 1; Thomas H. Montgomery, 1; F. Creighton Wellman and Walther Horn, 1; James A. G. Rehn, 1. Of these twenty-eight have been accepted for publication in the PROCEEDINGS and are now mostly in type; one was withdrawn by the author; one remains to be acted on, and one, by Clarence B. Moore, forms the fourth and concluding number of the thirteenth volume of the JOURNAL. It is illustrated with fine text figures and eight plates beautifully printed in colors. As usual we are indebted to the author for the entire cost of publication.

The issues of the various publications of the Academy during the year have amounted to 1939 pages and 133 plates, as follows: PROCEEDINGS for 1907, 159 pages and 9 plates; for 1908, 444 pages and 25 plates; JOURNAL, Vol. XIII, Pl. 4, 132 pages and 8 plates; ENTOMOLOGICAL NEWS, 500 pages and 25 plates; TRANSACTIONS OF THE AMERICAN ENTOMOLOGICAL SOCIETY (Entomological Section of the Academy), 375 pages and 25 plates; THE MANUAL OF CONCHOLOGY

329 pages and 41 plates. This is 217 pages and 29 plates more than the issue of the preceding year. The statistics of distribution remain the same as for the last two or three years.

Four members have been elected, the deaths of eleven members and six correspondents have been announced, and Caroline A. Burgin, Hannah Streeter and Morris Earle have resigned their memberships.

The Hayden Medal for 1905 was presented to Dr. Walcott at the meeting held January 7, advantage being taken of the occasion to invite the members of the Academy and their friends to meet the distinguished recipient of the award. The address of presentation was made by Dr. Persifor Frazer and responded to by Dr. Walcott. The delay in presentation was due to the preparation of a new and greatly improved design for the medal. Under the terms of the amended deed of trust providing for the making of the awards once in three years, the Hayden Memorial Committee unanimously recommended the grant for 1908 be made to Prof. John Mason Clarke, in recognition of the value of his brilliant work as State Geologist of New York.

The Council has authorized the Publication Committee to prepare an index to the entire series of the publications of the Academy, to include the issues to the end of 1910, and to be published in connection with the celebration of the centenary of the Academy in 1912. Such an index has been long desired by students of natural history, who have felt the need of a key to the wealth of the contributions to knowledge, many of them of the first importance, issued under the auspices of the Academy by many of the leading naturalists of America. Of the 83 volumes which will have been published by the Academy at the close of 1910, the manuscript index to the first eight volumes of the octavo JOURNAL and the first 19 volumes of the PROCEEDINGS has been completed. It is divided into two sections: Authors and subject, and genera and species.

Dr. Henry Skinner was appointed a delegate to the International Congress on Tuberculosis, held at Washington last September.

Resolutions were adopted and duly forwarded endorsing the action of the President of the United States in calling a conference to consider plans for the conservation of the forestry, agricultural, mineral and other natural resources of the United States, and in support of bills for the purchase and preservation of the forest areas of the Southern Appalachians and of the White Mountains as National Forest Reservations.

EDWARD J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

With regret the Corresponding Secretary records the death during the past year of the following named correspondents of the Academy: Henry Benedict Medlicott, Lord Kelvin, Henry Clifton Sorby, Prof. Spiridion Brusina, Prof. Gustav Mayr and Prof. William Kieth Brooks. No corresponding members were elected. During the year a few additional photographs and biographical sketches of correspondents were received and have been added to our files.

Invitations to the Academy to participate in the following notable events were received: The Third International Botanical Congress and the First Congress of Administrative Sciences, both to be held in Brussels in 1910; the Prehistoric Congress of France, the Centenary Jubilee of the Physico-Medical Society of Erlangen, the Inauguration of Dr. Albert R. Hill as President of the University of Missouri, the opening of the new Hall of the Physical Institute of Frankfort a. M., and the University of Cambridge celebration of the centenary of the birth of Charles Darwin and the fiftieth anniversary of the publication of the *Origin of Species*. Suitable letters of acknowledgment or congratulation were in each case forwarded, and as the Academy's representative to the last named Dr. Arthur Erwin Brown has been appointed. In this connection it may interest the members of the Academy to know that Darwin was elected a correspondent on March 27, 1860, within four months of the publication of the *Origin of Species*, and that this Academy was therefore probably the first society to place its official stamp of approval upon this epoch-making work.

An invitation from the Section of Geology and Mineralogy of the New York Academy of Sciences to join in organizing a series of general geological meetings for the eastern United States was referred to the Geological and Mineralogical Section of the Academy. A letter of thanks for the use of the Academy's Hall for its session of 1907 was received from the American Ornithologists' Union. Notices of the death of seven scientific men of distinction were received and acknowledged by letters of sympathy.

Copies of resolutions approving of the movement to establish White Mountain and Southern Appalachian forest reserves and commending the purpose of the conference to consider the conservation of natural resources were forwarded to members of Congress and other persons concerned and brought numerous favorable responses.

Pursuant to instructions of the Council the Corresponding Secretary received from several members subscriptions aggregating fifty dollars, which sum was forwarded as a contribution from the Academy to the fund for erecting in Paris a monument to Lamarck.

The numbers of letters requesting information received and answered continues to increase.

The statistics of the correspondence for the year follow:

Communications Received.

Acknowledging receipt of the Academy's publications,	217
Transmitting publications,	65
Requesting exchanges or the supply of deficiencies,	4
Invitations to learned gatherings,	7
Notices of death of scientific men,	8
Circulars concerning the administration of scientific institutions, etc.,	16
Biographies and photographs of correspondents,	4
Miscellaneous letters,	88
Total received,	409

Communications Forwarded.

Acknowledging gifts to the Library,	1073
Acknowledging gifts to the Museum,	56
Acknowledging photographs and biographies,	3
Requesting the supply of deficiencies in journals,	84
Letters of sympathy or congratulation,	9
Miscellaneous letters,	101
Annual Reports sent to correspondents,	221
Circular letters,	90
Total forwarded,	1637

Respectfully submitted,

J. Percy Moore,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The growth of the Library during the past year has been satisfactory, notwithstanding the inconvenience due to the alteration of the premises required by the plans adopted by the Council. The accessions since the first of last December number 7070, an increase on those received last year. There were 5905 pamphlets and parts of periodicals, 973 volumes, 192 maps, photographs and plates.

They were received from the following sources:

Societies, Museums, etc.	2,505
I. V. Williamson Fund	2,014
General Appropriation	677
Editors	530
United States Department of Agriculture	336
United States Department of the Interior	187
Authors	148
James Aitken Meigs Fund	139
Geological Survey of Canada	47
Geological Survey of Russia	42
Estate of Angelo Heilprin	40
Wilson Fund	30
Geological Survey of Japan	22
United States Department of Commerce and Labor	20
Pennsylvania State Department of Agriculture	18
North Carolina Geological Survey	17
Department of Agriculture of Netherland India	17
Trustees of British Museum	15
Department of the Interior of the Philippines	14
Geological Survey of Sweden	13
Ministry of Public Works, France	12
United States Public Health and Marine Hospital Service	11
International Bureau of American Republics	11
Illinois State Geological Survey	11
Department of Agriculture in India	10
Ministry of Colonization, Bolivia	9
United States War Department	9
Commission de la Belgica	7
University of Texas Mineral Survey	7
United States Treasury Department	7
United States Bureau of Fisheries	6
Edward J. Nolan	5
Geological Survey of India	5
Geological Survey of Georgia	5
Ministry of Works, Mexico	5
Geological Survey of Portugal	5
Wisconsin Geological and Natural History Survey	5
Victoria Department of Mines	5
Department of Mines, etc., New South Wales	5
H. A. Pilsbry	4
Publication Committee, Academy	4
Department of Agriculture, Jamaica	4
Western Australia Geological Survey	4
New Jersey Geological Survey	4
William J. Fox	4
Corps of Mining Engineers of Peru	4
Cape of Good Hope, Department of Agriculture	4
Bureau of American Ethnology	3
Superintendent of Documents, Washington	3
Rev. A. Boutlou	3
Department of the Interior, Canada	3
Geological Commission, Cape of Good Hope	3
Geological Institute of Mexico	3
Geological Survey of Virginia	3
United States Coast and Geodetic Survey	2
Library of Congress	2
Ministry of Agriculture, Buenos Aires	2
Bentham Trustees, Kew Gardens	2
Danish Government	2
Department of Agriculture, Canada	2
New Zealand Geological Survey	2
William B. Davis	2
Botanical Survey of India	2
Agricultural and Veterinary Faculty of La Plata	2
Observatoire Central Nicolas	2
Iowa Geological Survey	2

M. le Duc de Loubat	2
H. Müller, Hanover	2
Commissioners of Fisheries and Game, Massachusetts	2
Dr. Henry Tucker	2
Florida State Geological Survey	2
Central Bureau voor de Kennis Provincie, Groningen	1
Genaro Garcia	1
Marshall H. Saville and George G. Heye	1
L. Kreischer	1
Dr. H. C. Chapman	1
William H. Welker	1
Ministry of Works, Peru	1
Dr. Joseph Leidy	1
Geological Commission of Finland	1
L. Schützberger	1
Maryland Geological Survey	1
State Geological Survey of North Dakota	1
Nova Scotia Department of Mines	1
Kommission zur Wissensch. Untersuch. der Deutschen Meere in Kiel	1
Geodetic Survey of South Africa	1
Government of India	1
Estate of William Ziegler	1
Stewardson Brown	1
Department of Geology, etc., Indiana	1
Department of Fisheries, New South Wales	1
Hawaii Promotion Committee	1
Trustees Indian Museum	1

They were distributed to the several departments of the library as follows:

Journals	5,183
Geology	414
Agriculture	365
Botany	231
Voyages and Travels	150
Geography	145
General Natural History	99
Anatomy and Physiology	74
Ornithology	73
Entomology	68
Conchology	47
Anthropology	42
Ichthyology	28
Mammalogy	23
Mineralogy	22
Helminthology	21
Medicine	21
Physical Science	21
Bibliography	10
Herpetology	6
Encyclopedias	2
Mathematics	1
Chemistry	1
Unclassified	19

Eleven hundred and fifty-three volumes have been bound.

Fourteen volumes and 548 pamphlets dealing with subjects not germane to the objects of the Academy were sent to the Free Library of Philadelphia and, in compliance with the law, 8 duplicate volumes and 74 pamphlets were returned to the Government Printing Office.

At the beginning of the building operations it was necessary to temporarily arrange a part of the library on a section of the entresol floor to make room for the extension of the hall entered from Race Street, as required by the adopted plan of alteration. This change, of course, entailed disadvantages which, it is hoped, will be remedied when the entire library is arranged in the new building on the southern portion of the lot. With the exception of works of reference (encyclopedias, etc.), and possibly those on general natural history, the entire library is to be arranged in tiers of steel stacks. At present five such tiers are provided for, extending from the ground to near the roof of the rear section of the new building, thus securing increased room which is sadly needed and, it is hoped, safety from fire.

Mrs. James Woods, of Camden, Alabama, has thoughtfully presented to the Academy a collection of seventeen letters written by Isaac Lea, Timothy A. Conrad, Samuel G. Morton, Benjamin Silliman, William Hall and John Finch, from 1829 to 1835, to Judge Charles Tait, of Claiborne, Monroe Co., Alabama, who was the first to develop, with his correspondents, the Claiborne beds, of so much interest in American geology as furnishing the most noted deposits of Eocene shells. The letters contain several items of personal interest and indicate especially the zeal and enthusiasm of a former President of the Academy, Isaac Lea.

Acknowledgment is due William J. Fox, for his efficient assistance to the Librarian and the Publication Committee.

EDWARD J. NOLAN,
Librarian.

REPORT OF THE CURATORS.

The erection of the new library, stack, lecture hall and study rooms and the alteration of the old building were begun early in the spring. At the present time the alterations are practically completed, while the new building is nearly ready for the roof.

A handsome entrance hall has been constructed at the Logan Square front, which has been carried through the old lecture room, making a direct communication with the first floor of the Museum. The stairways which formerly connected the floors of the Museum have been removed to the vestibule, and all the rooms have been shut off both from the vestibule and from each other by regulation fire-doors, which greatly increase the safety of the collections.

A fire-proof room has been constructed in the lower part of the old lecture hall, which will be fitted up for the accommodation of the alcoholic collections, where they will be shut off from all other parts of the Museum.

Heat and gas pipes and electric light wires have been installed in the vestibules and entrance hall and a new boiler placed in the engine house.

During the early part of the year much time was spent in moving cases and rearranging exhibits preparatory to the alterations, and since July 5 the Museum has been closed to the public, the cases being covered up and many specimens removed for safety.

During the past month the cases on the first and second floors have been rearranged preparatory to reopening the Museum, and the work of reconstructing some of the bird cases is well under way.

Many shifts of position among the exhibition cases have been made necessary by the changes in doors and stairways and the walling off of the vestibule.

The final cleansing of the halls will be undertaken as soon as the painting of the walls and fire-proofing of the columns are completed.

Early in the year the work of labelling the mounted birds was completed with the exception of the song birds, and the exhibition collection of Mollusca was entirely rearranged. Many of the articulated skeletons have also been cleansed and remounted.

Owing to the condition of the Museum, however, most of the work of the staff has been devoted to the study collections.

The old rooms of the Ornithological department having been largely torn away, the entire series of bird and mammal skins has been removed to the top floor of the Museum, where far more desirable quarters have been provided.

Thirty-eight moth-proof metal cases and ten large white pine cabinets have been provided for plants, insects and birds, as well as 200 standard insect boxes.

Mr. Clarence B. Moore has presented another plate glass and mahogany case for the valuable additions to his collection of Indian antiquities obtained in the Southern States and Arkansas. Dr. Pilsbry and Mr. Rehn each visited North Carolina for a few weeks during the year and made collections respectively of Mollusks and Orthoptera.

Through the liberality of Mrs. Charles Schäffer, Mr. Stewardson Brown was enabled to spend the entire summer in little known parts of British Columbia, where he secured a valuable collection of plants largely new to the herbarium. He also visited Bermuda in February, with the aid of the Esther Hermann Research Fund of the New York Academy of Sciences, where another important collection was made.

Dr. J. P. Moore spent the summer at Woods Hole, where some marine material was collected and numerous local collecting trips were made by other members of the Museum staff.

Among the important accessions of the year may be mentioned the

Henry Skinner collection of Lepidoptera, the Vanderpol collection of East Indian birds, the Quadras collection of Philippine Mollusks, all obtained by purchase. Also the Herbst collection of Fungi, presented by Mr. Herbst's estate, and a valuable collection of Central American Coleoptera, presented by Mr. F. D. Godman. A number of interesting mammals were received from the Zoological Society of Philadelphia, including the fine Indian elephant "Bolivar," nearly ten feet in height, which is now being mounted in the taxidermical department.

Details of work in several departments will be found in the special reports, in addition to which Mr. H. W. Fowler has continued his care of the fishes, and Dr. J. P. Moore of the Annelids, while Miss H. N. Wardle has been engaged upon the arrangement and cataloguing of the ethnological collections.

The Curators are also indebted to Mr. S. S. Van Pelt for valuable assistance in the herbarium, and to Dr. P. P. Calvert and Mr. E. T. Cresson, Jr., in the Entomological department.

Many specialists have made use of the collections during the year and specimens have been loaned to Dr. C. Hart Merriam, Dr. Charles H. Eigenmann, Samuel N. Rhoads, W. D. W. Miller and Robert Ridgway.

An idea of the extent of the Academy's collections at the present time may be gained from the following summary, although some of the figures are necessarily approximate.

Of Mammals there are 12,416 specimens, of which 2,500 are osteological or alcoholic preparations, 500 are mounted and the rest skins with skulls prepared separately. The more important individual collections are the S. N. Rhoads collection of North American Mammals and the H. H. Smith collection from southern Brazil.

The Birds number 59,579 specimens, of which about 9,000 are mounted and 1,075 are osteological preparations. There are also about 2,500 nests and sets of eggs. The notable collections comprise that of Massena, Duke of Rivoli; the John Gould Australian collection; the Boys collection of Indian birds; Canon Tristram's collection; the Josiah Hoopes collection of North American birds; the Harrison and Hiller collection from Sumatra; the George L. Harrison collection from British East Africa (on deposit) and the Delaware Valley Ornithological Club local collection. There are about 600 types, mainly of Cassin, Gould, Townsend, Gambel and Audubon.

The Reptiles and Batrachians amount to 18,000 specimens, the great majority being alcoholic; they comprise among others the E. D. Cope collection and the Arthur Erwin Brown collection and include many types, mainly of Cope and Hallowell.

The collection of Fishes consists of about 40,000 specimens, and contains the historic Bonaparte collection, the Cope collection and also those of Hauxwell, Orton, H. H. Smith, Harrison and Hiller, Rijgersma and others. There are many types of Cope, Abbott and Fowler, as well as cotypes of Girard's Mexican boundary fishes.

The Insects number about 369,000 pinned specimens divided as follows:

	North American		*Exotic*		
	Species.	*Specimens.*	*Species.*	*Specimens.*	*Types.*
Hymenoptera	10,000	50,000	1,000	4,000	3,000
Lepidoptera	3,645	17,000	3,000	14,000	500
Neuroptera	300	2,400	1,200	400	100
Orthoptera	684	17,000	1,038	10,000	150
Diptera	1,300	10,000	100	150	121
Hemiptera	700	3,500	200	600	50
Coleoptera	10,000	140,000	5,000	10,000	2,000

The most notable special collections are the Horn and Wilt collections of Coleoptera; the Martindale and Skinner collections of Lepidoptera; the Calvert collection of Neuroptera (on deposit); the Osten-Saken cotypes of Diptera; the Cresson and Bassett collections of Hymenoptera and the Henry C. McCook collection of Insect Architecture.

The collection of Mollusks numbers over 100,000 trays and more than 1,500,000 specimens. Of this number 40,000 trays have been catalogued and numbered as new accessions since 1893. The older collection consists of the original collection of the Academy, begun about 1817 by Thomas Say; the Robert Swift collection of West Indian shells, about 10,000 specimens; the A. D. Brown collection of land shells, bequeathed to the Academy in 1887, 5,400 trays. About 10,000 trays of these collections have been catalogued and numbered.

The alcoholic collection of Mollusks consists of about 6,000 lots, probably over 75,000 individual specimens. The number of types of Say, Conrad, Tryon and others is not known, but since the year 1901, 925 types have been described from the new material received.

Other invertebrates number about 11,500 specimens, of which 4,000 are Crustacea and 2,800 worms. The most important collections are the Guerin collection of Crustacea, the H. C. Chapman collection of Marine Invertebrates from Naples and the Edward Potts collection of fresh-water sponges.

The Herbarium contains about 584,000 specimens of flowering plants and ferns, comprising among others the collections of Muhlenberg (on deposit), Pursh, de Schweinitz, Nuttall, Short, and Charles E. Smith. The Fungi, Mosses, Lichens and Algæ number about 50,000 specimens and include the collections of Sullivant, de Schweinitz, Eckfeldt, Ashmead, Martin, Ellis and Everhart, Herbst and Rex. Both departments of the Herbarium are rich in types.

There is also a local Herbarium presented by the Philadelphia Botanical Club, which contains about 20,000 specimens.

The Palæontological collections comprise some 5,000 specimens of Vertebrates and 45,000 Invertebrates, of which 3,000 belong to the collection of the Pennsylvania Geological Survey (on deposit) and 7,500 to the Isaac Lea collection; also 1,500 fossil plants. There are many types of Leidy and Cope among the vertebrates and of Lea, Conrad, Gabb and Heilprin among the invertebrates.

The general collection of minerals consists of 8,500 specimens, while the William S. Vaux collection contains about 7,500 additional. Of rock specimens there are over 10,000 in the Pennsylvania Geological Survey collection and about 3,000 additional.

The general Archæological and Ethnological department contains about 14,000 specimens, including the Samuel G. Morton collection of human crania; the Peale Hawaiian collection, the Haldeman American Indian collection and the Poinsett Mexican collection (on deposit).

The Clarence B. Moore collection of Indian antiquities from mounds of the Southern States includes some 5,000 specimens, the basis of Mr. Moore's papers in the JOURNAL of the Academy. The William S. Vaux collection contains 2,500 specimens, largely from North America and Europe.

SUMMARY.

Mammals,	12,416
Birds,	59,579
Reptiles,	18,000
Fishes,	40,000
Insects,	369,000
Mollusks,	1,575,000
Other Invertebrates,	11,500
Herbarium,	654,000
Fossils,	46,500
Minerals,	29,000
Archæology and Ethnology,	21,500
Total,	2,836,495

SAMUEL G. DIXON,
HENRY A. PILSBRY.

Report of the Department of Mollusca.

The rearrangement of the general collection in exhibition cases has been almost completed, table-cases of gastropods having been worked over during the year. Considerable time has been given by Mr. Vanatta to the determination and description of Hawaiian mollusks sent by Mr. D. Thaanum, of Hilo, Hawaii, and to the work of picking out and assorting upwards of 500 trays of shells from material gathered by the Curator last year in the Florida Keys. Large quantities of leaves and forest débris, gathered by Mr. C. B. Moore, have also been picked over, and much valuable material, especially of very small mollusks, obtained.

Mr. Y. Hirase has continued to send Japanese and Formosan material; his latest sendings contain Korean mollusks, which hitherto have been almost unknown. About 100 new species have been described from this source during the year.

Other valuable accessions are a series of marine shells from the Great Barrier Reef, Australia, including cotypes of 19 new species, from Charles Hedley. A collection from northeastern Mexico, from A. A. Hinkley. A series of Irish slugs from Dr. R. F. Scharff, and many smaller accessions from numerous donors. A large part of this material has been worked up, and papers published thereon. The time of the special Curator has been largely occupied in the preparation of the Manual of Conchology, in which the families *Oleacinidæ* and *Ferussacidæ* have been described.

H. A. Pilsbry,
Special Curator, Dept. of Mollusca.

REPORTS OF THE SECTIONS.

The Biological and Microscopical Section.

The membership of the Section has changed but little during the year. Nine regular and several informal meetings have been held. On March 30, the fiftieth anniversary of the founding of the Biological and Microscopical Section was observed by a banquet held in the Section Room, at which were present regular and former members and the officers of the Academy. The Director, Dr. J. Cheston Morris, presided, and addresses were made by Dr. Samuel G. Dixon, Dr. George A. Piersol, Dr. Arthur E. Brown, Mr. Witmer Stone, Dr. Henry Skinner, Dr. James Tyson, Dr. Henry A. Pilsbry, Mr. F. J. Keeley and Mr. C. S. Boyer.

The communications made during the year may be briefly summarized as follows: Uses of the microscope in testing chemical preparations, by Dr. D. E. Owen; Leucocythemia, the Tsetze Fly and various contagious diseases, by Dr. T. S. Stewart; opaque illumination and numerous other subjects, by Mr. F. J. Keeley; miscellaneous objects exhibited and described by Mr. William B. Davis; new and rare forms of diatomaceæ, by Mr. C. S. Boyer; rare forms of diatoms from Barbadoes, by Mr. J. A. Shulze; the organisms contained in various infusions, by Mr. John G. Rothermel; other communications, by Mr. T. C. Palmer, Mr. W. H. Van Sickel and Mr. Hugo Bilgram.

The officers elected for the year 1909 are as follows:

Director,	J. Cheston Morris, M.D.
Vice-Director,	T. Chalkley Palmer.
Conservator,	F. J. Keeley.
Recorder,	C. S. Boyer.
Corresponding Secretary,	S. L. Schumo.
Treasurer,	Thomas S. Stewart, M.D.

Charles S. Boyer,
Recorder.

Entomological Section.

During the present year ten meetings of the Entomological Section have been held with an average attendance of ten persons. As usual the large number of additions to the cabinet has necessitated the greatest amount of work in the department. The large collection of American butterflies made by Dr. Henry Skinner, numbering over 10,000 specimens, was purchased by the Academy. Dr. F. D. Godman has presented 3,529 Coleoptera, representing 1,140 species, from the *Biologia Centrali-Americana* collection, a most valuable addition. One hundred and eighty-four insects from Burma were purchased from W. Crumb. Dr. Henry Skinner presented 56 Lepidoptera from various parts of the United States. Seven hundred Orthoptera were collected by the Academy expedition to Virginia and North Carolina, conducted by Mr. J. A. G. Rehn. About five hundred Orthoptera were presented by Witmer Stone, Morgan Hebard and J. A. G. Rehn, from Pennsylvania and New Jersey. One hundred and fifty-four Brazilian Orthoptera were purchased from C. F. Baker. Two hundred Diptera from British Guiana were received from Charles T. Greene. In all over 16,000 specimens of insects were added to the collection. Two hundred Schmitt boxes and four Brock tin cases were purchased.

The large collection of North American Hymenoptera has been rearranged and some work done preparatory to the rearrangement of the Micro-lepidoptera. All the determined Diptera, except a few of the family Muscidæ, have been arranged in Schmitt boxes and many genera and species new to the collection were determined. All of Osten-Sacken's types of Tipulidæ and Tabanadæ were marked and numbered. In the order Orthoptera, reports were completed on the specimens collected in Arizona in 1907 by Rehn and Hebard. Considerable rearrangement has been done in the study series. Dr. P. P. Calvert has continued his important work on the collection of Odonata and has finished his contribution to the pages of the *Biologia Centrali-Americana.* A large number of Coleoptera has been incorporated into the collection, including some interesting material from Fort Wingate, New Mexico. The JOURNAL of the Section, *Entomological News,* has been continued and volume nineteen completed with 500 pages and 25 plates. Two Associates were elected and one member died.

The following were elected to serve as officers for the year 1909:

Director,	Philip Laurent.
Vice-Director,	H. W. Wenzel.
Treasurer,	E. T. Cresson.
Recorder,	Henry Skinner.
Secretary,	E. T. Cresson, Jr.
Conservator,	Henry Skinner.
Publication Committee,	E. T. Cresson,
	E. T. Cresson, Jr.

Respectfully submitted,

HENRY SKINNER, M.D.

BOTANICAL SECTION.

During the year further progress has been made in placing the specimens in species covers, and it is hoped to complete this important work at an early date.

The additions to the Herbarium consist of the Herbst collection of Fungi, numbering more than 5,000 specimens, being the life-work of Dr. William Herbst, of Trexlertown, Pa., and presented to the Academy by Mrs. Herbst; a collection of Pennsylvania Flowering Plants and Ferns numbering about 2,000 specimens, presented by Dr. H. D. Heller, of Hellertown, Pa.; presentations from various members numbering about 200 specimens; a small collection of Rubus, Amelanchier and Betula, purchased by the Section from Mr. W. H. Blanchard, and a collection of 930 specimens of Balkan Plants, purchased by the Academy.

The Conservator spent about a month in the Bermudas during February and March of the present year, by the aid of a grant from the Esther Hermann Research Fund of the New York Academy of Sciences, when collections of over 800 herbarium specimens were made. During the summer, through the liberality of Mrs. Charles Schäffer and Miss Mary W. Adams, he was enabled to make further studies of the flora of the Canadian Rocky Mountains, ten weeks being spent in the region about the headwaters of the Saskatchewan and Athabasca Rivers, when collections of more than 3,000 herbarium specimens were made, including a number of probably new species. Owing to the pressure of other duties it has not been possible to yet give this collection critical study.

The activity manifested in previous years by the members of the Philadelphia Botanical Club has been maintained during the past season, more than 2,000 specimens being added to the local herbarium, including a number of species not previously recorded as occurring in the region. Mr. Samuel S. Van Pelt has continued his valuable services during the year as Curator of this important and rapidly growing section of the herbarium.

At the annual meeting of the Section, the following officers were elected for the year:

Director,	Benjamin H. Smith.
Vice-Director,	Joseph Crawford.
Recorder,	Charles S. Williamson.
Treasurer and Conservator,	Stewardson Brown.

Respectfully submitted,
STEWARDSON BROWN,
Conservator.

MINERALOGICAL AND GEOLOGICAL SECTION.

The Section has this year held eight meetings (besides the December meeting yet to come), with an average attendance of about ten. Communications were made by Prof. Amos P. Brown, on ripple marks, tracks and trails; by Mr. Edgar T. Wherry, on two new antholite dikes in Philadelphia County, and on the geology of the neighborhood of Jacksonwald, Berks County; by Dr. W. J. Sinclair, on the geology of a portion of the Grand Canyon of the Colorado River; by Prof. B. L. Miller, on the geology of the Allentown quadrangle, compared with the Philadelphia region; by Mr. Gilbert Van Ingen, on the geology of the area drained by the upper Susquehanna River; by Mr. J. F. Vanartsdalen, on silicified wood in the Norristown shales of Bucks County; by Prof. O. C. S. Carter, on tubular concretions, sheets and plates of Pensauken gravel, cemented with iron hydroxide; by Col. Joseph Willcox, on the geology and mineralogy of St. Lawrence County, New York; and there were a number of shorter communications and various discussions.

There were ten field excursions, with an average attendance of 25. The excursions visited: (1) The copper deposits of Upper Salford and Frederick Townships in Montgomery County; (2) The crystalline schists and limestones between Alton and Glen Hall, in Chester County; (3) the New Red traps and shales between Quakertown and Perkasie, in Bucks County; (4) the region of Bethlehem, in Northampton and Lehigh Counties; (5) the New Red traps and shales in northern Bucks County; (6) the silicified wood of the New Red and the minerals of the crystalline rocks between Woodbourne and Neshaminy Falls, in Bucks County; (7) the Cretaceous and Pleistocene formations near Pensauken Creek, in Camden and Burlington Counties, New Jersey; (8) the trap at Aldham, Chester County, and the Cambrian Sandstone thence to Valley Forge; (9) the crystalline rocks and their minerals near Lansdowne and up Darby Creek, Delaware County; (10) the cross-section of the Chester Valley, from Devault to Malvern, Chester County.

Three associate members have been added to the Section.

The following officers of the Section have been elected for the coming year:

Director, ...	Benjamin Smith Lyman.
Vice-Director, ...	George Vaux, Jr.
Recorder and Secretary, ...	Silas L. Schumo.
Treasurer, ...	Miss Emma Walter.
Conservator, ...	Frank J. Keeley.

Respectfully submitted,

BENJAMIN SMITH LYMAN,

Director.

ORNITHOLOGICAL SECTION.

Since the last annual report the Ornithological Department of the Academy has been removed from its old quarters to the top floor of the Museum building—a far more desirable location, well lighted and with ample space for the growth of the collections.

New racks have been erected to hold the cases and the latter have been arranged in systematic order. Many cases of large birds formerly stored elsewhere have been placed in their proper position, so that the entire study series of birds is now for the first time brought together where it is readily accessible.

Mr. Rehn finished the cataloguing and relabelling of the Tristram collection during the year, and this material, numbering 6,180 skins, together with several smaller collections, has been distributed in the general series.

Ten large wooden cabinets were secured for the accommodation of the Anatidæ and other large birds formerly arranged in temporary cases.

The labelling of the mounted birds was resumed early in the year, and all the specimens, with the exception of the song birds, are now labelled with technical and vernacular names and locality. Owing to the alterations to the building some of the exhibition cases had to be taken down or altered, so that the collection has been temporarily disarranged, but the erection of new cases will soon permit of their proper display. Many specimens of interest were secured during the year, the most important being the Van der Pol collection of East Indian birds, comprising 1,070 specimens, representing many species not heretofore in the Academy's collection.

The Delaware Valley Ornithological Club and the Pennsylvania Audubon Society have continued to hold their meetings in the building and have done much to maintain activity in this department. In December, 1907, the American Ornithologists' Union held its twenty-fifth annual meeting at the Academy, which in point of attendance and interest was the most successful ever held.

The officers of the Section for the ensuing year are:

Director, ...	Spencer Trotter, M.D.
Vice-Director, ...	George Spencer Morris.
Secretary, ...	William A. Shryock.
Recorder, ...	Stewardson Brown.
Treasurer and Conservator, ...	Witmer Stone.

WITMER STONE,
Conservator.

The annual election of Officers, Councillors and Members of the Committee on Accounts to serve during 1909 was held, with the following result:

President, ...	Samuel G. Dixon, M.D.
Vice-Presidents, . . .	Arthur Erwin Brown, Sc.D.,
	Edwin G. Conklin, Ph.D.
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, ...	Arthur Erwin Brown, Sc.D.,
	Samuel G. Dixon, M.D.,
	Henry A. Pilsbry, Sc.D.,
	Witmer Stone.
Councillors to serve three years,	Charles B. Penrose, M.D.,
	Charles Morris,
	Henry Tucker, M.D.,
	Spencer Trotter, M.D.
Committee on Accounts, .	Charles Morris,
	Samuel N. Rhoads,
	Dr. C. Newlin Peirce,
	John G. Rothermel,
	Howard Crawley, Ph.D.

COUNCIL FOR 1909.

Ex-officio.—Samuel G. Dixon, M.D., Edwin G. Conklin, Ph.D., Arthur E. Brown, Sc.D., Edward J. Nolan, M.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry A. Pilsbry, Sc.D., Witmer Stone.

To serve Three Years.—Charles B. Penrose, M.D., Charles Morris, Henry Tucker, M.D., Spencer Trotter, M.D.

To serve Two Years.—Thomas H. Fenton, M.D., John Cadwalader, Edwin S. Dixon, Henry Skinner, M.D.

To serve One Year.—Dr. C. Newlin Peirce, Philip P. Calvert, Ph.D., Thomas Biddle, M.D., and Frederick Prime.

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 G. Vanatta,
	Henry W. Fowler,
	J. A. G. Rehn.
ASSISTANT, ...	H. Newell Wardle.
TAXIDERMIST, ...	David N. McCadden.
Jessup Fund Students, . .	H. Newell Wardle,
	Ezra T. Cresson, Jr.
Janitors,.	Charles Clappier
	Daniel Heckler
	James Tague,
	Jacob Aebley.

ELECTIONS DURING 1908.

MEMBERS.

January 21.—William J. Sinclair.
February 18.—Burton Chance, M.D.
April 21.—Henry H. Donaldson, M.D.
November 17.—Sydney L. Wright, Jr.

ADDITIONS TO THE MUSEUM.

Mammals.

George Bassett. Red Bat (*Lasiurus borealis*).

Otto Behr. Skeleton of Red Fox (*Vulpes fulvus*), Sullivan County, Pa.

James Chatwin. Mounted Gray Fox ((*Urocyon cinereo-argenteus*).

Benjamin Chew. Six heads of African Antelope.

Mrs. U. P. Crumb. Skull of Man-eating Tiger (*Felis tigris*), Tongoo, Burma.

H. H. Firth. Mounted Porcupine (*Erethizon dorsatum*).

E. M. Fryer. Whale vertebra, South Carolina.

Dr. Joseph Grinnell. Forty-two skins and skulls of California mammals.

J. W. Holman. Red Squirrel (*Sciurus hudsonicus loquax*), Ocean County, N. J. (alcoholic).

David McCadden. Skulls of Sumatran Pig (*Sus vittatus*), Mexican Puma (*Felis oregonensis aztecus*), Mexican Lynx (*Lynx baileyi*), Wolf (*Canis mexicanus*) (2), Canada Lynx (*Lynx canadensis*) and (2) Black Bear (*Ursus americanus*).

Stephen Milstead. Jumping Mouse (*Zapus hudsonius americanus*), Atlantic County, N. J.

Mrs. T. R. Owen. Mummified cat.

Purchased. Skeleton of Black Fish (*Globiocephalus* sp.), Cape May County, N. J.; skin and skull of Orang-utan (*Simia satyrus*); skin and skull of Gray Fox (*Urocyon cinereo-argenteus*), Bucks County, Pa.

J. A. G. Rehn. Jumping Mouse (*Zapus hudsonius americanus*), Rhoads' Red-backed Mouse (*Evotomys gapperi rhoadsi*), and Deer Mouse (*Peromyscus leucopus*), Ocean County, N. J.

S. N. Rhoads. Two mice, Adirondacks, N. Y.

Dr. R. W. Shufeldt. Axis and atlas of Bear.

Zoological Society of Philadelphia. Mounted: Springbok (*Antidorcas euchore*).

Skins and skulls: Two Slender Loris (*Loris gracilis*); Clouded Leopard (*Felis nebulosa*); Serval (*Felis serval*); Eyra Cat (*Felis eyra*); Pine Marten (*Mustela martes*); Bandicoot (*Peragale* sp.) [some to be mounted].

Skins and skeletons: Long-armed Baboon (*Papio langheldi*); Indian Elephant "Bolivar" (*Elephas maximus*) [now being mounted]; East African Eland (*Taurotragus oryx livingstonci*) [to be mounted].

Skins: Six skunks, female and young (*Mephitis mesomelas*), from Oklahoma; Himalayan Tahr (*Hemitragus jemlaicus*); Robust Kangaroo (*Macropus robustus*).

Skull: Brazilian Tapir (*Tapirus terrestris*).

Birds.

Charles Beck. Purple Gallinule (*Ionornis martinica*) from New Jersey (mounted).

EXCHANGE (with H. K. Coale). Two California Black Rail (*Creciscus coturniculus*).

PURCHASED. Van der Pol Collection of East Indian Birds (1,150 specimens).

JOSEPH SAPP. European Starling (*Sturnus vulgaris*), Ocean County, N. J.

DR. R. W. SHUFELDT. Two bird crania.

R. R. TAFEL. Eggs of Arctic Birds.

MISS ANNA J. VALENTINE. Nest of Cassique (*Cassicus* sp.).

ZOOLOGICAL SOCIETY PHILADELPHIA. Skins of White-eyebrowed Guan (*Penelope superciliaris*).

Crested Guinea Fowl (*Guttera cristata*) and Parson Bird (*Prosthemadera novæzealandiæ*).

Skull and sternum of Guira Cuckoo (*Guira guira*).

REPTILES AND AMPHIBIANS.

O. H. BROWN. One Salamander, Cape May, N. J.

C. H. CONNER. House Snake (*Lampropeltis doliatus clericus*), Montgomery County, Pa.; Hog-nosed Snake (*Heterodon platyrhinus*).

H. W. FOWLER and B. W. GRIFFITH. Small collection of Amphibians from Cecil County, Md.

J. W. HOLMAN. Anderson's Tree Toad (*Hyla andersoni*), Ocean County, N. J. Red-bellied Snake (*Storeria occipitomaculata*), Ocean County, N. J.

C. J. HUNT. Several Amphibians and Terrapin (*Pseudemys*) from New Jersey.

J. P. MOORE. *Bufo fowleri*, Martha's Vineyard, Mass.

JOSEPH PARKER. Anderson's Tree Toad (*Hyla andersoni*), Ocean County, N. J.

PURCHASED. Twelve species of Lizards, Orlando, Fla.

S. N. RHOADS. Two Salamanders, Adirondacks, N. Y.

W. STONE. House Snake (*Lampropeltis doliatus*), Sullivan County, Pa.

E. G. VANATTA. Queen Snake (*Regina leberis*), Chester County, Pa.; two Frogs, Chester County, Pa.

FISHES.

C. C. ABBOTT. One Chub (*Semotilus bullaris*), New Jersey.

CHARLES ADAMS. Cush (*Lota maculosa*), Somerset County, Me.

CHARLES A. BASTIAN. Wall-eyed Pike (*Stizostedion vitreum*).

JAMES BOYCE. One Hake (*Merluccius bilinearis*) from Asbury Park.

W. G. CAROTHERS. Several Fishes, Cape May County, N. J.

DR. C. H. EIGENMANN. Small series of Cuban and South American Fishes.

J. B. FINE. Genitalia of Hermaphrodite Shad.

W. J. FOX. Puffer (*Lagocephalus lævigatus*); *Selene vomer* and Sea Cat (*Felicthys*), Cape May County, N. J.

H. W. FOWLER. Small collection of Fishes, Cape May County, N. J.; two climbing Perch (*Anabas scandens*); small collection of Fishes, Florence, N. J.; small collection of Fishes from Bucks County, Pa.

H. W. FOWLER and B. W. GRIFFITH. Small collection of Fishes from Cecil County, Md.; small collection of Fishes, Delaware County, Pa.

H. W. FOWLER and P. H. HERTZOG. Small collection of Fishes, Lancaster County, Pa.

H. W. Fowler and C. J. Hunt. Several collections of Fishes from Cape May County, N. J.

H. W. Fowler and T. D. Keim. Collections of Fishes from Burlington County, N. J., and Newbold Island, Delaware River.

H. W. Fowler and David McCadden. Collection of Fishes, Ocean City, N. J.

H. W. Hand. File-fish (*Alutera* sp.), Cape May, N. J.

Joseph Henderson. Gar (*Tylosurus marinus*).

Miss Agnes F. Kenyon. Eel, Australia.

D. McCadden. *Seriola zonata*, Ocean City, N. J.; Hake (*Merluccius bilineatus*), Cape May County, N. J.

R. F. Miller. Collection of Fishes and Reptiles.

Pennsylvania Department of Health. *Micropterus dolomieu.*

Dr. R. J. Phillips. Collection of Fishes, Cape May, N. J.

H. A. Pilsbry. Small collection of Fishes from North Carolina.

E. G. Vanatta. Trout, Chester County, Pa.

Lieut. Hugh Willoughby. Barrel of Fishes, Florida.

Insects.

C. F. Baker. One hundred and fifty-four Orthoptera, Brazil (purchased).

William Beutenmüller. One Lepidoptera, Manitoba.

Brooklyn Institute of Arts and Sciences. Four Orthoptera, Venezuela (for determination).

P. P. Calvert. Eighteen insects, Pennsylvania.

D. M. Castle. Two Coleoptera, Pennsylvania.

E. R. Cheney. One Orthoptera, New Jersey.

Connecticut Agricultural Experiment Station. Seventeen Orthoptera, Connecticut.

E. T. Cresson, Jr. Thirty-four Diptera, United States.

U. P. Crumb. One hundred and eighty-four Insects, Burma (purchased).

S. G. Dixon. One Orthoptera, Pennsylvania.

L. A. Duhring. Six Orthoptera, Algeria.

H. T. Fernald. Sixteen Hymenoptera, United States.

W. G. Freedley, Jr. Eight Lepidoptera, India.

F. D. Godman. Three thousand, five hundred and twenty-nine Coleoptera, Central America.

C. T. Green. Two hundred Diptera, British Guiana.

F. Grinnell, Jr. Ninety-six Orthoptera, California.

F. Haimbach. Four Heterocera, United States.

M. Hebard and J. A. G. Rehn. Sixty-six Insects, Arizona.

M. Hebard. One hundred and eighty-eight Orthoptera, five Lepidoptera, Pennsylvania.

C. Ilg. Twenty-five Blown Larvæ, Pennsylvania.

F. M. Jones. Two Heterocera, South Carolina.

H. H. Lyman. Three Heterocera, Canada (exchange).

J. M. MacFarland. Three Heterocera, Alabama.

A. H. Manee. Thirteen Insects, North Carolina (exchange).

J. H. Matthews. Eleven Lepidoptera, Cuba; thirty-five, India (exchange).

J. A. G. Rehn. One hundred and forty-four Orthoptera, New Jersey; seven hundred Orthoptera, Virginia and North Carolina (Academy Expedition).

H. SKINNER. Ninety Lepidoptera, United States.
H. SKINNER. Ten thousand Lepidoptera (purchased).
T. SPALDING. One hundred and twenty-nine Insects, Utah.
W. STONE. One hundred and ninety-six Orthoptera, Pennsylvania.
E. S. TITUS. One hundred and forty-seven Hymenoptera, United States (exchange).
M. TOMURA. Six Butterflies, Celebes.
J. F. TRISTAN. Seventeen Orthoptera, Costa Rica.
H. T. VAN OSTRAND. Twenty-five Lepidoptera, Mexico.
H. L. VIERECK. Three Hymenoptera, United States.
H. W. WENZEL. Eight Coleoptera, New Jersey.
G. B. WOOD. One Myriapod, Texas.
J. WOODGATE. One hundred and thirty-one Insects, New Mexico.
Total specimens, 16,200.

RECENT MOLLUSCA.

JACOB AEBLY. *Vallonia pulchella* Müll. from Philadelphia, Pa.
JOHN A. ALLEN. Thirty-one trays of shells from Maine and Ohio.
JOSHUA BAILY, JR. *Arion ater rufa* L. from Neuen Ahr, Germany.
DR. CHARLES BAUM. *Helix muralis* L. from Paestum, Italy.
BERNICE PAUAHI BISHOP MUSEUM. Fifteen species of *Helicina* from the Hawaiian Islands.
S. S. BERRY. Eleven trays of freshwater and land shells from California.
E. BETHEL. Seven trays of *Oreohelix* from Colorado.
DR. SAMUEL A. BINION. *Cypræa cervus* Lam. and *Liguus fasciatus* Müll. from Key Largo, Florida.
STEWARDSON BROWN. Fourteen trays of shells from Bermuda and British Columbia.
HORACE F. CARPENTER. *Polygyra apressa sculptior* Chadw. from Crystal Cave, Bermuda.
GEORGE H. CLAPP. Three species of land shells from Arizona and Jamaica.
T. D. A. COCKERELL. Nine species of shells from Jamaica.
CHARLES CONNER. *Sphærium striatinum* Lam., Jonestown, Pennsylvania.
PROF. W. H. DALL. *Gonidea angulata haroldiana* Dall, from near San José, California; also *Milax gagates* Drap. from Easter Island.
C. ABBOTT DAVIS. Two species of *Pleurodonte* from Jamaica.
DR. SAMUEL G. DIXON. *Polygyra albolabris* Say, from near Mt. Alto, Franklin County, Pennsylvania.
M. J. ELROD. Seven trays of land shells from Montana.
J. H. FERRISS. Four species of land shells from Arizona.
REV. W. H. FLUCK. Five species of shells from South Africa and Central America.
H. W. FOWLER and B. W. GRIFFITHS. Two trays of shells from Pennsylvania.
W. J. FOX. *Crepidula fornicata* L. from Sea Isle City, New Jersey.
W. J. GILCHRIST. *Micrarionta desertorum* P. and F. from near Parker, Arizona.
A. DACOSTA GOMEZ. *Ancillaria tankervillei* S. from Venezuela.
GEORGE M. GREENE. Four species of land and freshwater shells from New Jersey.
G. DALLAS HANNA. Eighteen species of shells from Lawrence, Kansas.

Dr. J. W. Harshberger. *Mya arenaria* L. from Long Branch, New Jersey.

Miss A. C. Hartshorne. Three species of Japanese land shells.

Charles Hedley. Thirty-four species of marine shells from Masthead Island, Queensland.

J. B. Henderson, Jr. Twenty-three trays of land shells from Eastern United States and West Indies.

A. A. Hinkley. Fifty trays of Mexican shells.

Wilmer Hinkley. *Planorbis trivolvis* Say, from Boisé, Idaho.

Y. Hirase. Three hundred trays of Japanese shells.

P. C. Jarvis. Eight trays of Jamaican land shells.

N. W. Lermond. Ten species of land shells from Maine.

D. N. McCadden. *Polygyra albolabris maritima* Pils. from Ocean City, N. J.

Clarence B. Moore. Sixty-seven trays of land and freshwater shells from Arkansas and Florida.

H. B. Oakley. Fifty-five species of shells from Barbadoes.

H. A. Pilsbry. One hundred and eighty-four trays of shells.

John Ponsonby. Two land shells from Africa and Bermuda.

Purchased. Two hundred and forty-two trays of shells from the Lowe-Wollaston Collection and twelve hundred and eighty-eight trays of Philippine Island shells from the J. Quadras Collection.

J. A. G. Rehn. *Venus mercenaria* L. from Tuckerton, New Jersey.

S. N. Rhoads. *Cochlicopa* from Hampshire, England.

S. Raymond Roberts. Four trays of shells from Massachusetts and Jamaica.

Paul Rowland. *Cochlicopa lubrica* Müll. from near Sapporo, Yesso, Japan.

Mrs. Mary T. Schaeffer. Two freshwater shells from British Columbia.

Dr. R. F. Scharff. Seventeen jars of slugs from Ireland.

Dr. B. Sharp. *Pleurodonte bornii* Pfr. and *Drymæus elongatus* Bolt. from San Juan, Porto Rico.

Burnett Smith. Fifteen species of land and freshwater shells from Skaneateles Lake, New York.

George W. Soelner. *Vertigo pygmæa* Drap.

R. E. C. Stearns. Three species of freshwater shells from California.

Witmer Stone. *Polygyra albolabris maritima* Pils. from Piermont, N. J.

D. Thaanum. Sixty-one trays of Hawaiian shells.

Dr. Henry Tucker. *Ostrea virginica* L. from the Eastern Shore of Virginia.

E. G. Vanatta. Nine trays of shells from Maryland and Pennsylvania.

H. L. Viereck. *Pyramidula perspectiva* Say, from near Harrisburg, Pennsylvania.

Bryant Walker. Twelve species of freshwater shells from Alabama and Michigan.

Walter F. Webb. Eight species of land shells from Tangulandang and Cuba.

Dr. H. E. Wetherill. One hundred and twelve species of shells from the Philippine Islands.

J. Renton White. Seven species of land shells from Paestum, Italy.

Joseph Willcox. Five species of land shells from New York.

Helen Winchester. Two species of land shells from Canadensis, Pennsylvania.

H. W. Winkley. *Cæcum johnsoni* W. from Woods Hole, Massachusetts.

Other Invertebrates.

Stewardson Brown. One tray of *Julus* from Bermuda.

W. B. Davis. One jar of surface towings, Woods Hole, Massachusetts.

E. Denholtz. One *Mygale heintzi.*

W. J. Fox. One sponge and sea cucumber from Cape May, New Jersey.

J. B. Henderson, Jr. One tray of *Cypris* from near Amarillo, Texas.

Mrs. A. Kenyon. Four jars of invertebrates from Australia.

H. B. Oakley. Seven trays of invertebrates from Barbadoes.

H. A. Pilsbry. Two jars of Crustacea from Florida and North Carolina.

S. N. Rhoads. One jar of *Cambarus* from Hamilton County, New York

B. Frank Teal. One king crab from Cedar Beach, New Jersey.

Dr. Henry Tucker. *Astrangia daniæ* Ag. from the Eastern Shore of Virginia.

U. S. Fish Commission. Seventeen jars of Barnacles.

E. G. Vanatta. One jar of *Pseudoscorpion* from near New Garden, Pennsylvania.

H. L. Viereck. *Gelasimus* from St. Augustine, Florida.

Dr. H. E. Wetherill. *Tetraclita porosa* Gmel. from the City of Panama, Panama.

Invertebrate Fossils.

Stewardson Brown. Eight fossils from Alberta.

C. P. Cardwell (through Dr. Henry Tucker). Several Miocene fossils from Virginia.

Dr. Samuel G. Dixon. One tray of fossil bivalves from York County, Pennsylvania.

Exchange. Twenty-four trays fossils from Missouri.

E. M. Fryer. Two fossils, South Carolina.

Morgan Hebard. Three trays of fossils from Florida and Michigan.

Estate of Angelo Heilprin. Several fossils.

Mr. Garrison. Two trays of fossils from Santo Domingo.

George Lucas. One fossil tree stump from Santiago, Cuba.

H. A. Pilsbry. *Rhynchonella concinna* from Wiltshire, England, and *Meekella occidentalis* Newb. from the Chiricahua Mountains, Arizona.

G. Roumain. One *Ostrea* from Haiti.

R. L. Shivers. One *Placenticeras placenta* Dek. from a well in Camden County, New Jersey.

Miss A. Stone. *Portlandia glacialis* Wood, from Drinkwater Point, Casco Bay, Maine.

W. W. Webster. Seven trays of fossils from Haiti.

Joseph Willcox. Sixty trays of fossils from Virginia.

Plants.

Academy Expeditions. Bermuda, Stewardson Brown collector, 800 specimens; Canadian Rockies, Stewardson Brown collector, 3,000 specimens.

Miss Margretta Atkinson. *Macrocalyx nyctelia.*

Charles C. Bachman. *Conioselinum chinense* and *Naumburgia thyrsiflora.*

Edwin B. Bartram. Three hundred and sixty-three specimens from various places in the New England and Middle States.

Botanical Section. Collection of one hundred and forty-three specimens of *Rubus*, *Amelanchier* and *Betula* purchased from William H. Blanchard.

Mrs. William Herbst. Dr. Herbst's collection of Fungi, numbering about 5,000 specimens.

Bayard Long. Seventy-nine specimens from Delaware.

Philadelphia Botanical Club. Twenty-five hundred specimens of local plants, received from various members.

E. G. Vanatta. Eleven specimens from Chestertown, Md.

S. S. Van Pelt. Forty-six specimens from Delaware.

C. S. Williamson. Two hundred and ninety-four specimens from Delaware.

Fossil Plants.

Purchased. Fossil stump, Santiago de Cuba.

Minerals.

H. A. Green. Several minerals from Tryon, N. C.

Estate of Angelo Heilprin. Specimens of ores.

Estate of Sophie F. Riley. Collection of Transvaal minerals and set of Centennial medals.

William S. Vaux Collection. Twenty-nine specimens purchased.

Archæology, Ethnology.

Clarence B. Moore. Numerous specimens from Indian mounds of the Southern States for the Clarence B. Moore Collection.

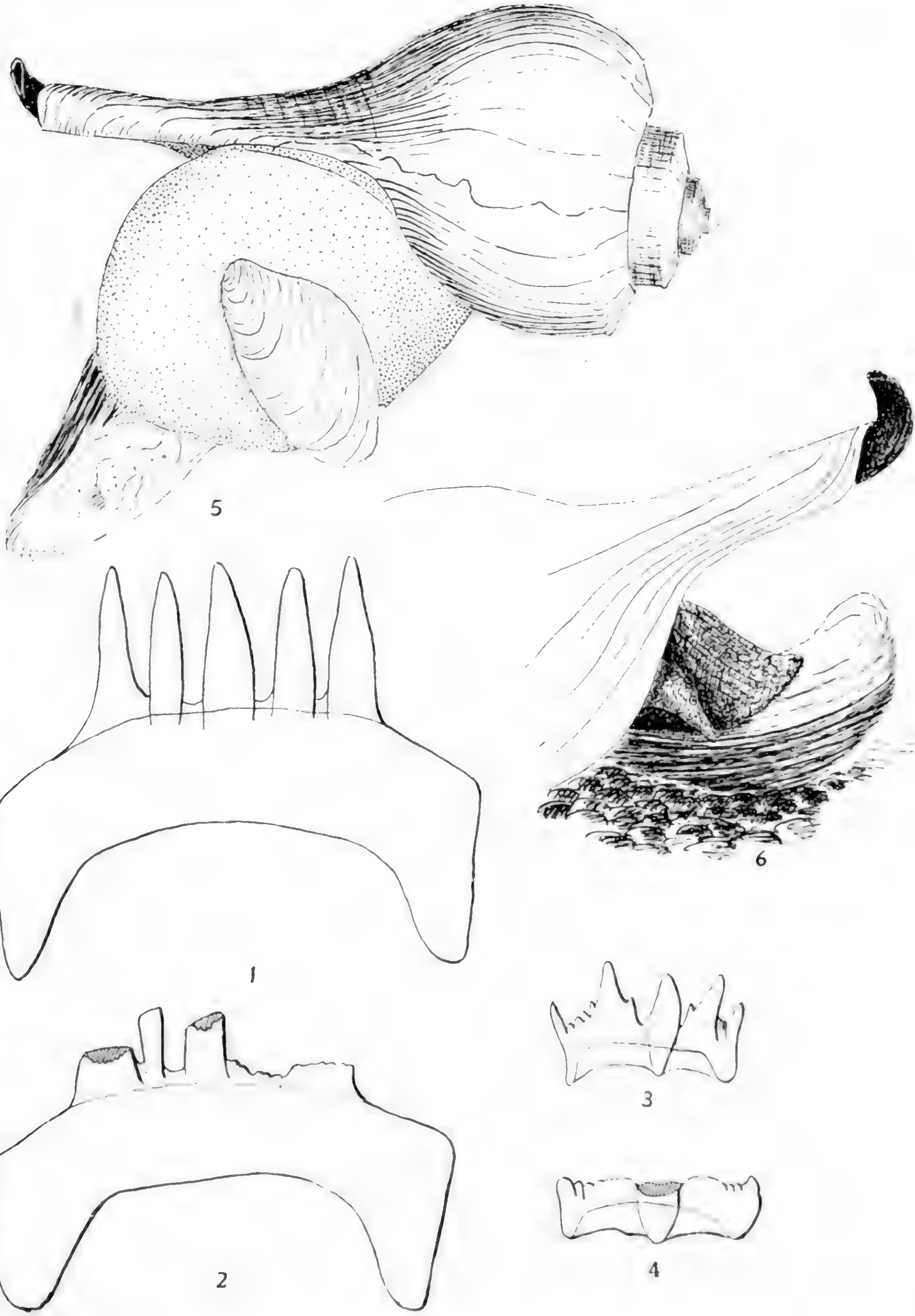
Mrs. W. P. Douglas. Canadian Indian Canoe.

INDEX TO GENERA, SPECIES, ETC., DESCRIBED AND REFERRED TO IN THE PROCEEDINGS FOR 1908.

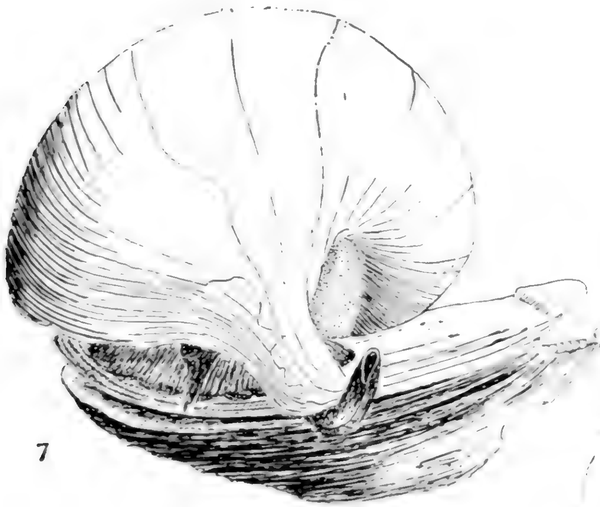
Species described as new are indicated by heavy-faced; synonyms by italic numerals.

GENERAL INDEX.

1908.

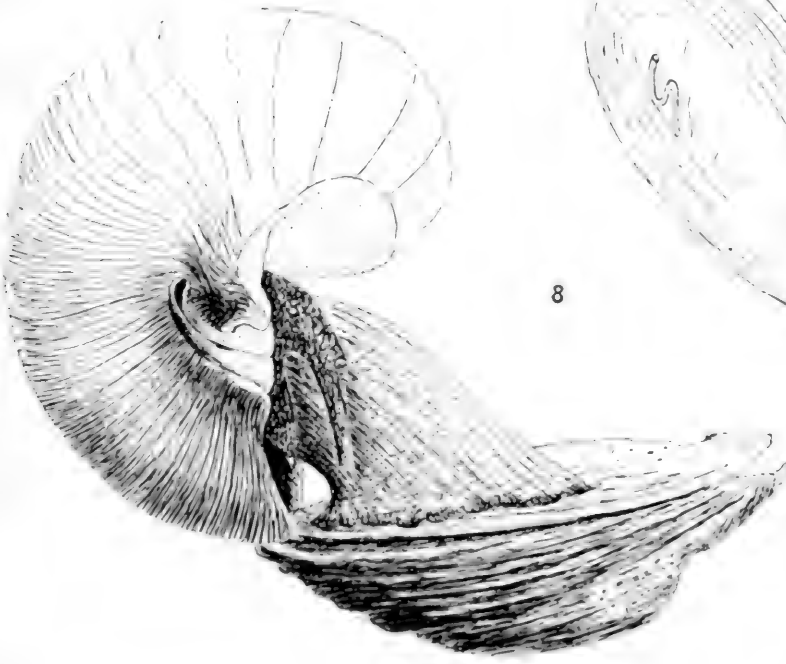


COLTON. HOW FULGUR AND SYCOTYPUS EAT OYSTERS, ETC



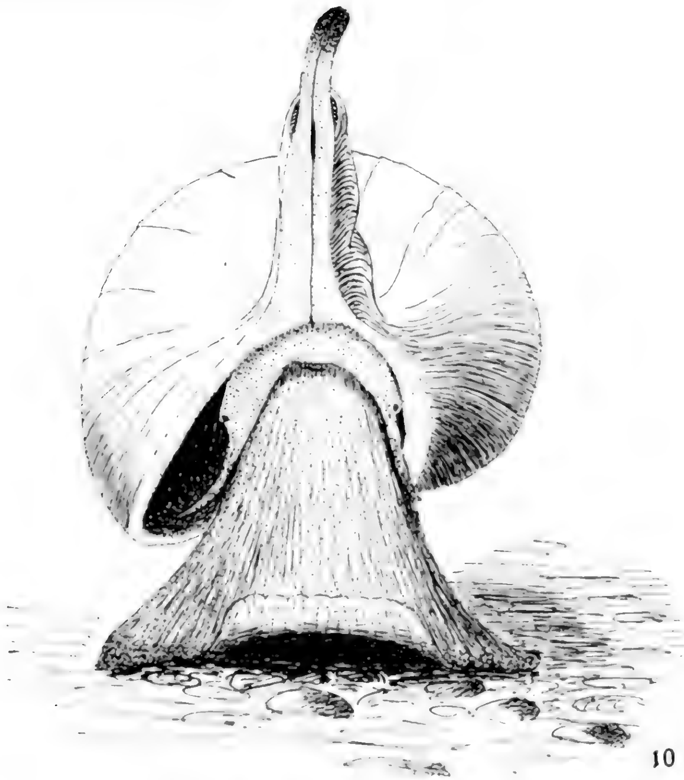
7

9



8

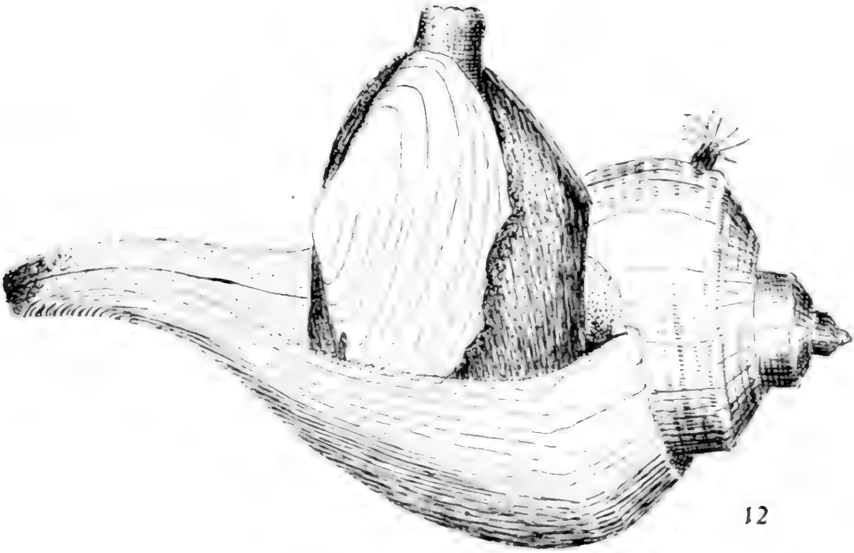
COLTON. HOW FULGUR AND SYCOTYPUS EAT OYSTERS ETC



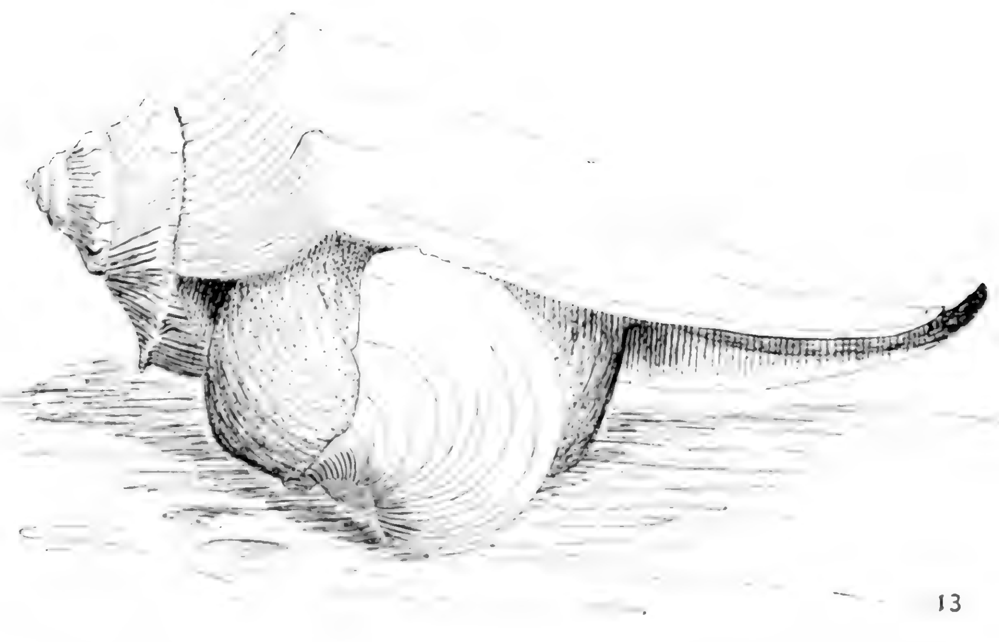
10

11

COLTON. HOW FULGUR AND SYCOTYPUS EAT OYSTERS, ETC.



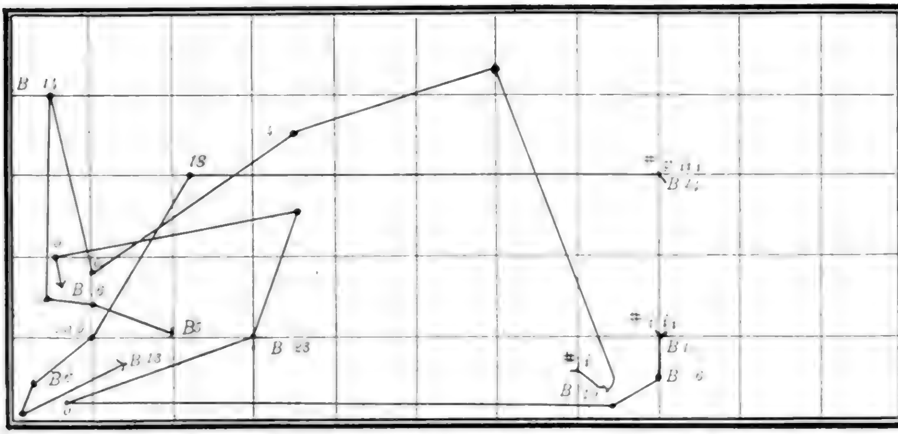
12



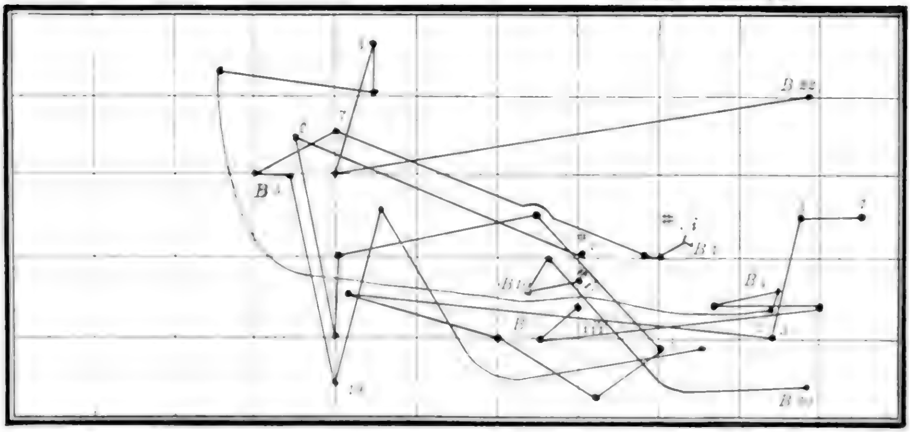
13

COLTON. HOW FULGUR AND SYCOTYPUS EAT OYSTERS, ETC.

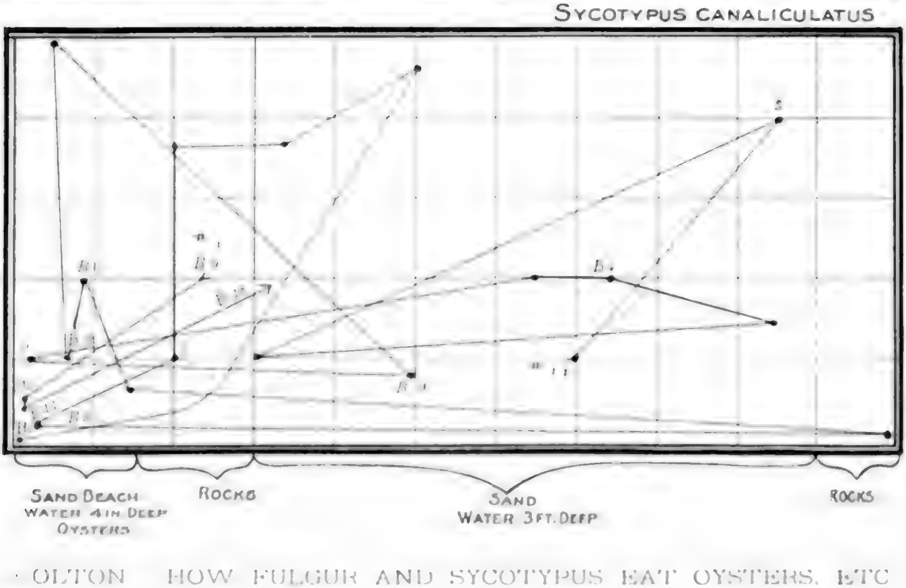
FULGUR PERVERSA



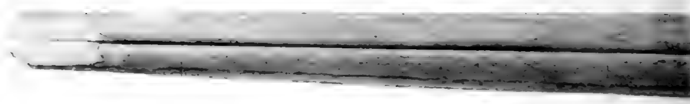
FULGUR CARICA

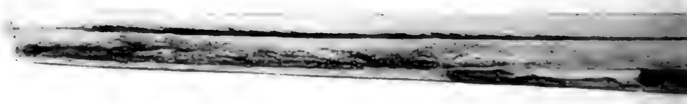


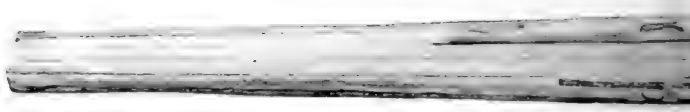
SYCOTYPUS CANALICULATUS



COLTON HOW FULGUR AND SYCOTYPUS EAT OYSTERS, ETC

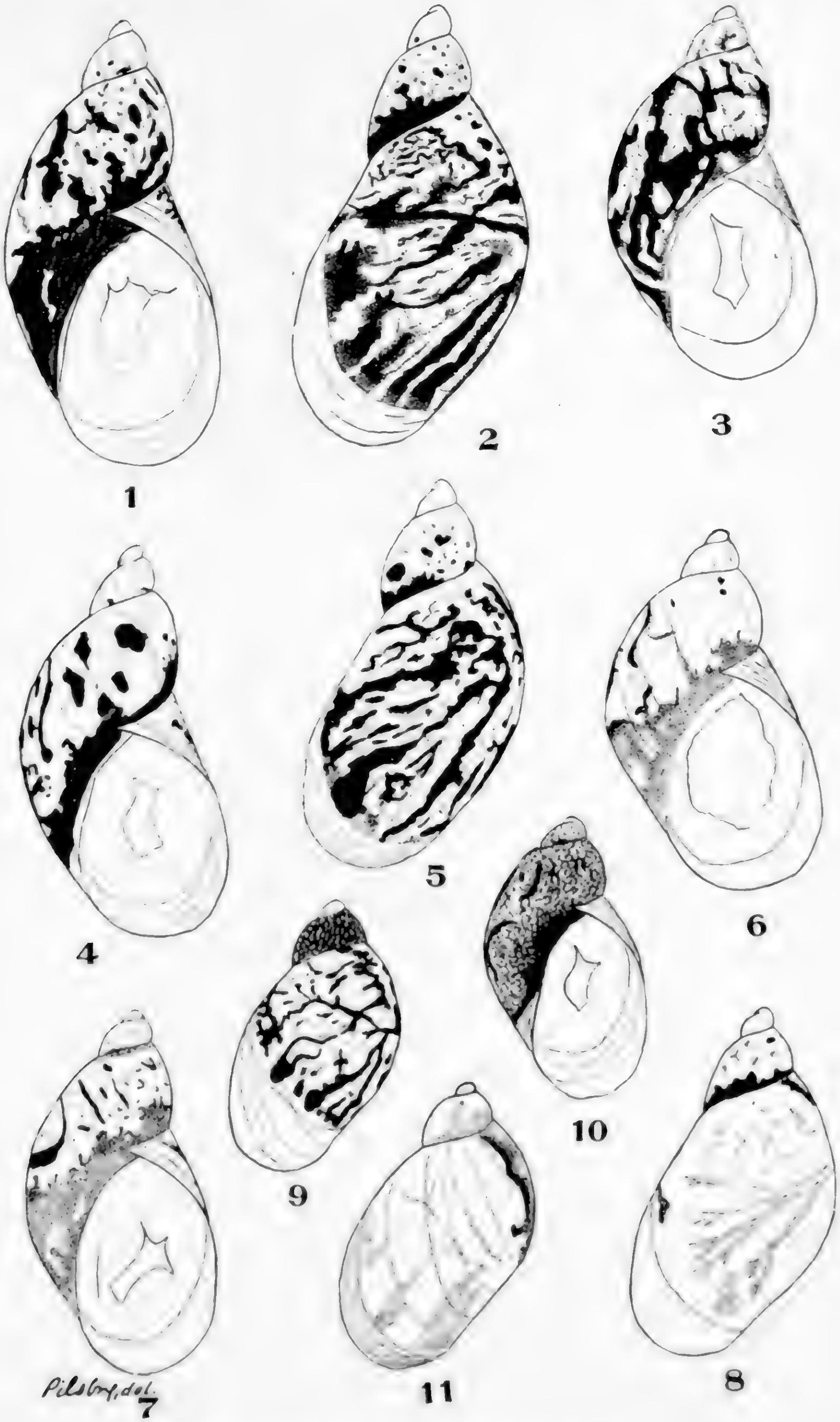






TRUE ON RHABDOST

LATIRADIX Cope



PILSBRY ON SUCCINEA OVALIS

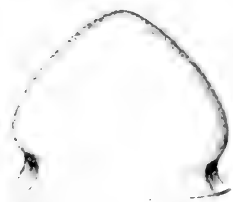
1

2

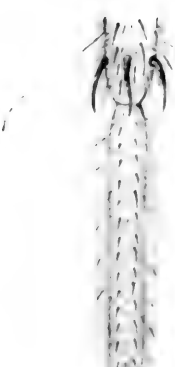
3

4

5

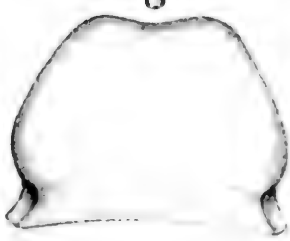


6



7

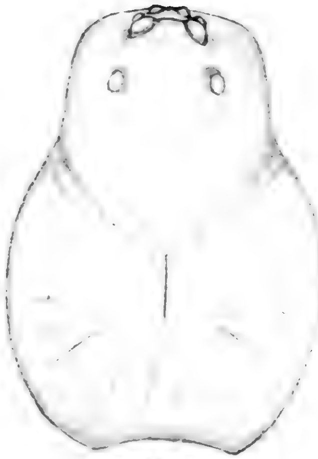
8



9

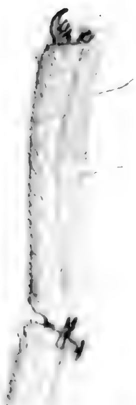
CHAMBERLIN ON LYCOSIDÆ

1



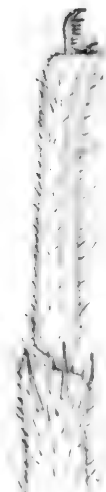
2

3



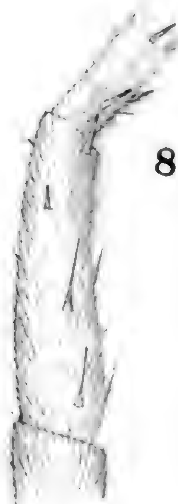
4

5



6

7

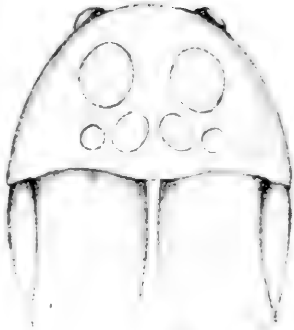


8

9

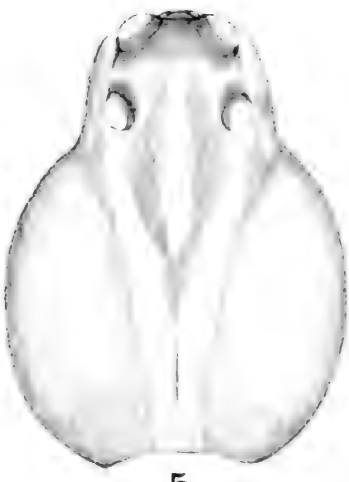
CHAMBERLIN ON LYCOSIDÆ


1

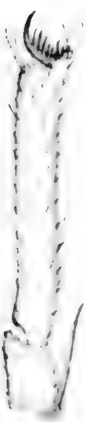

2


3


4


5

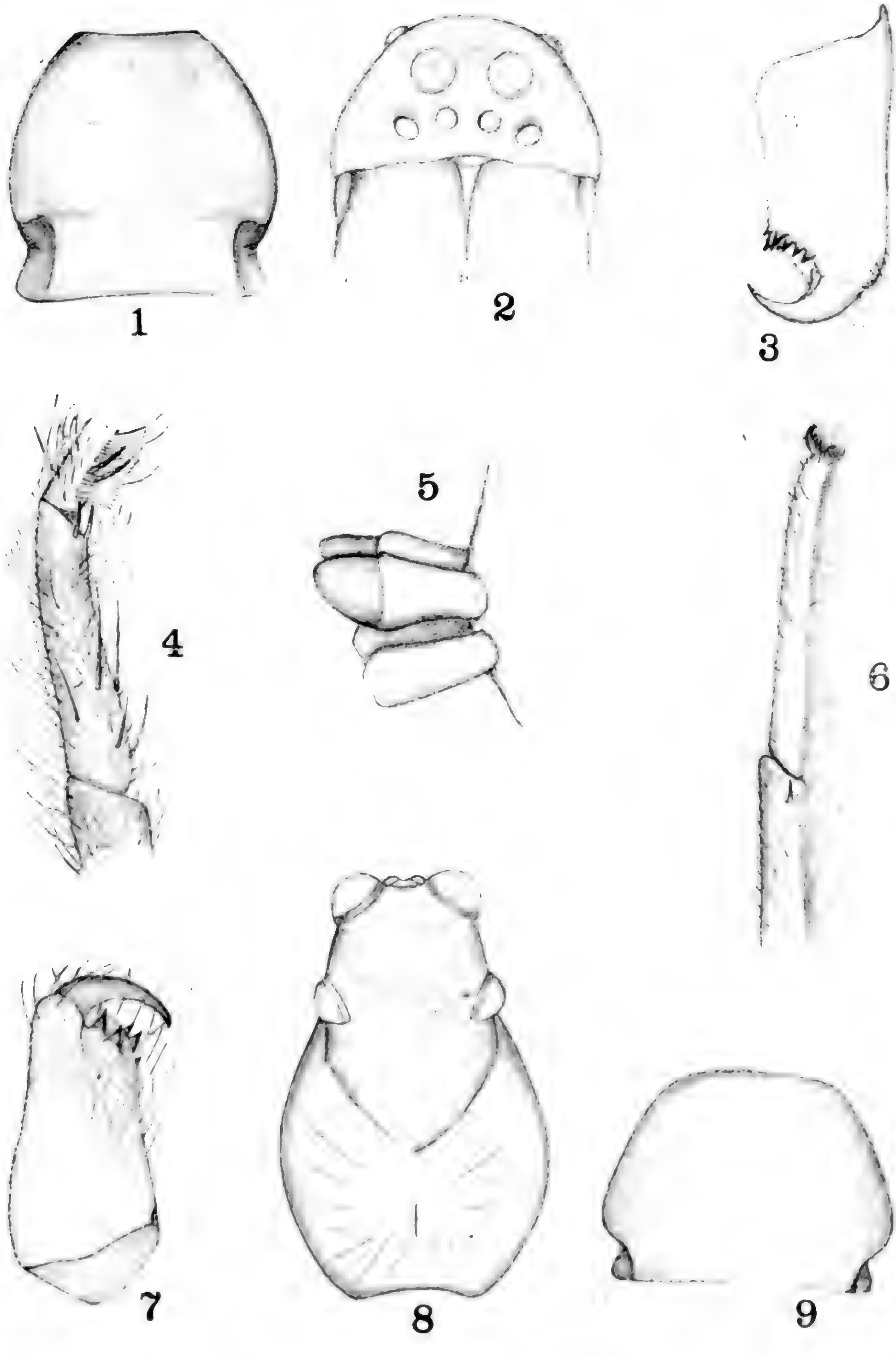

6


7

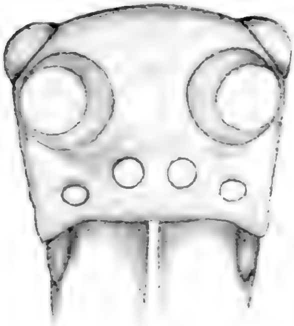

8


9

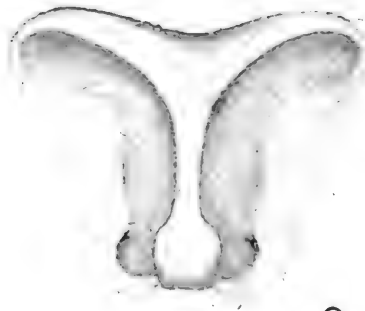
CHAMBERLIN ON LYCOSIDÆ.



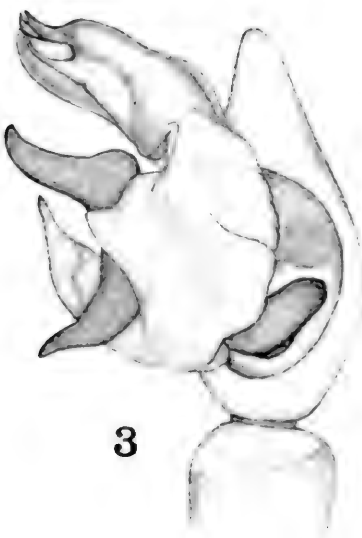
CHAMBERLIN ON LYCOSIDÆ.



1



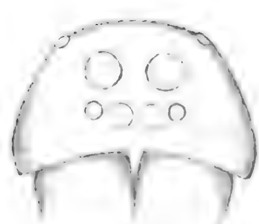
2



3

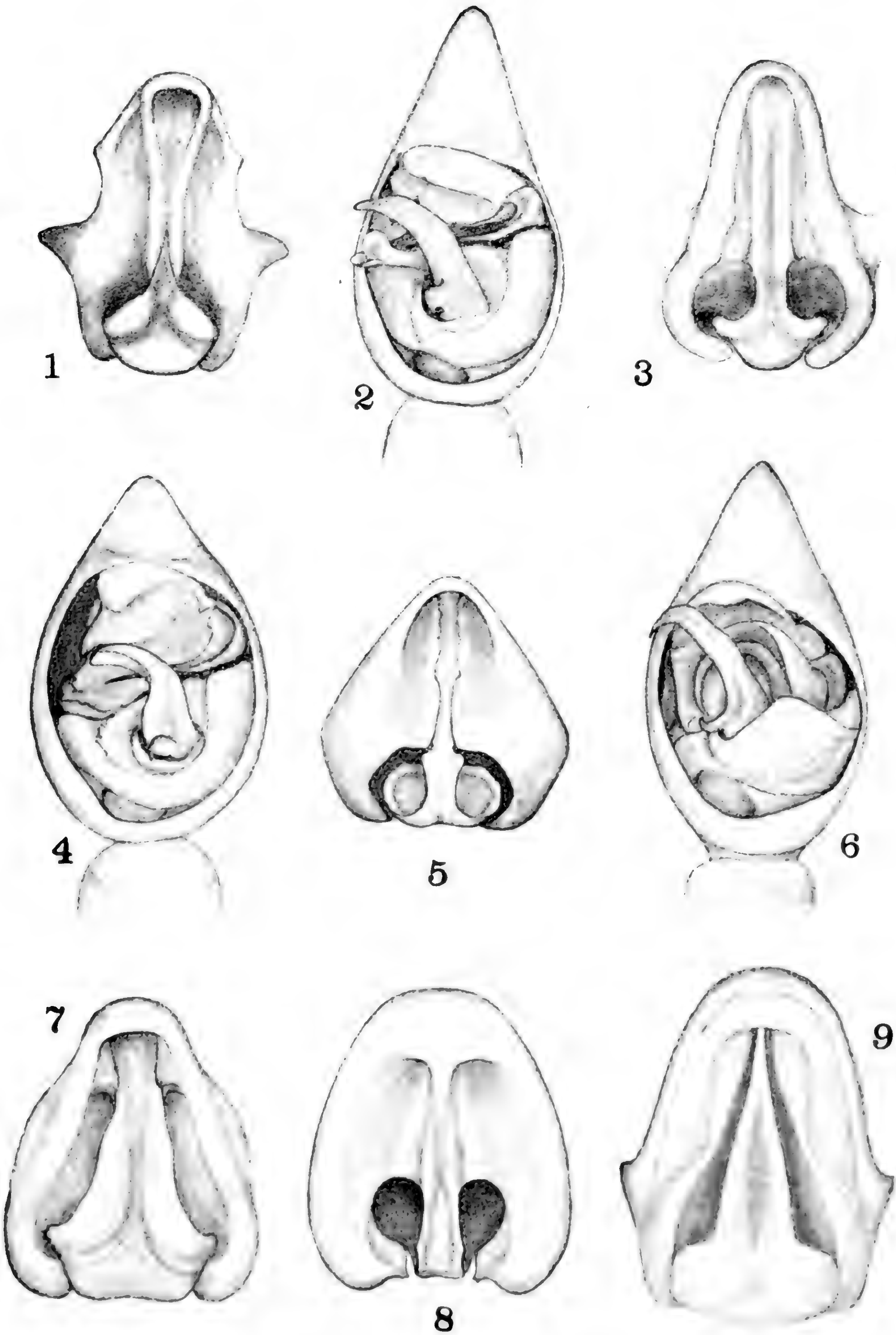
4

5

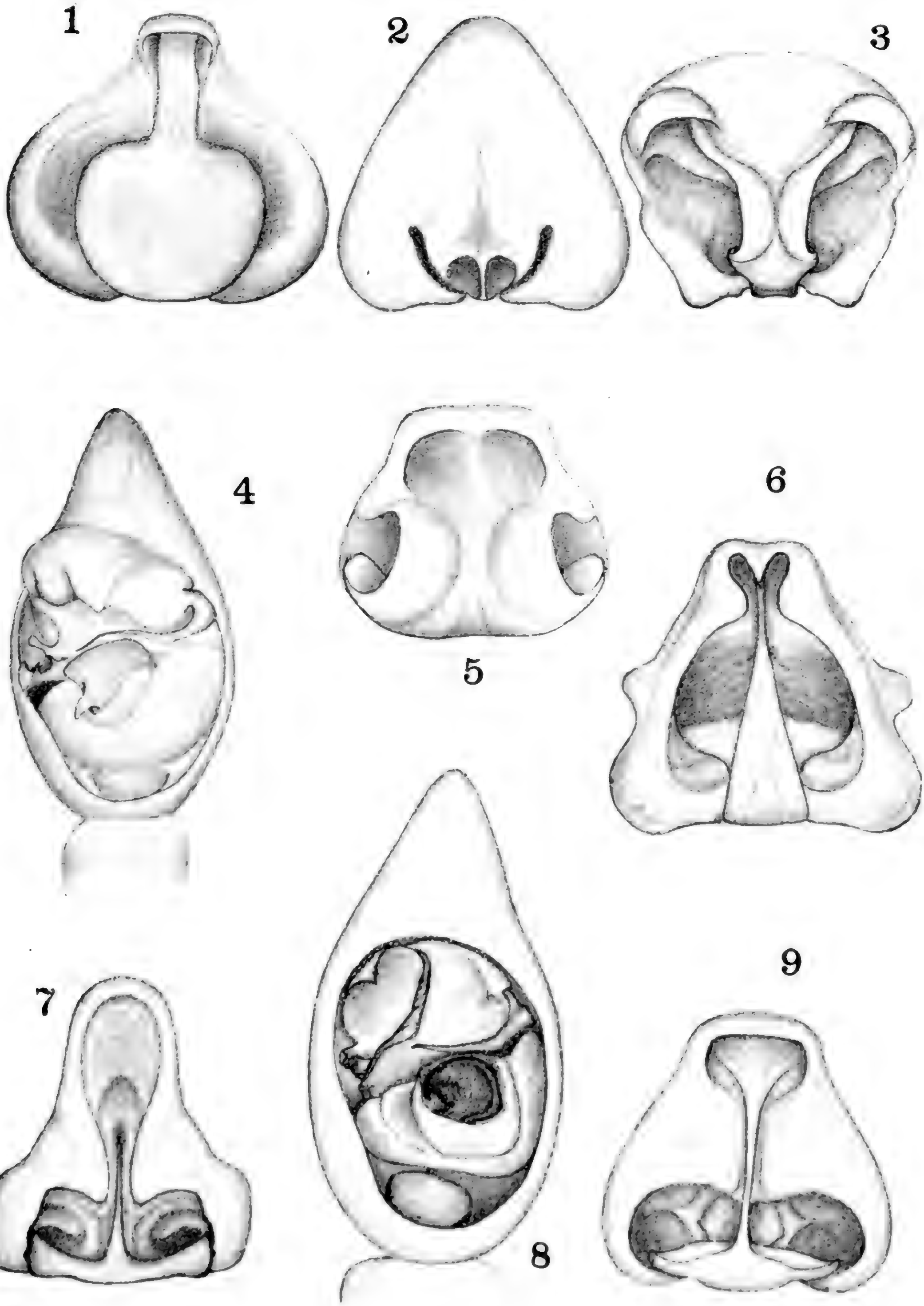


6

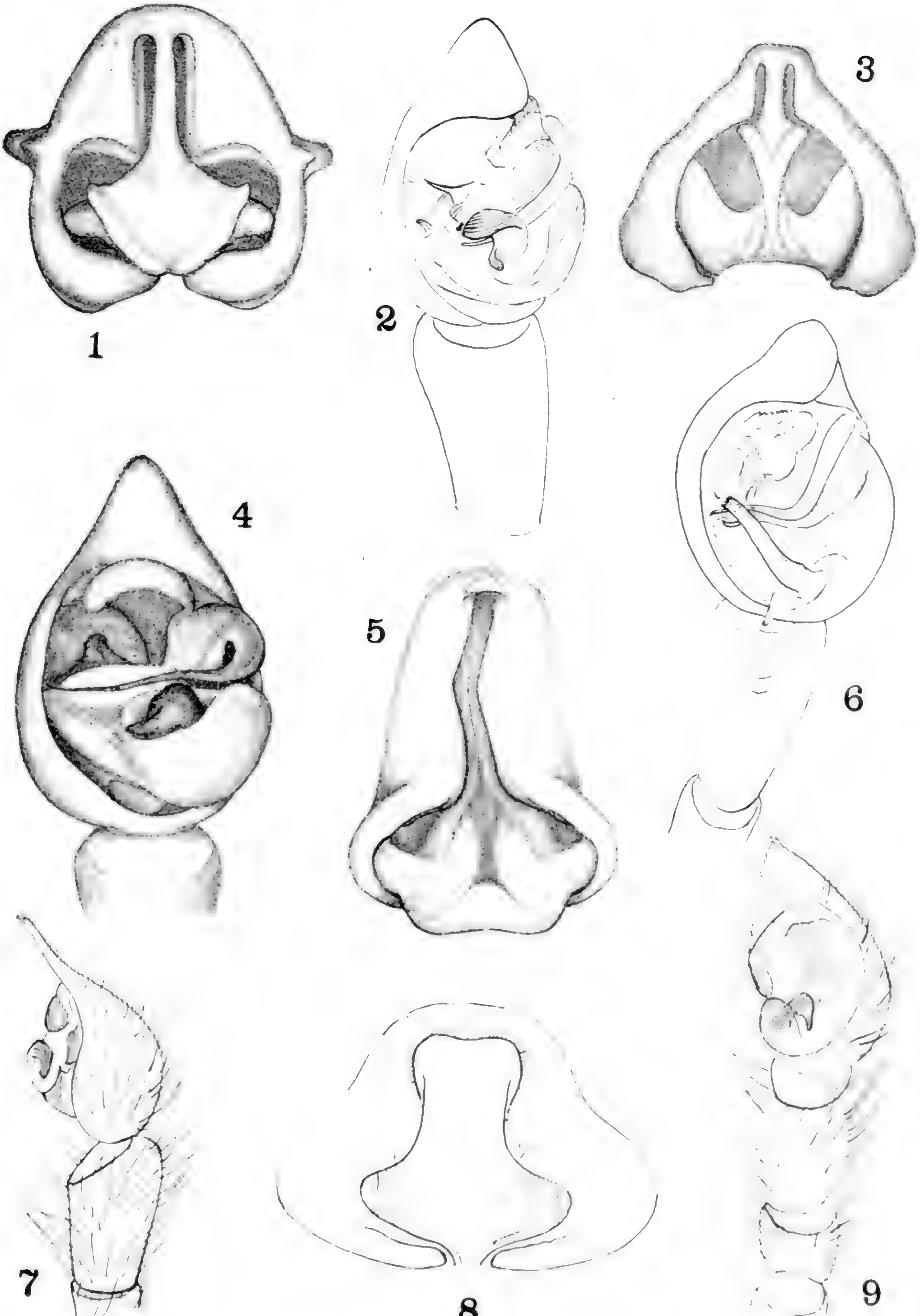
CHAMBERLIN ON LYCOSIDÆ.



CHAMBERLIN ON LYCOSIDÆ.



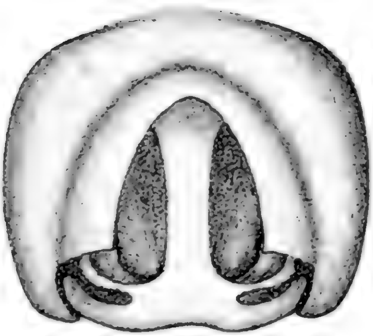
CHAMBERLIN on LYCOSIDÆ.



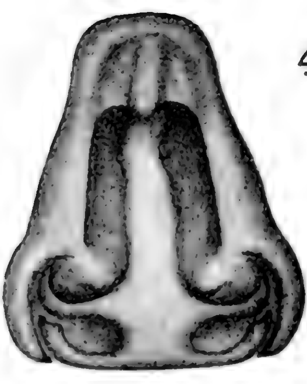
CHAMBERLIN ON LYCOSIDÆ.

1

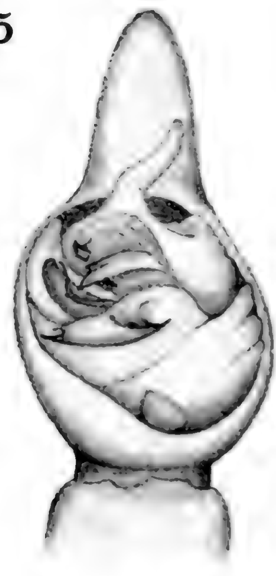
2



3

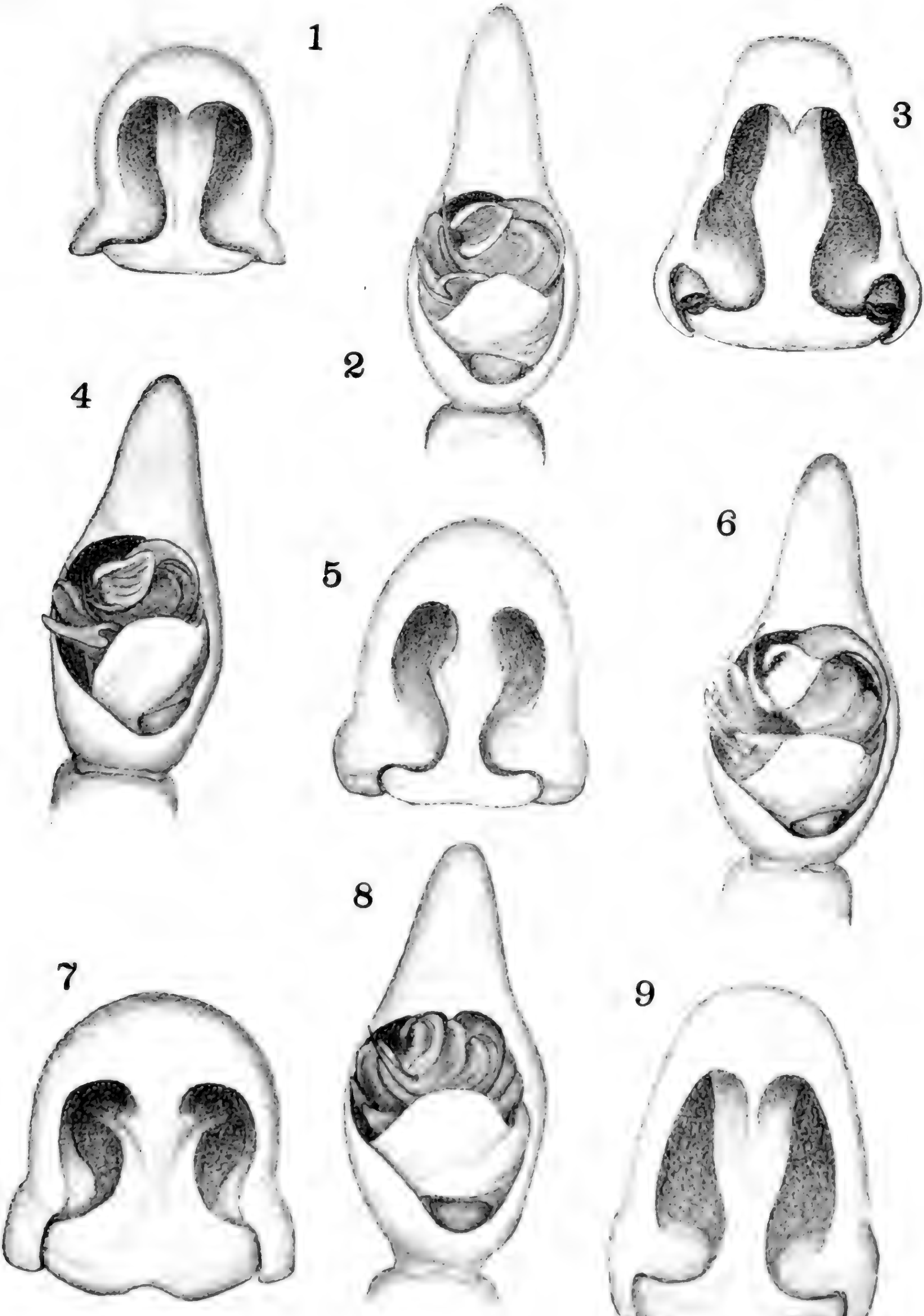


4

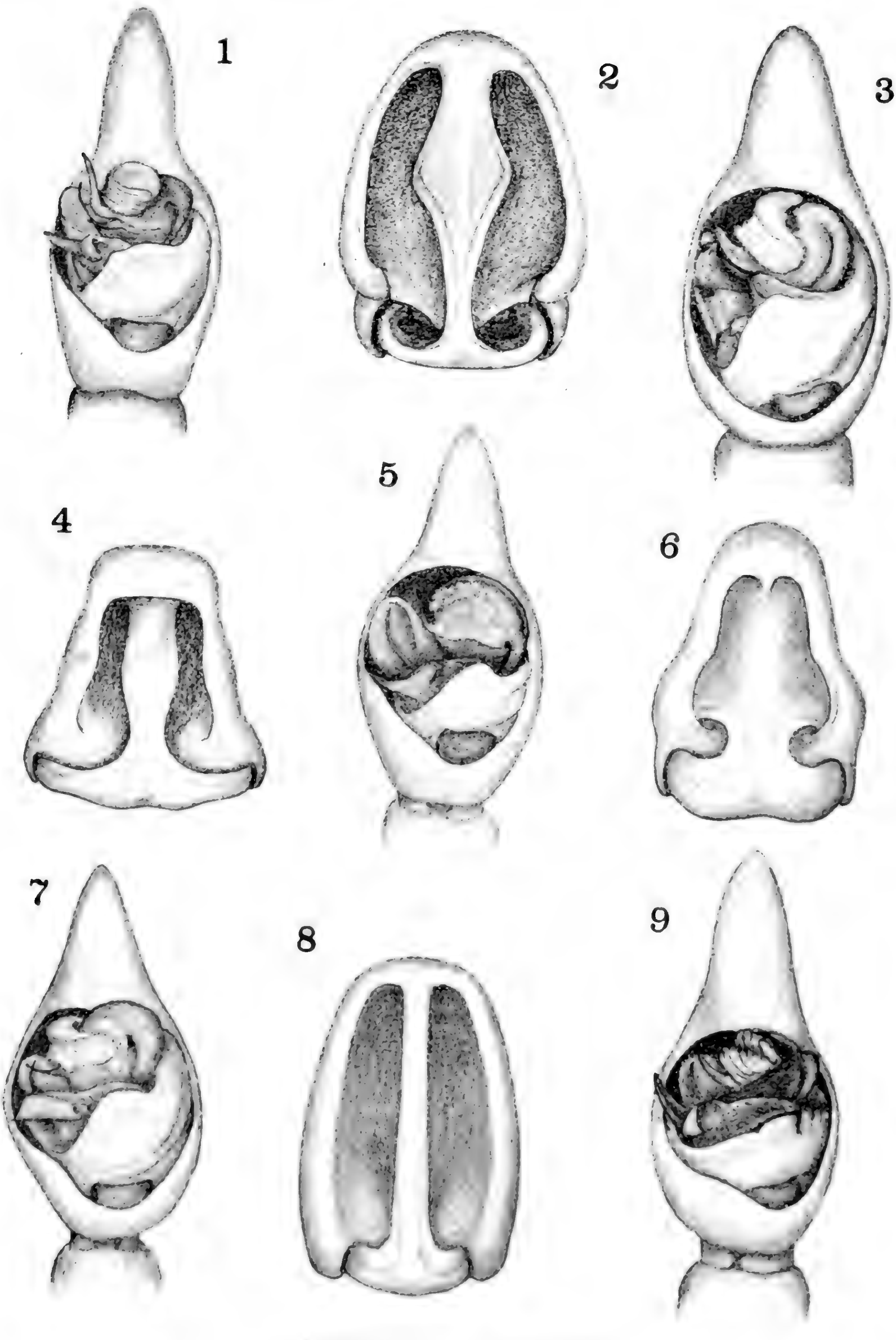


5

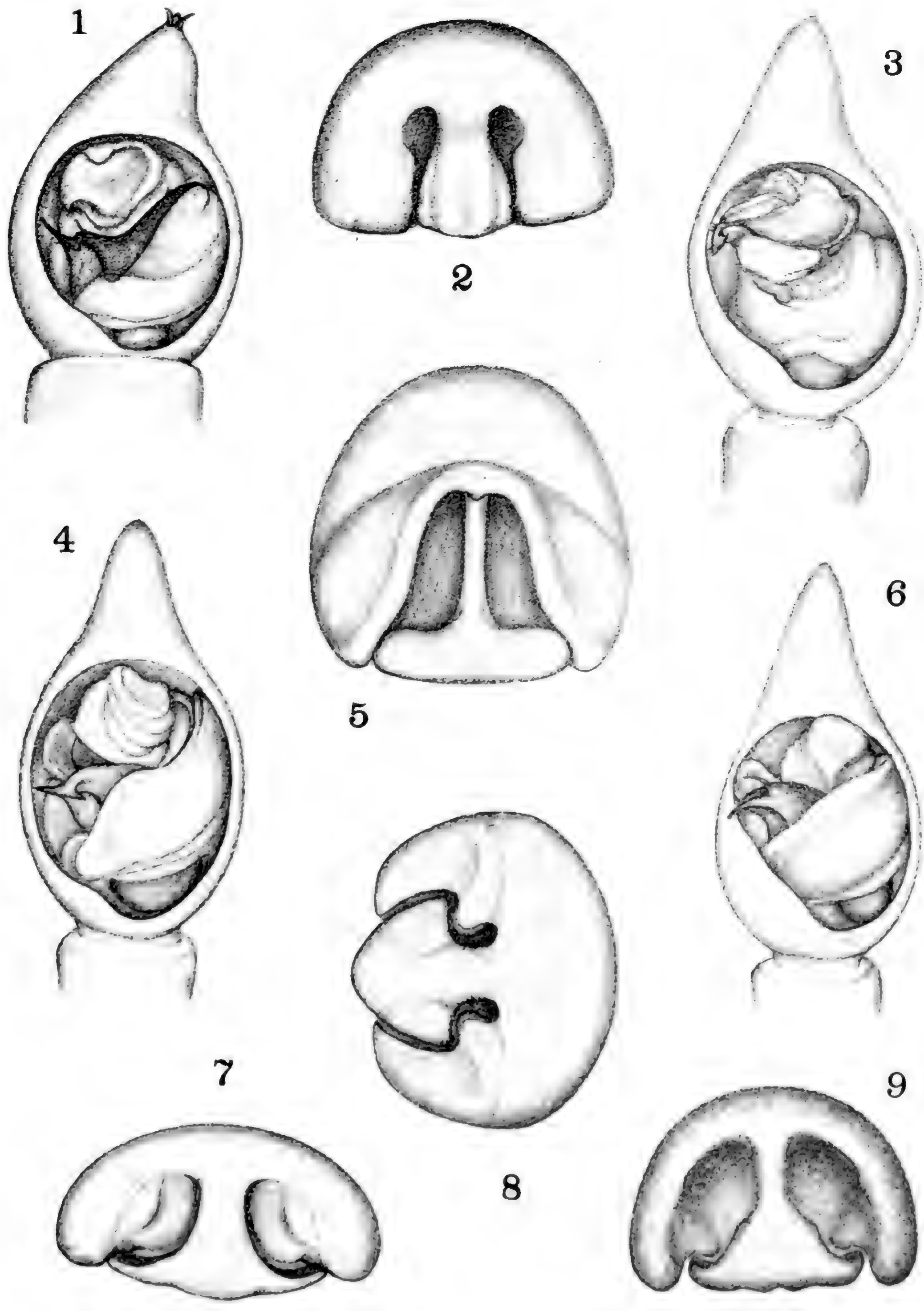
CHAMBERLIN ON LYCOSIDÆ.



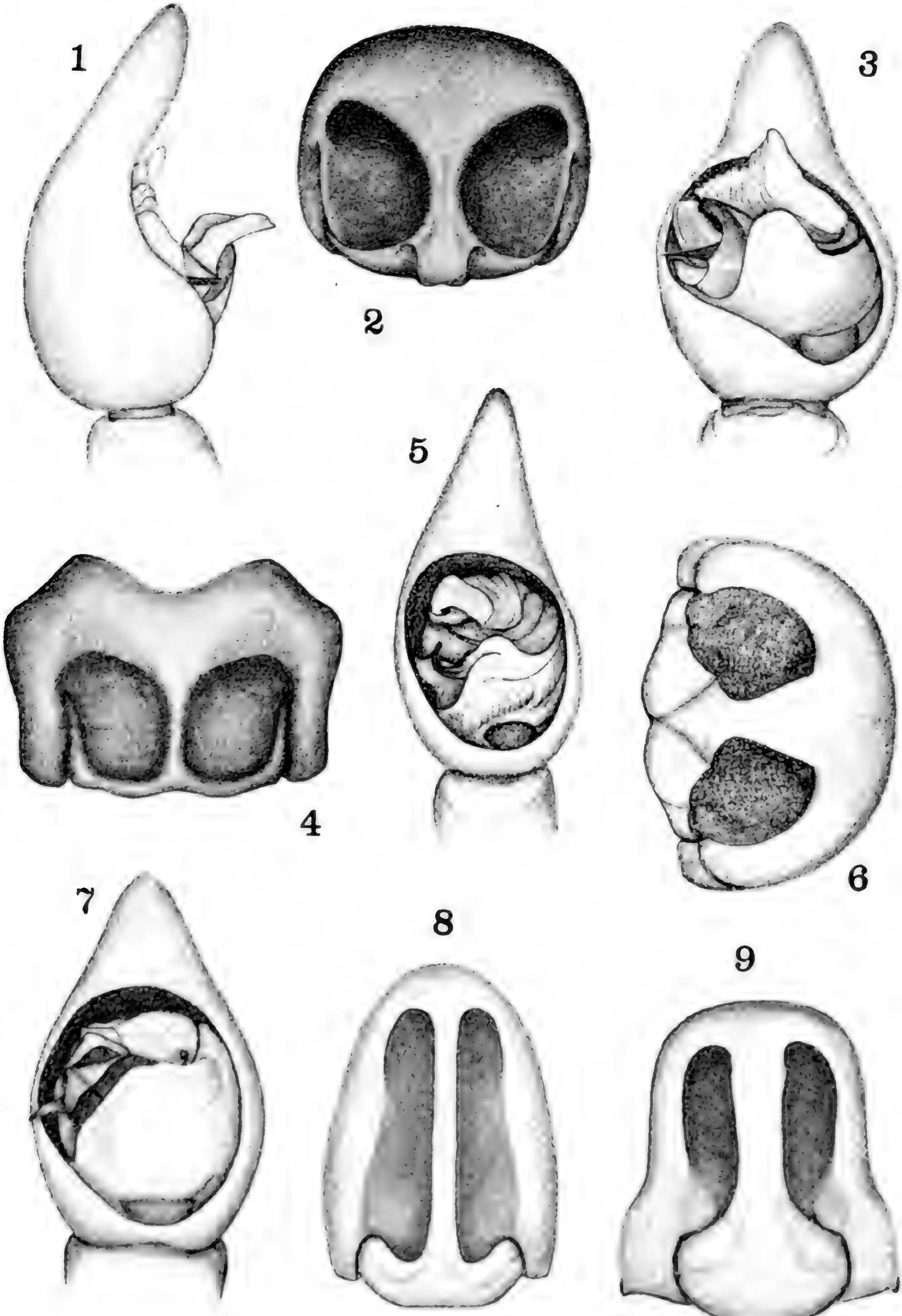
CHAMBERLIN on LYCOSIDÆ.



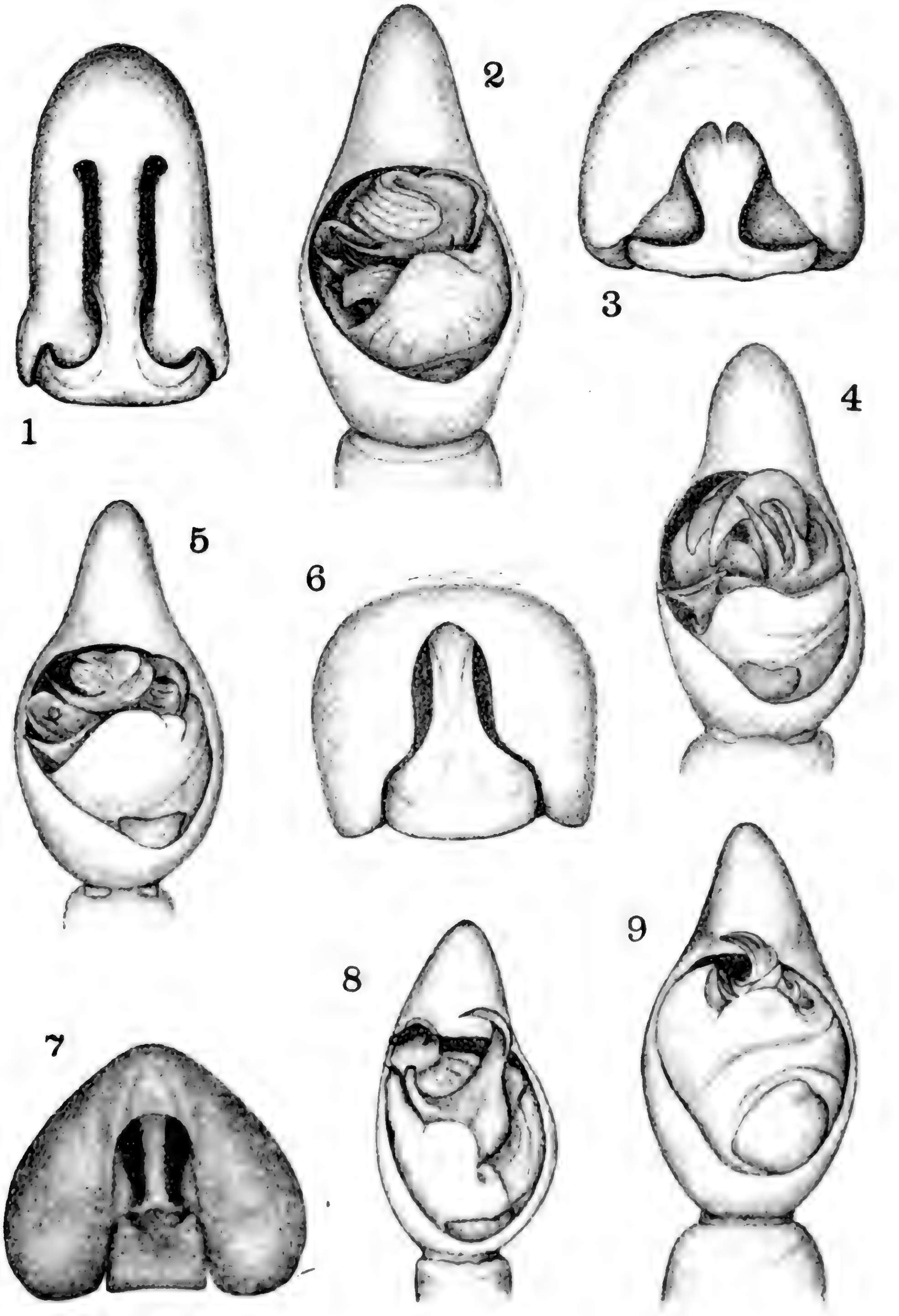
CHAMBERLIN ON LYCOSIDÆ.



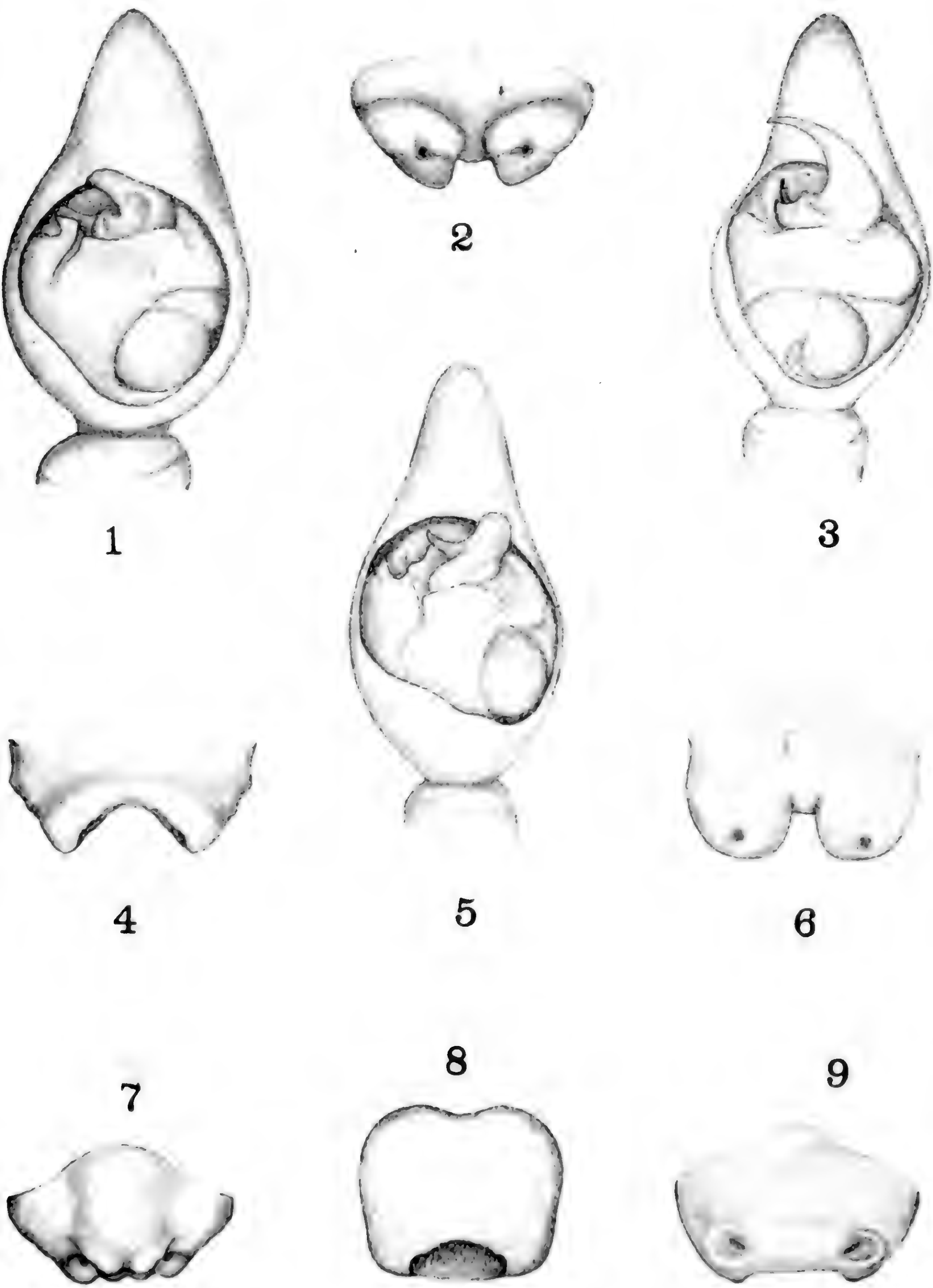
CHAMBERLIN ON LYCOSIDÆ.



CHAMBERLIN ON LYCOSIDÆ.



CHAMBERLIN ON LYCOSIDÆ

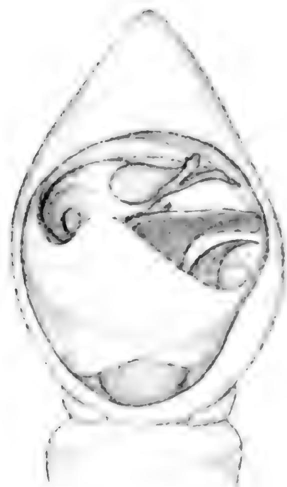


CHAMBERLIN ON LYCOSIDÆ.

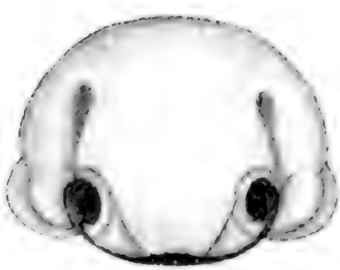
1

2

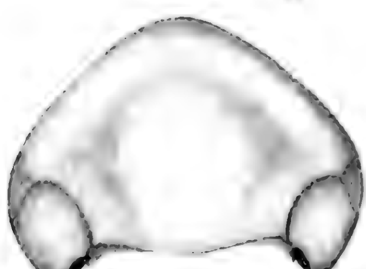
3



4

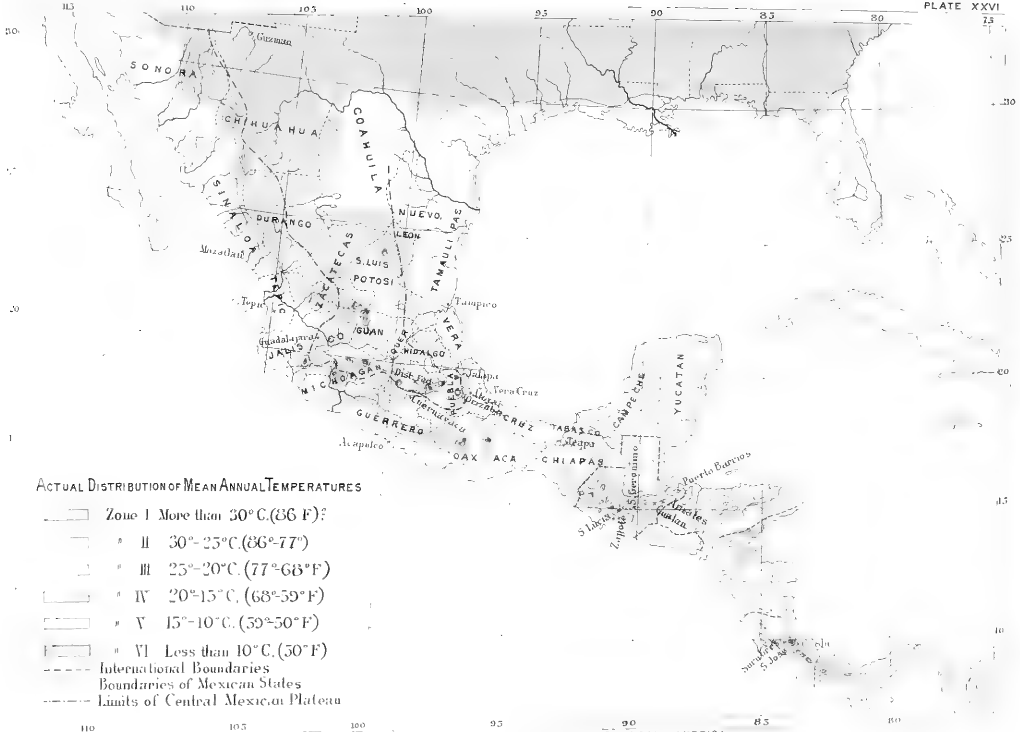


5



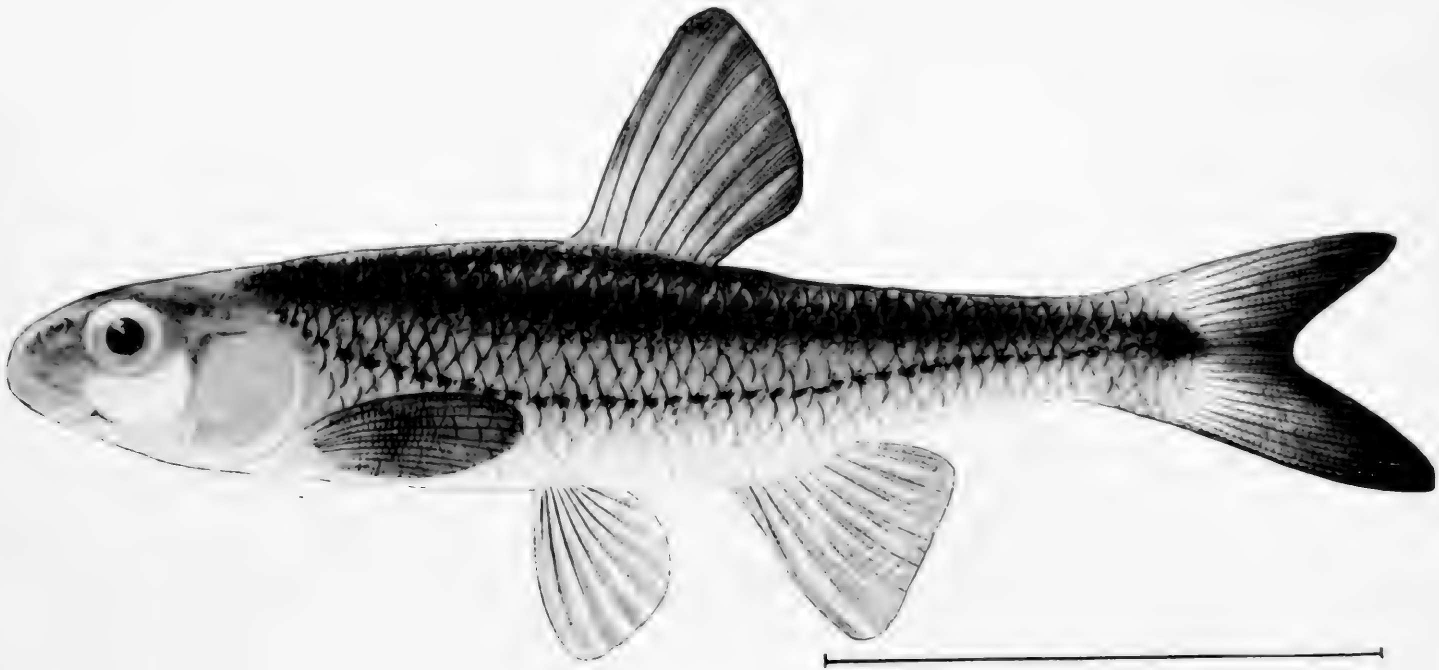
HARSHBERGER ON INFLUENCE OF LIGHT.

PLATE XXVI

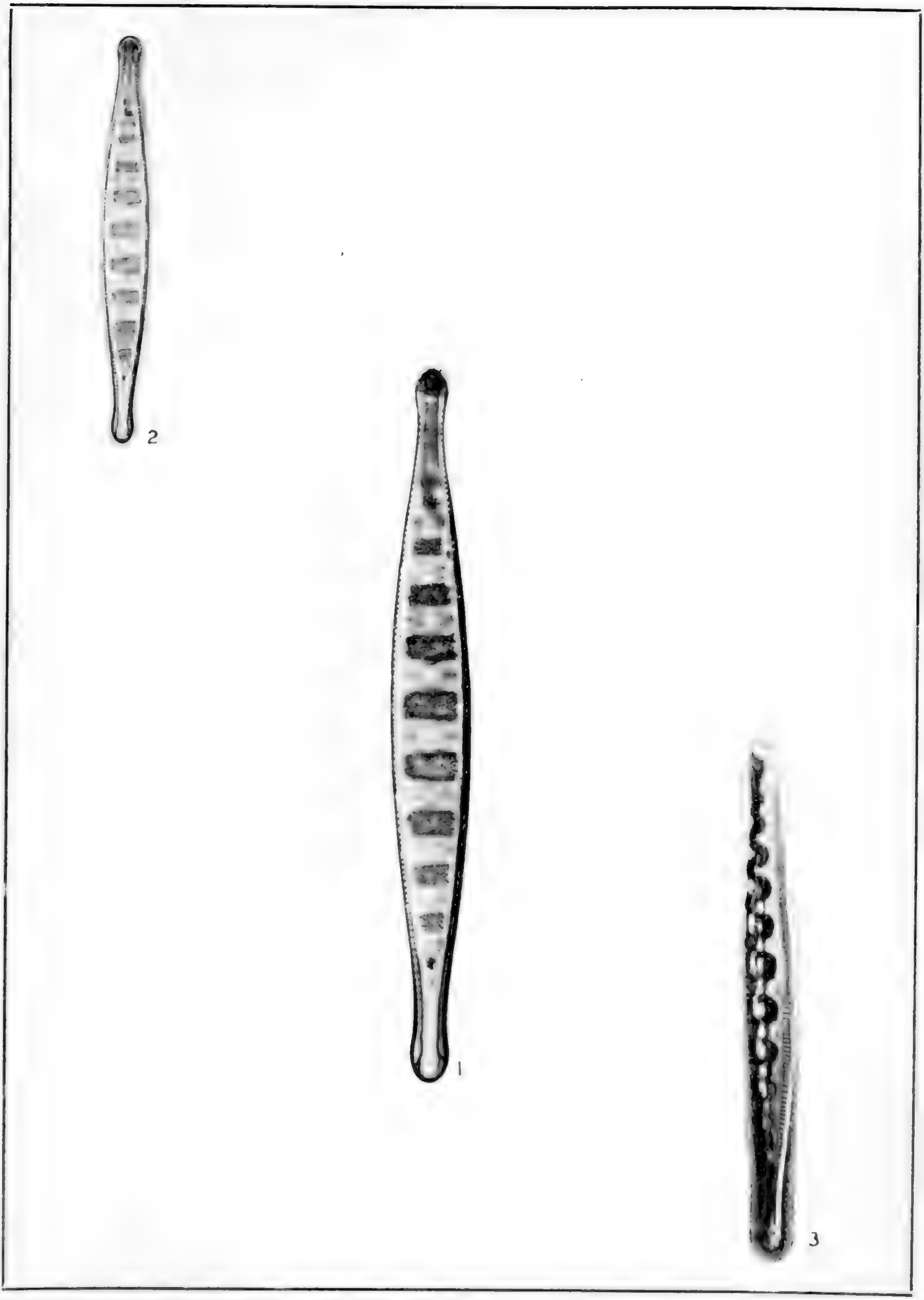


P. P. Calvert del et pinx.

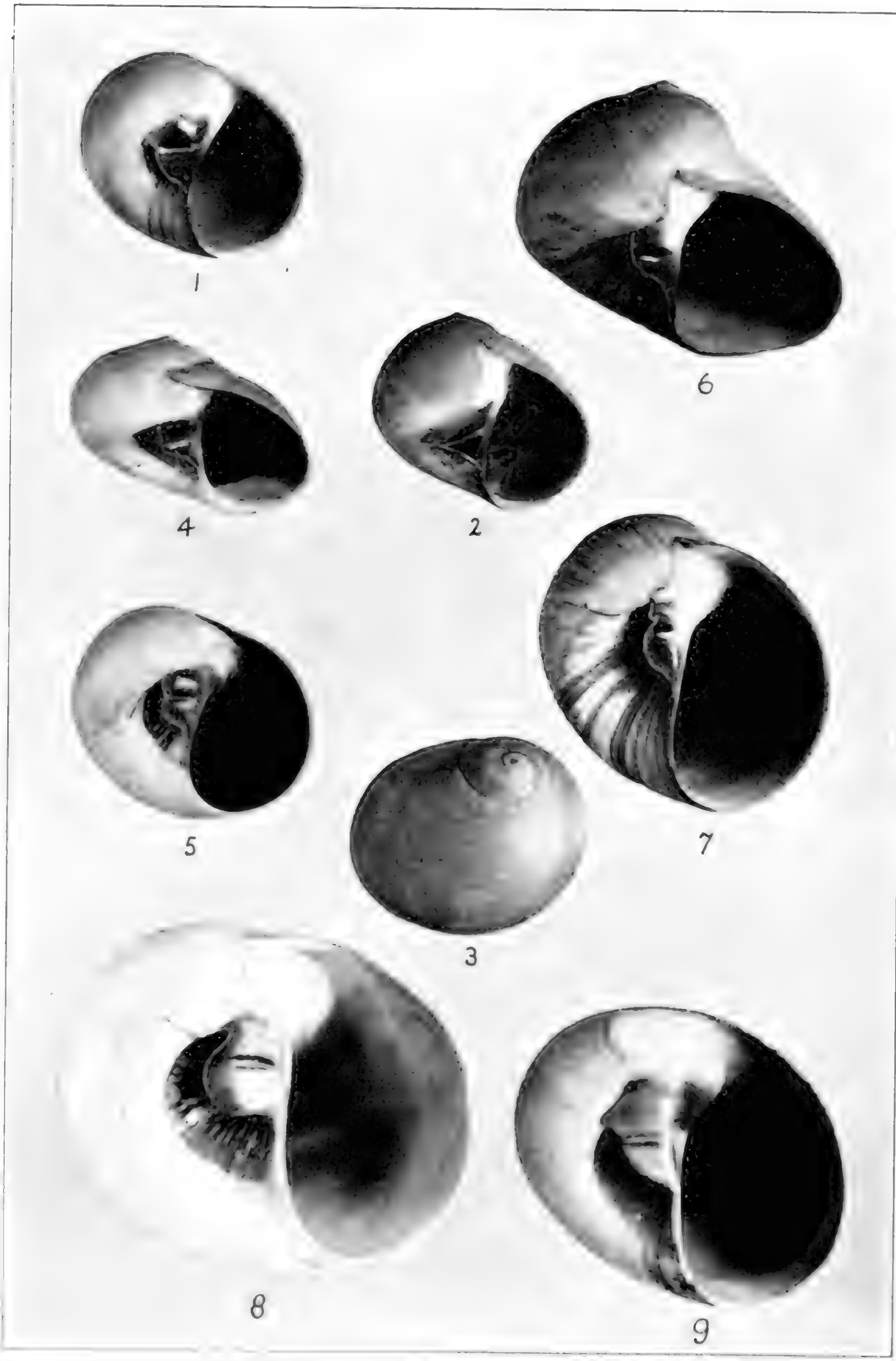
CALVERT, ODONATE FAUNA OF MEXICO AND CENTRAL AMERICA



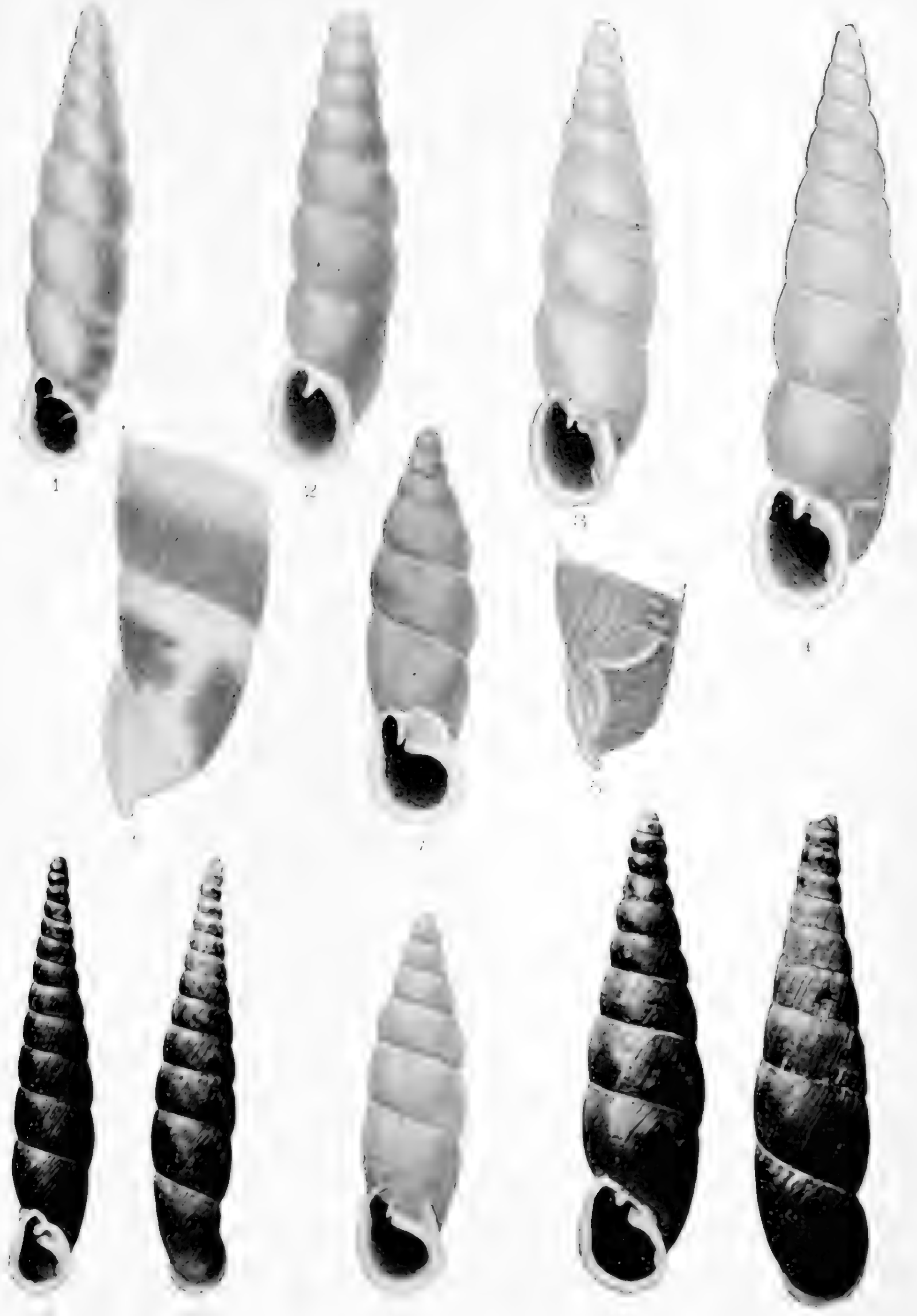
NOTROPIS KEIMI FOWLER.



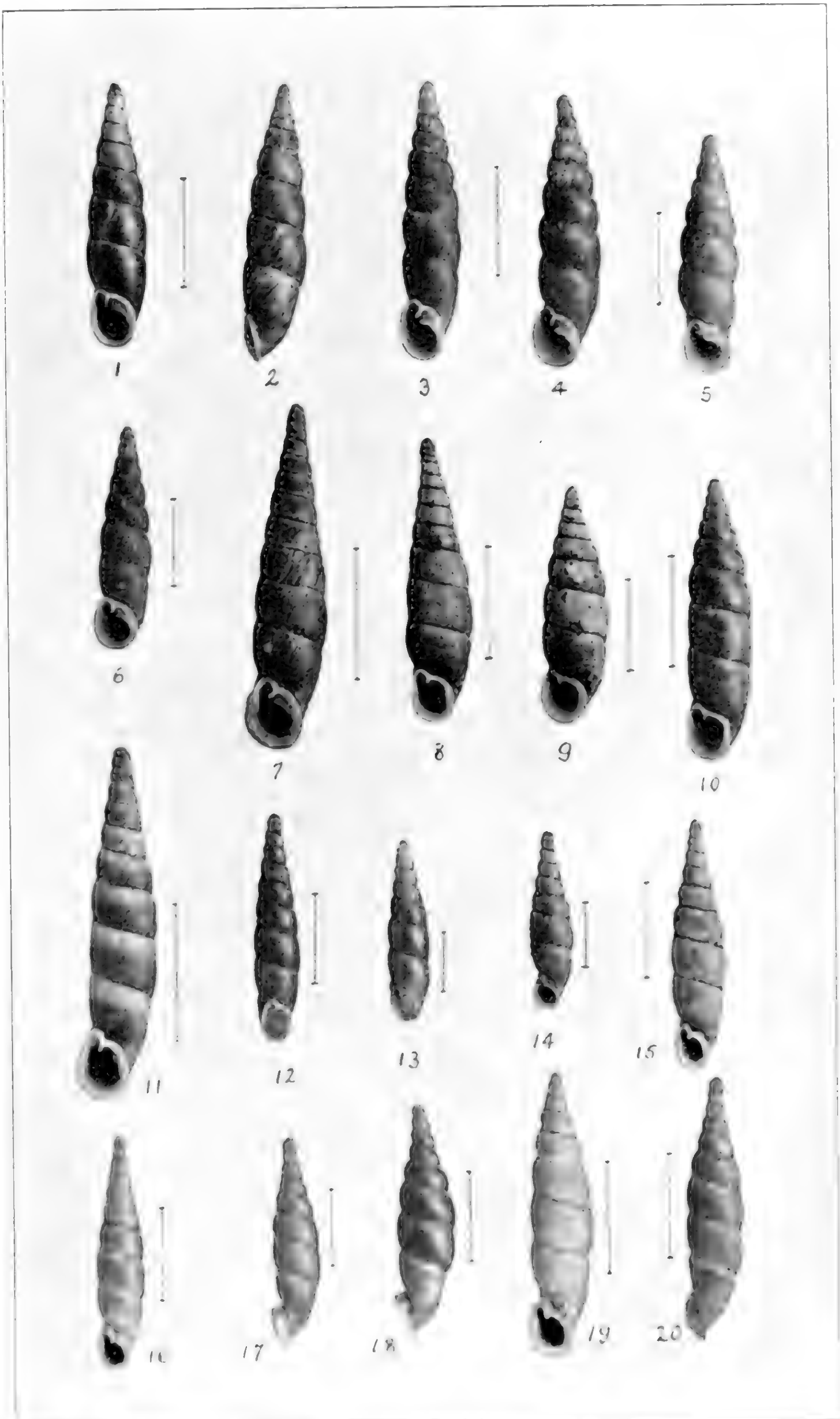
CYMATOPLEURA SHULZEI BOYER



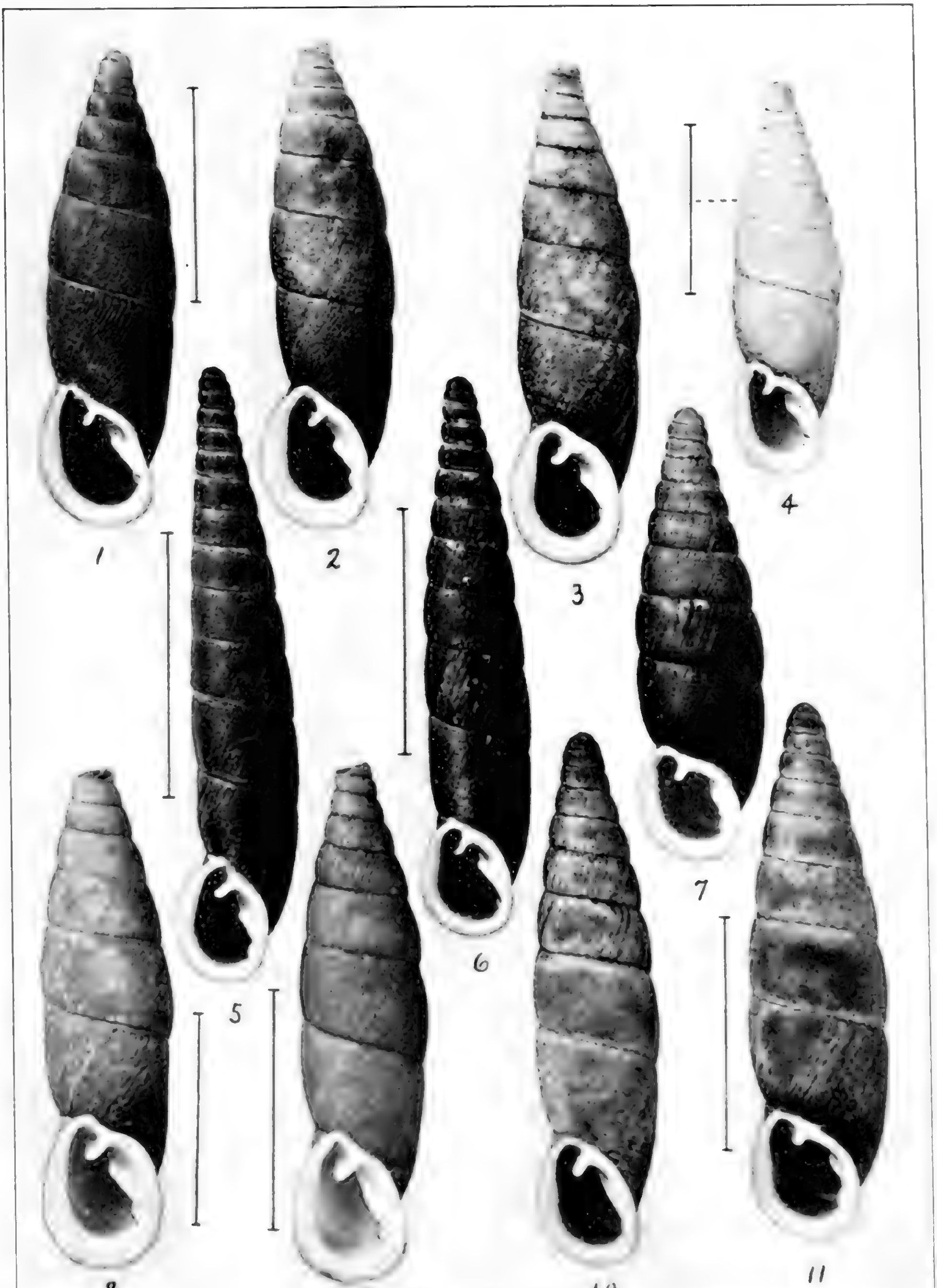
PILSBRY AND VANATTA. ON POLINICES, [illegible] ETC.



PILSBRY. CLAUSILIIDAE OF THE JAPANESE EMPIRE.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

[illegible]



PILSBRY. CLAUSILIIDAE OF THE JAPANESE EMPIRE.

4/