

ON THE PARASITES OF THE HESSIAN FLY.

BY C. V. RILEY, Ph. D.

Considering the number of articles that have been written upon the Hessian Fly (*Cecidomyia destructor*), very little of a critical and exact nature has been published concerning its parasites.

But two species have hitherto been described with any detail, although two others are mentioned by Herrick without identification, and without description sufficient to render them recognizable. In Europe the same uncertainty seems to exist. Even Dr. Balthazar Wagner, in his admirable paper,* gives very little that is definite concerning the parasites, and although he states that he sent specimens to Dr. Foerster, I am unable to find that this celebrated hymenopterist ever named them. The advantage of correct knowledge as to the habits of these parasites, and of being able to refer to them definitely, is apparent when we consider the importance of their host, which was conspicuous for its ravages on the wheat of New England in pre-revolutionary times and has recently crossed the Rocky Mountain range so as to threaten the wheat of the Pacific. During the past few years I have made a special study of these parasites, and will consider five of them in what seems to be the order of their importance. The figures accompanying this paper were prepared at the Department of Agriculture and are used here with the kind permission of Commissioner Colman.

Merisus destructor (Say).

[Plate XXI, fig. 1].

SYNONYMY.

Ceraphron destructor Say. Journal of the Academy of Natural Sciences of Philadelphia, vol. i, No. 3, pp. 45-48, read June 24, 1817. Say's Complete Writings, Le Conte edition, vol. ii, p. 6.

Eurytoma destructor (Say). Harris, a report on the insects of Massachusetts injurious to vegetation. Cambridge, 1841, p. 432.

"*One of the Eulophides.*" Westwood, Introduction to the Modern Classification of Insects. London, 1840, vol. ii, p. 160.

Pteromelas destructor (Say). Curtis. Journal of the Royal Agricultural Society. London, 1846, vol. vi., p. 139.

Raphitelus, or *Storthygocerus destructor* (Say). Harris, *op. cit.*, 2d ed. Boston, 1852, p. 586.

Semiotellus destructor (Say). Fitch. Seventh report on the noxious, beneficial, and other insects of the State of New York. Transactions of the State Agricultural Society for 1861. Albany, 1862, p. 827.

It will be seen from this synonymical list that there has been much difficulty in properly placing this insect. Since Fitch placed it in the genus *Semiotellus* it has remained undisturbed, but in view of Thomson's recent studies of the Pteromalinae it is necessary to transfer *destructor* to his genus *Merisus*.

* Untersuchungen ueber die neue Getreidegallmücke. Fulda, 1861. Translated by Dr. Carl Gissler, it appears as an appendix to the Third Report of the United States Entomological Commission, p. [8]. Washington, 1883.

This species would seem to be the most abundant of any of the parasites of the Hessian Fly, judging from the records of previous authors. Packard, in his bulletin on the latter insect,* has collected statements concerning the numbers in which these parasites occur. He quotes Herick to the effect that probably nine-tenths of every generation of the Hessian Fly is destroyed by parasites, this species constituting the larger proportion. He also quotes a Michigan correspondent, who stated that in 1877 the Hessian Fly in Kalamazoo County was nearly exterminated by the "Semioteilus," nearly all the "flaxseeds" being destroyed by it.

The relative abundance of this and the other species of the same genus is, however, in all probability, a question of latitude or location, for, in the breeding from infested wheat received from Missouri, the species described as *subapterus* in this paper has been much the most common.

The eggs of this parasite are without much doubt deposited in the half-grown larvæ of the Hessian Fly early in the spring, and in the more southern portions of the wheat belt there are in all probability two generations, the first issuing from the puparium in April and May, and the second issuing all through the summer and fall. Many, judging from my experience in-doors, hibernate in the pupa state within the Cecidomyid puparium, and cut their way out the following spring. In the North, however, there seems to be but one annual generation.

The so-called puparium is at first really nothing but a rigid, quiescent larva, corresponding to what I have called the coarctate larva in the Meloïdæ, and it will help to prevent confusion if we do so designate it in the Hessian Fly, up to the period when the real pupa is formed within it, for it must not be forgotten that another soft and final larva stage is assumed within this coarctate larva shell, and lasts much longer than the pupa state proper. I would restrict the term puparium in this case to the period during which the pupa proper dwells within it.

Whether or not there exist wingless individuals of this species becomes extremely doubtful. So far as my own breeding is concerned, none have been obtained. Harris makes no reference to them, nor does Packard in his description of the species. Say makes no reference to them in his description proper, but in the note† which Mr. Howard has called attention to as having been omitted from the Le Conte edition,‡ he remarks that the parasite "throws off its wings as a useless incumbrance," &c. So far as I am aware this habit does not occur in any of the species of the family and there has certainly been no tendency in that direction among the specimens that have come under my observation.

* Bull. 4, U. S. Entomological Commission, Washington, 1880. Reprinted, with additions, in the third report U. S. E. C., Washington, 1883.

† Journal of the Academy of Natural Sciences of Philadelphia, July, 1817, vol. i, p. 63.

‡ See *Psyche*, vol. iv, p. 206. August, September, 1884.

Herrick also disproved Say's explanation, but was in doubt whether or not to consider the wingless individuals that he observed as belonging to the same species. He says: "At page 63, it is stated that the so-called *Ceraphron destructor* throws off its wings, &c. This is not true. I have kept many of them six weeks without any such results, and never saw anything in my intercourse with them which induced me to suspect it. But it is certain that many of them are evolved with only rudiments of wings. I have seen them come out of the puparium in this state. This apterous animal is so similar to the female that I have considered it the same species; but I hardly know how to consider it. In the field I have never seen these apterous ones ovipositing or *in coitu*. Are they neuters, and if so, for what use?"

The question is answered by the existence of the other species described in this paper, which, as will be seen, is apterous as a rule, and winged only as an exception, and which was evidently mistaken by both authors for wingless specimens of *destructor*. In order to properly separate this last I have drawn up a full description, which will show its distinctive characters as compared with other allied species.

DESCRIPTIVE.

Merisus destructor (Say).

Male.—Length (average) 1.98^{mm}. Expanse of wings 3.25^{mm}. Greatest width of fore wing 0.62^{mm}. Antennæ long filiform, strongly pilose; funicle joints sub-equal in width, decreasing slightly in length from 1 to 6; joint 1 a little more than twice as long as broad; the club is nearly as long as the two preceding joints of the funicle together, ovate, flattened on the sides and acuminate at tip. The ocelli are large and prominent. Head and notum densely and rather finely punctate, the punctures on the mesoscutellum and metanotum finer than those on the head, pronotum and mesoscutum, those on the metanotum being deeper; metanotum with an indication of a median carina. The abdomen is oval, convex above, flattened below, glabrous, but very finely shagreened. The hind tibiæ have but a single apical spur, and the hind trochanter has two very minute tooth-like projections below. General color black; antennal scape yellowish, pedicel and flagellum brown to blackish, pedicel often yellowish below; head and thorax with a bluish-green metallic reflection; all coxæ black with metallic reflections; all femora black or dark brown, with yellowish tips; all tibiæ and tarsi honey-yellow. Wings perfectly hyaline; wing veins very distinct, dark brown in color; spurious veins more distinct than in *M. destructor*. Abdomen black with a yellowish spot varying in size above and below at base.

Female.—Averages in size a little larger than the male, from which she differs principally in the antennæ, which are short and have a slight clavate tendency; the funicle joints increase slightly in width and decrease slightly in length from 1 to 6; club short and obliquely acuminate; scape short, light yellow-brown in color; flagellum brown; club lighter in color than the remainder of the flagellum; pile very short and fine.

Described from 4 ♂'s, 10 ♀'s.

Differs from all other described species of the genus in the combination of the pale scape, hyaline wings, and flattened abdomen.

There can be little doubt that this is the species described by Say and elaborated by Fitch. Say's description is of a very general character, but there are two points in it that would seem to settle the question as between this and *subapterus*. The fact that he had both sexes

is made evident from the reference to the male and some of its distinguishing characters. His description therefore makes the antennæ in both sexes pale brown, and, by inference, the legs, with the exception of the tarsi, are dark. The only valid reason to question the species intended by him is his subsequent reference to the wingless form; but we must assume that, like Herrick, he looked upon his wingless individuals as probably the same species without very critically using them for descriptive purposes.

Fitch's description, while quite lengthy, is lacking in a remarkable degree in important structural characters, but his description of the legs supplements Say's and makes it, in connection with other characters given, quite evidently apply to the species under consideration.

Packard's description is largely a repetition of Fitch's with some additional statements as to the coloration of the legs which, together with his statement that the antennæ are black, make it somewhat doubtful as to the species intended. There is, however, some variation in the color of the antennæ which might well be called black in some specimens, especially upon hasty examination.

No wingless individuals of this species have been found. A number of specimens were bred between May and August, 1880, from wheat-stalks received from Mr. E. J. Chiswell, Dickerson's, Md. In each case the parasites issued from the coarctate larva, and in no instance more than one Chalcid each. From wheat sent by Mr. Barlow, from Cadet, Mo., in the spring and summer of 1883, two females of the species issued, one in July and one in August, and in April two more females and two males issued from the straw, in company with many specimens of *M. subapterus*.

Mr. L. O. Howard would place this species in the genus *Merisus* with which it seems to have considerable affinity, although it possesses certain characters which would exclude it according to Thomson's rigid definition. Thus the abdomen approaches much more nearly that of *Dimachus*, while the rudimentary median carina of the metanotum would place it between this latter genus and *Merisus*. It is a well-marked form, and may rest quietly in this genus until the American Pteromalinae are thoroughly studied as a whole.

***Merisus (Homoporus) subapterus*, n. sp.**

[Plate XXI, fig 2.]

Wingless male.—Length varies from 1.58^{mm} to 2.74^{mm}. Antennæ inserted a little below the middle of the face, their bases close together, but still distinctly separated; scape reaching to the ocelli; flagellum short, finely pilose, club oval-acuminate, flattened laterally; joints of the funicle subequal in length, joint 1 a trifle longer than broad, the rest increasing very slightly in width to joint 6, which is as wide as long. Cheeks well rounded; ocelli in a curved line, middle ocellus indistinct; head considerably broader than thorax, densely and finely punctate. Pro- and mesonotum with punctation similar to that of the head; metanotum rounded, with somewhat larger and deeper punctures. Abdomen ovate, acuminate, not flattened, perfectly glabrous. Color: Head and thorax with a dark-greenish metallic luster; bulla of antennæ black, scape and pedicel honey yellow; flagellum yellow-brown, often with

Oct. 3

Vol. VIII, No. 27. Washington, D. C. Sept. 17, 1885.

a darker metallic tinge, especially at joints, causing the flagellum in some instances, particularly in the smaller individuals, to appear dark; pile whitish; all legs honey-yellow; coxæ very slightly metallic at base; tarsi, and sometimes distal end of tibiæ, whitish; abdomen black; penis (often extruded to a considerable length) brown.

Female (winged and wingless).—Length varies from 1.8^{mm} to 2.8^{mm}; average wing expanse, 3.75^{mm}. Differs from male in the following respects: The antennæ are more clavate, the sixth funicle joint slightly broader than long; the flagellum is always black, with a slight metallic tinge, and the pedicel is usually tipped with black at its distal end; the pile is much shorter and finer than in the male. The femora and the tibiæ are in general of a darker brown, in which case the knees and the distal third of the tibiæ are whitish. The metallic luster of the thorax is more subdued, and the abdomen has the characteristic female notch when seen from the side. The wings are perfectly hyaline, and the veins are only faintly tinged with yellowish; the spurious veins are very faintly perceptible.

Described from many ♂ and ♀ specimens, only 3 of the latter being winged. All bred from final larva of the Hessian Fly, collected at Cadet, Mo., by J. G. Barlow, and issuing through the coarctate larva shell.

Distinguished from other described species by the contrasting antennæ in the sexes and by the ovate abdomen which, when fresh, has no flattened dorsal surface.

There can be no question but that the wingless and winged individuals are specifically identical. The proportion of the wingless to the winged varies at different seasons and in different parts of the country. Thus from a lot of puparia of the Hessian Fly, received in the summer of 1883 from Missouri, there issued 31 wingless males, 28 wingless females, and 3 winged females. Of these, about one-third issued from the straw in August, 1883, and the rest, including all the winged individuals, hibernated in the straw and issued in April and May, 1884.

While, as the descriptions show, there are many very important points of difference between these two species—points that would even separate them subgenerically and, according to some authors, generically, the distinguishing features that will be most readily observed by casual examination are as follows:

Destructor is on an average of smaller size; more uniformly metallic in color; has a flatter abdomen, with yellowish spot at base; has the antennæ similar in both sexes (generally darkest in the male), and either pale-brown or blackish-brown; has the coxæ metallic-black, the femora brown or black, except toward tip; the paler parts of legs whiter than in *subapterus*. It does not, so far as we now know, occur in the apterous condition.

Subapterus is on the average larger; of darker color and less metallic, with the flagellum of the antennæ pale in the male and black in the female; the abdomen much more rounded and without pale spot; the coxæ, trochanters, femora, and basal part of tibiæ honey-yellow. It occurs mostly in wingless condition.

The jaws are brown in both sexes, but more conspicuously so in *Subapterus*.

Eupelmus allynii (French).

[Plate XXI, figs. 3 and 4.]

SYNONYMY.

Isosoma allynii French. Canadian Entomologist, vol. xiv, p. 9. (January, 1882.)*Eupelmus allynii* (French). Riley, American Naturalist, vol. xvi, p. 247. (March, 1882.)

This species was originally published by Prof. G. H. French as a wheat depredator of the genus *Isosoma*. Specimens which he sent me, however, soon after his publication of the species, showed that it belonged to *Eupelmus* and not to *Isosoma*, and that, therefore, it was a parasite and not a plant-feeder. The question at once arose: "Upon what is it parasitic?" Professor French answered this question as follows: "The genus *Eupelmus* is parasitic as far as known, and I presume *E. allynii* is no exception. I may say that I have obtained another specimen of this species from a gall in a stalk, produced evidently by the regular joint-worm (*Isosoma hordii*). From this and from the fact that my specimens were obtained from burrows made in the wheat-stalks by this new *Isosoma*, it seems to me that we have here a parasite on the real wheat-stalk worm. * * * It should be borne in mind, also, that the *Eupelmus* is a probable destroyer of the real wheat enemy.* In the annual report of the U. S. Entomologist for 1881-'82, I wrote (p. 186): "Although we cannot yet say with certainty that *Eupelmus allynii* is parasitic upon our wheat *Isosoma*, yet, considering the circumstances under which it was obtained, this seems probable." Prof. S. A. Forbes also remarks: "Professor French found *Eupelmus allynii* also in the straws, thus confirming the hypothesis of its parasitism on *Isosoma*."† It is thus rendered quite certain that *Eupelmus allynii* is parasitic on *Isosoma*, and I was able to confirm the evidence quoted by subsequently breeding the parasite from *Isosoma hordii* received from Mr. E. C. Brooke, of Cuckoo, Louisa County, Virginia, and but a few days later a large series was raised from straw containing only *Isosoma tritici*, received from F. M. Webster, Oxford, Ind. There can, therefore, be no question but that the species is parasitic upon both *Isosoma hordii* and *I. tritici*.

While, therefore, there can be no doubt about the real parasitism on *Isosoma* there is just as little doubt as to its being parasitic on the Hessian Fly; for I find that two specimens (both females) were bred by me from coarctate larvæ of the Hessian Fly on July 18, 1876, at Saint Louis, Mo., the straw having been received from the interior of

* Eleventh Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. By Cyrus Thomas, Ph. D., Springfield, 1882, p. 81, foot note.

† Thirteenth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. S. A. Forbes, Springfield, Ill., April, 1884, p. 34.

the State. Three other specimens, consisting of one male and two females, were also bred at Washington, July 31, and August 8, 1883, from coarctate larvæ received a few weeks before from Mr. J. G. Barlow, of Cadet. Mo.

That there can be no question as to the identity of the parasite I will state that the specimens just mentioned were carefully compared, not only with Professor French's description, which might leave a doubt, but also with type specimens of both sexes received from him.

In the genus *Eupelmus* there is great want of uniformity of habit in regard to host, while in most other Chalcid genera the uniformity in this respect is very marked. On account of this polyphagic habit, as well as by virtue of its other peculiarities, the genus long ago interested me, and I have obtained it from Lepidopterous eggs, from Orthopterous eggs, from Hemipterous eggs, from Cynipid galls, from Cecidomyid galls, from Lepidopterous larvæ, from Coleopterous larvæ, and from free Cecidomyid larvæ.

I am not aware that this species has ever before been bred from the Hessian Fly, although it may be the fourth parasite mentioned so indefinitely by Herrick.*

***Tetrastichus productus* n. sp.**

[Plate XXI, fig. 5.]

This species was bred in considerable number March 31, 1884, from coarctate larvæ sent by Mr. Barlow from Missouri the summer previous. It is impossible from the evidence we possess to say with certainty whether this species is really a parasite upon the Hessian Fly or whether it is a secondary parasite, having some one of the other parasites as its proper host. This is always an extremely difficult point to determine, in considering any insect from which several species of parasites have been bred. In such cases all of the parasites have usually been described as *primary, i. e.*, true parasites of the species from which they were reared; but the habits of the genus, so far as known, should guide us in our conclusions, in default of absolute data or direct observation. Several cases have come under my notice in which *Tetrastichus* was without question a secondary parasite and several more are given by Giraud and Laboulbène.† From these facts I am strongly inclined to believe that the species of *Tetrastichus* are usually, if not invariably, parasitic upon the smaller Hymenoptera belonging to the Chalcididæ, Cynipidæ and Braconidæ, and I am thus inclined to consider *T. productus* not as a parasite of the Hessian Fly, but a secondary parasite feeding upon some one of the others, and probably upon *Merisus destructor*.

* American Journal of Science and Arts, vol. xli p. 155. New Haven, October, 1841.

† Liste d'Éclousions d'Insectes. Ann. de la Soc. Ent. de France, t. vii, Sér. V, pp. 433, 444 (1877).

DESCRIPTIVE.

Male.—Average length, 1.5^{mm}; wing expanse, 2.6^{mm}; greatest width of fore wing, 0.5^{mm}. Scape somewhat broadened below, inserted near the middle of the face in a deep groove, and reaches nearly to the ocelli. Flagellum long, flattened, hairy, each joint except club with a whorl of long slender hairs at base. Funicle joints decreasing in length slightly from 1 to 4, joint 1 rather more than twice as long as wide. Head considerably shrunken after death. Head, pronotum, and mesonotum smooth and shining; metanotum, pro, meso, and metapleura, and all coxæ above, finely punctate. Submarginal vein of the fore wing with a single stout superior bristle behind its middle; marginal vein three times as long as stigmal; post-marginal wanting. Median impressed line of mesosternum very distinct; metanotal carina distinct, rather short. Abdomen narrow, compressed laterally, sub-acuminate. General color shiny black, with slight metallic reflections; flagellum, brown; all trochanters, distal end of all femora, all tibiæ, and tarsi, honey yellow; wing veins, brown, very distinct.

Female.—Length (average), 2.1^{mm}; wing expanse, 3.2^{mm}; greatest width of fore wing, 0.55^{mm}. Scape slender, pedicel ovoid, ring joints very small; flagellum rather short, but slightly compressed; club ovate; funicle joints subequal in size, joint 3 rather shorter than 1 and 2, its length exceeding its width but slightly. Abdomen narrow, flattened dorso-ventrally, prolonged to an acute tip.

Described from six males and seven females.

Belongs in the first division of section 1 of Thomson's revision of the genus, and is more nearly related to *T. scaposus* than to other species, chiefly on account of the dilation of the ♂ scape, but from this it is at once separated by the produced abdomen of the ♀.

Platygaster herrickii Packard.

[Plate XXI, fig. 6.]

SYNONYMY.

Platygaster error Fitch (?) Packard. Bulletin 4, U. S. Entomological Commission, pp. 20, 21; Washington, 1880. Third Report U. S. E. C., pp. 219, 220; Washington, 1883.

Platygaster herrickii (?) Packard. *Ibid.*

In Bulletin 4 of the United States Entomological Commission Dr. Packard gave a description of a parasite received from Prof. A. J. Cook, which had been bred from the coarctate larva of the Hessian Fly. This parasite he identified doubtfully as the *Platygaster error* of Fitch, stating that if later it should prove to be a different species it might be called *Platygaster herrickii*. I adopt this latter name for the reason that Fitch's description is so very indefinite that it will apply equally well to almost any species of the genus, and that, inasmuch as *Platygaster error* was bred by Fitch from the eggs of a Heteropterous insect, it was in all probability different from this Hessian Fly parasite.

Concerning this parasite Professor Cook, in his lecture on the Hessian Fly, says:

"One of the parasites of the genus *Platygaster* is an egg parasite, as its young feed on the eggs—mere specks as they are—of the Hessian Fly.

"It is black and looks not unlike a tiny guat. The female feels for the eggs with

her antennæ, and when found intrudes the fatal egg, which I find takes three-fourths of a minute, full three times as long as it takes the Hessian Fly. The little parasite is much longer, too, in finding the eggs than the fly is in laying them. I find that each egg receives one, two, or three of the parasite's eggs. The eggs of these latter are tardy in hatching, so that the larva of the parasite may feed on the maggot of the Hessian Fly, not her eggs. These pupate in the puparium of the fly."*

Dr. Packard considers it probable that this insect is the same species as Herrick mentions and speaks of as follows:

"The insect is abundant in the autumn. I first saw it September 23, 1833, in the act of depositing its eggs in the eggs of the Hessian Fly. From subsequent observations it appears that four or five eggs are laid in a single egg of the Hessian Fly. The latter egg hatches, and the animal advances to the pupa state as usual, but from the puparium no Hessian Fly ever comes forth. The parasite forms within the puparium a silky cocoon of a brownish color."†

There is probably some error in the above recorded observations. It is contrary to all precedent, as remarked by Mr. Howard in a note to page 219 of Dr. Packard's article, just quoted, that a female *Platygaster* should oviposit in an egg, and, even allowing such a possibility, it is highly improbable that an egg so pierced would hatch and the *Platygaster* imago issue only from the coarctate *Cecidomyia* larva, as parasitized eggs so far as we now know do not hatch. We should be slow to reject asserted observation, however opposed to general rule, but in this case verification is very desirable on account of the soft nature of the *Cecidomyia* egg and its general resemblance to the young larva.

The twenty-two specimens of this species which I have studied were all bred in March, 1884, from the puparia of the Hessian Fly which were received in August, 1883, from Mr. Barlow, of Cadet, Mo.

The Hessian Fly in Europe is also parasited by one or more species of the genus *Platygaster*, and Dr. Packard has received specimens, which I have examined, from Prof. Ferdinand Cohn, of Breslau. These are so badly mutilated, however, that nothing more than the genus could be determined. It is evidently a different species from *Pl. herrickii* and is considerably smaller.

It will be unnecessary to give a detailed description of *herrickii*, as Dr. Packard has already described it at length in Bulletin 4 of the United States Entomological Commission, and also in the third report of the commission. The description is recognizable, but the figure given in both of these reports is taken from Fitch, and is so poor that I have had a new figure made (Pl. XXI, Fig. 6).

A single female *Tetrastichus* was sent to me last June as a parasite of the Hessian Fly, by Prof. S. A. Forbes. It differs from *T. productus*, and he has given it the indistinctive MS. name of *carinatus*, but there is the same question as to whether it is a primary or secondary parasite which I have raised in speaking of *productus*. It is smaller than *pro-*

*Sixteenth Annual Report of the Secretary of the State Board of Agriculture of the State of Michigan (1877), p. 375.

†American Journal of Science and Arts, xli, 153-158 (October, 1841).

ductus, from which it strikingly differs in its bright lemon-yellow legs, in its shorter and less produced abdomen, and in other less obvious characters. But two other ♀'s were bred, so that the ♂ is unknown.

Finally, I have reared a single *Microgaster* from straws infested with Hessian Fly, but as there is doubt about its parasitism on this insect I omit consideration of it for the present.

DESCRIPTION OF LEPTOPHIDIUM CERVINUM AND L. MARMORATUM, NEW FISHES FROM DEEP WATER OFF THE ATLANTIC AND GULF COASTS.

By G. BROWN GOODE and TABLETON H. BEAN.

Leptophidium cervinum, n. s.

The type (No. 28764, U. S. National Museum), an individual 262^{mm} in length, was taken at "Fish Hawk" station 941, latitude 40° 01' N., longitude 69° 56' W., at a depth of 76 fathoms.

Description.—Body elongate, slender, its greatest height (25^{mm}) 10½ in its total length.

Head slender, somewhat compressed, its length (40^{mm}) 6½ in total length. Interorbital area broad, convex, its width equal to the length of the snout and 5⅓ in head's length. Snout sharp, conical, armed with a short but sharp spine, and somewhat overhanging the mouth. Eye circular, its diameter (10^{mm}) 4 in head's length, and much exceeding the length of the snout. Maxilla extending nearly to the vertical through the posterior margin of the orbit, its length (15^{mm}) three-eighths of head's length. Mandible extending behind the same vertical, its length (18^{mm}) equal to that of head without its postorbital portion. Jaws, vomer and palatines with narrow bands of villiform teeth, some of which are noticeably enlarged (*not movable*). Pseudobranchiæ present. Gill-rakers short, 8 below angle of first arch, 4 of which are rudimentary, the longest (2^{mm}) 5 in diameter of eye. (In *L. profundorum* the gill-rakers are slenderer and longer, though about equally numerous on the first arch.)

Scales in about 11 rows from the origin of the dorsal to the median line of the body.

Ventrals with length (13^{mm}) 3 in that of head.

Dorsal origin far back, at a distance from the snout (55^{mm}) 4¾ in total length; at a distance from the eye equal to head's length. (In *L. profundorum* this distance is two-thirds of the head's length and the first ray of the dorsal is nearly over the middle of the extended pectoral; in *L. cervinum*, over its tip, or nearly so.)

Anal origin with distance from snout (84^{mm}) 3 in total length. Length of pectoral (19^{mm}) 2 in head's length and 13 to 14 in that of body (10 in *L. marmoratum*, 11 in *L. profundorum*).

EXPLANATION OF PLATE XXI.

FIG. 1. Head of *Hesperomys Truei*, ♂, life size. From the specimen captured at Fort Wingate, N. Mex., March 16, 1885.

FIG. 2. Head of *Hesperomys leucopus sonoriensis*, ♂, life size. From the specimen taken at Fort Wingate, N. Mex., May 16, 1885.

FIG. 3. Head of *Ochetodon humilis*, ♀, life size. From the specimen taken at Fort Wingate, N. Mex., June 30, 1885.

FIG. 4. Superior aspect of the cranium of *Neotoma floridana*, ♂, natural size. Specimen taken at Fort Wingate, N. Mex., January 11, 1885.

n. mx. Nasal process of the superior maxilla.

FIG. 5. Superior aspect of the cranium of *Hesperomys Truei*, ♂, natural size. Type specimen.

n. mx. Nasal process of the superior maxilla.

FIG. 6. Left lateral view of mandible of *Neotoma floridana*, natural size. Same specimen as Fig. 4.

FIG. 7. Left lateral view of mandible of *Hesperomys leucopus*, natural size. Specimen 4856, National Museum Collection.

FIG. 8. Left lateral view of mandible of *Hesperomys Truei*, natural size. Same specimen as Fig. 5.

(All the figures drawn from nature by the author.)

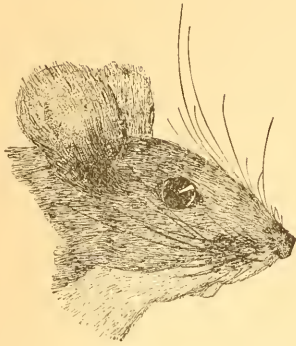


Fig. 2.

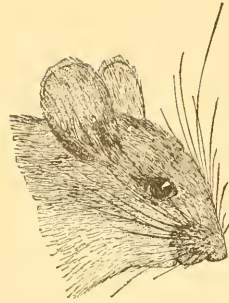


Fig. 3.



Fig. 1.

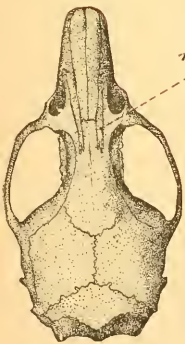


Fig. 4.

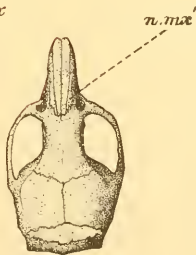


Fig. 5.



Fig. 7.



Fig. 8.



Fig. 6.