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LIST OF GENERA, SPECIES AND FORMS NEW TO SCIENCE

ART. I. TWO NEW PASSERINE BIRDS FROM ANGOLA

By James P. Chapin

The American Museum of Natural History

During the years when Mr. Rudyerd Boulton was devoting special attention to the birds of Angola, he made several valuable collections there, for the American Museum of Natural History and for the Carnegie Museum. A number of the new forms he discovered were described by Mr. Boulton, but two more which deserved new names still remained in the Carnegie Museum collection. At the request of Mr. W. E. Clyde Todd, I have prepared the following diagnoses.

The Representative of Bradypterus mariae in Angola.

In the revisions of the genus *Bradypterus* by Mackworth-Praed and Grant (*Ibis*, 1941, pp. 441-455) and by J. Delacour (*Ibis*, 1943, pp. 31-40), there is no mention of any race of *B. mariæ* or *B. cinnamomeus* from the highlands of Angola. Yet the Carnegie Museum has long had three skins from that region which clearly represent *Bradypterus mariæ*. Two of them are immature birds, retaining a yellowish wash on the underparts, from 6,200-6,300 feet on Mount Moco, February, 1931; and the other is an adult female from Mombolo, around 5,000 feet, taken on March 7, 1931. All were collected by Rudyerd Boulton.

It might seem unwise to describe a new race with but one adult specimen, and I do it only because the Angola highland is so far removed from any district where a race of *B. mariæ* has hitherto been known to live. The new race is named in honor of my friend Rudyerd Boulton.

Bradypterus mariæ boultoni, subsp. nov.

Type, No. 109,511, Collection Carnegie Museum, adult female; Mombolo, in the northwestern part of the Benguela highland, March 7, 1931; Rudyerd Boulton.

Subspecific characters.—Rather similar to *Bradypterus mariæ usambaræ* Reichenow of eastern Africa, but a little lighter brown on crown, back, and rump, somewhat lighter beneath, and more tinged with buff on breast and flanks. Somewhat larger than *B. m. camerunensis* Alexander of Mount Cameroon.

Measurements.—The type has the wing 62 mm.; tail 61; culmen to base 15.5; tarsus 25. Two immature females from Mount Moco have wings 63, 64; tails 59, 60; culmen to base 15, 16; tarsi 23, 24.5.

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Range.—This probably includes many more districts of Angola in addition to Mombolo and Mount Moco, at elevations above 5,000 feet, where suitable scrubby woods exist.

Remarks.—Both young individuals have 10 rectrices, but the tail of the type is incomplete. There is good reason to suppose that the *Bradypterus mariæ* group is conspecific with *B. barratti* Sharpe of South Africa, and the one specimen of *barratti* I have recently examined also had a tail of only 10 quills.

A New Race of Terpsiphone from Northwestern Angola.

The Lower Congo district and the adjacent Loango Coast are the home of a Paradise Flycatcher with rather short crown-feathers, blackish head, underparts more grayish, and back, wings, and tail rufous, the median rectrices lengthened in adult males. It was named *Terpsiphone rufocinerea* by Cabanis in 1875, the type locality being Chinchoxo, a little north of Landana.[1]

In 1857, Verreaux had described *Tchitrea melampyra* from the Gaboon,[2] and that name has often been supposed to antedate *rufocinerea*. But in 1938, Professor Erwin Stresemann informed me that he had examined the type of *melampyra* in the British Museum and found it to be a dull-colored example of some form of *T. viridis*.

Terpsiphone rufocinerea batesi Chapin[3] is a well-marked race living in the forests of the Upper Congo and Cameroon, lighter and grayer on head and breast, with median rectrices never much longer than the rest of the tail. In 1921, I examined four specimens of nominate *rufocinerea* from Chinchoxo in the Berlin Museum, and compared with them an adult male I had myself collected at Boma on the lower Congo River. The range of this race seems to extend northward along the coast to the base of Mount Cameroon, and examples of intermediate nature are not uncommon in forested southern Cameroon.

To the southward, *rufocinerea* has been reported as extending to Ndala Tando and even Novo Redondo in Angola. Doctor D. A. Bannerman, in

[1] *Terpsiphone rufocinerea* Cabanis, 1875, Jour. Ornith., p. 236 (Chinchoxo, Loango Coast).

[2] *Tchitrea melampyra* Verreaux, 1857, *in* Hartlaub, System der Ornithologie Westafrica's, p. 90 (Gaboon).

[3] *Terpsiphone batesi* Chapin, 1921, Amer. Mus. Novitates, no. 7, p. 6, fig. 3 (Medje, northeast Belgian Congo).

1936,[4] discussed the possibility that specimens from Ndala Tando were different from those of the Loango Coast, but he regarded the name *rufocinerea* as a synonym of *melampyra*, and came to no final conclusion.

In March, 1931, at Ngara, some 30 kilometers northeast of Novo Redondo, Rudyerd Boulton collected two adult males which are plainly conspecific with *T. rufocinerea*, but distinctly grayer on head and throat than the nominate form, although retaining the bright rufous under tail-coverts. At the same locality, on September 29, 1939, he had also secured an adult male of *T. viridis plumbeiceps*. This does not prove that both birds nest there, for *plumbeiceps* is known to be migratory between April and October.

The two males of *T. rufocinerea*, taken in March, were noted as ready to breed, and they show that an unnamed race of that species does live in northwestern Angola. Doctor Bannerman found that eight specimens from Ndala Tando were lighter in color than all but one of those he had seen from farther north; and in the Rothschild Collection there is a female from Canhoca, Angola, which plainly represents the race I propose to name in honor of my friend David Bannerman.

Terpsiphone rufocinerea bannermani, subsp. nov.

Type, No. 109,533, Collection Carnegie Museum, adult male; Ngara, northwestern Angola, March 10, 1931; Rudyerd Boulton.

Subspecific characters.—Similar to *Terpsiphone r. rufocinerea* Cabanis of the Loango Coast, but with head, throat, and breast lighter and grayer, much less glossy on throat. There is a slight crest in *bannermani*, and the whole crown is very dark gray, glossed with blue-green. The longest feathers in the crest measure 14-14.5 mm. The rufous coloration of back and tail is usually a little lighter than in nominate *rufocinerea*, the rufous of under tail-coverts not quite so deep. The under wing-coverts are whitish, washed with pale rufous, and becoming more rufous toward the outer edge of the wing.

Measurements.—The type has the wing 84 mm.; long median tail-feathers 252, next longest pair 122, and outermost rectrices 79 mm.; culmen to base 19.5; tarsus 15.5. The second male from Ngara has wing 84; median rectrices 227, next pair 94, outermost 75; culmen to base 19; tarsus 16. The female from Canhoca, wing 79; tail 84; culmen to base 18; tarsus 15.5.

[4] D. A. Bannerman, 1936, The Birds of Tropical West Africa, vol. 4, p. 301.

Range.—Northwestern Angola, from the vicinity of Novo Redondo at least to Ndala Tando, probably to be found only in the more heavily wooded situations.

Remarks.—In this same region *Terpsiphone viridis plumbeiceps* is widely distributed; but it is readily distinguished by its better-developed crest, with feathers measuring 15 to 19 mm. in males, and by its pale under tail-coverts, which are either whitish or tinged only lightly with rufous.

In more ways than one, this new race, *bannermani*, is intermediate between *T. r. rufocinerea* and *T. v. plumbeiceps*. Yet it would be difficult to treat all three as conspecific, because from the interior of southern Cameroon to the forested Upper Congo *T. rufocinerea batesi* lives side by side with *T. viridis speciosa*, the former keeping to the heavy shade of primary forest, while the latter haunts second growth and leafy trees in clearings. A similar difference in haunts may well prevail in Angola, especially during the breeding season.

ART. 2. CRITICAL REMARKS ON THE WOOD-HEWERS

By W. E. Clyde Todd

The Wood-hewers or Tree-creepers (Dendrocolaptidæ) are represented in the collection of the Carnegie Museum by 2,544 specimens,[1] belonging to 155 species and subspecies. The Wood-hewers are wholly neotropical in their distribution, and their center of abundance is in the equatorial region of South America. Studies made some years ago resulted in the description of eight new forms of this family, and a more recent critical study has revealed the existence of eleven additional subspecies which appear to be new to science. In connection with the descriptions of these new forms there are included herewith some taxonomic discussion of other known forms which seem to be in need of further elucidation. Certain of these studies were made possible only through the loan of specimens from other collections. I am deeply grateful to Mr. John T. Zimmer of the American Museum of Natural History and to Dr. Herbert Friedmann of the U. S. National Museum for the loan of key specimens of Wood-hewers from the collections of their respective institutions.

All measurements are in millimeters, and that of the bill is for the exposed culmen. The names of colors are taken mostly from Ridgway's "Color Standards and Color Nomenclature." Most of the localities appearing in the present paper were listed by the author in an earlier paper, on Hummingbirds (Annals Carnegie Museum, Vol. 29, 1942, pp. 365-370).

Xiphocolaptes orenocensis paraensis Pinto

Three specimens: Santarem, Colonia do Mojuy, and Apacy, Brazil.

This form was described by Sr. Oliveira Pinto (Papéis Avulsos Departmento de Zoologia, etc., São Paulo, 5, No. 15, 1945, 135) as a race of *Xiphocolaptes promeropirhynchus*, which according to Hellmayr's views is not conspecific with *X. orenocensis*. With this disposition I agree, after examination of the several forms involved. Pinto's type-series (all but one specimen) came from the right bank of the Rio Madeira, but his description applies well enough to our birds from the Rio Tapajóz. They resemble *Xiphocolaptes orenocensis berlepschi* Snethlage of the Rio Purús and upper Amazon, but the pileum is more blackish, less brownish, with

[1] This number includes 249 specimens alienated from the collection by exchange.

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narrower shaft-streaks, and the bill is much darker-colored. According to the collector's notes, the maxilla in *paraensis* is "blackish," and the mandible is "intensely dark horn gray with blackish tip." In the Rio Purús specimens, however, the maxilla is "dark horn gray," and the mandible is "light horn gray with a faint bluish pearly gloss on the basal half." Hellmayr (1925, 285) also mentions these differences, as well as Griscom and Greenway (1941, 210), but they made no formal separation.

Compared with two specimens of true *orenocensis* (American Museum), our Rio Tapajóz birds have the bill darker-colored, while the striping on the underparts is much heavier, and the pileum is blacker. One of our specimens is more rufescent than the other two.

Xiphocolaptes orenocensis orenocensis von Berlepsch and Hartert.

Except for its deeper coloration, a single specimen from Manacapurú agrees well enough with two Orinoco skins, and should doubtless be referred to *orenocensis*, the range of which will have to be extended accordingly.

Dendrocolaptes certhia ridgwayi Hellmayr.

Messrs. Griscom and Greenway (1941, 208-9) remark that this series "supports Zimmer's comments [1934b, pp. 2-3] on the variability of this species." They add that "three Santarem birds are the *concolor* type," but I find myself unable to pick them out, and I unhesitatingly refer all our fifteen specimens from the east bank of the Rio Tapajóz to one and the same form, which, as these authors show, must bear the name *ridgwayi*.

Dendrocolaptes certhia juruanus von Ihering.

Twenty-three specimens: Hyutanahan, Nova Olinda, Arimã, São Paulo de Olivença, and Caviana.

Caviana birds are almost certainly subspecifically separable by reason of their paler coloration and narrower barring, but inasmuch as they are closely approached in these respects by certain of the Rio Purús series I do not care to take this step with only two specimens available. Birds from São Paulo de Olivença, on the other hand, in their heavier barring and their tendency to more rufescent coloration, approach *polyzonus* of Bolivia. If we discard the supposed record from Marabitanas on the Rio Negro, as suggested by Zimmer (1934b, 1), *juruanus* emerges as a race confined to the region south of the middle and upper Amazon.

Dendrocolaptes concolor von Pelzeln.

Nine specimens: Villa Braga and Itaituba, Brazil.

To my eye these birds are perfectly distinct from the east-bank birds, for which the name *ridgwayi* will have to be restored, as already said. The very fact that the two forms behave as they do, as described by Zimmer (1934b, 2-3), indicates that they are really distinct species. I find no specimens in our series which cannot certainly be referred to one or to the other.

Xiphorhynchus eytoni vicinalis, subsp. nov.

Type, No. 78,061, Collection Carnegie Museum, adult male; Apacy, Rio Tapajóz, Brazil, April 30, 1920; Samuel M. Klages.

Subspecific characters.—Similar to *Xiphorhynchus eytoni eytoni* (Sclater) of the Pará region of Brazil, but underparts with more buffy suffusion, and the abdomen usually tinged with clay-color; streaking of the upper- and underparts averaging heavier.

Range.—Rio Tapajóz region of Brazil, and eastward for an undetermined distance.

Remarks.—Mr. Zimmer (1934c, 1-4) has fully discussed the variations in the series of this and related forms examined by him. In spite of his dictum that *eytoni* is best left undivided, I agree with Griscom and Greenway (1941, 212) in believing that another form should be recognized. They call attention to the fact that Zimmer had no topotypes of *eytoni*. Certainly there is a definite line of demarcation between our twelve Benevides birds on the one hand and those from the Rio Tapajóz (twenty-five) on the other, as above indicated. I have examined also ten specimens (from Villa Bella Imperatriz, Borba, and Faro) which Zimmer calls *eytoni*, but which are not *eytoni* at all, but the new form I am describing herewith. Some of them come from the same places as undoubted specimens of *guttatoides*, from which they can at once be distinguished by the differently colored bill. *X. guttatus guttatoides*, be it noted, has a pale bill, while *eytoni* and the new form both have dark-colored bills (at least the maxilla is dark). *X. g. guttatoides* and the present form may be subspecies, separated ecologically, as Zimmer suggests, but would not this be a new kind of subspecies? I am inclined under the circumstances to rank them as species. Two specimens from Faro show that this new form ranges north of the Amazon.

Xiphorhynchus guttatus connectens, subsp. nov.

Type, No. 83,523, Collection Carnegie Museum, adult male; Obidos, Brazil, January 29, 1921; Samuel M. Klages.

Subspecific characters.—Most nearly resembling *Xiphorhynchus guttatus polystictus* (Salvin and Godman) of the Guianas and eastern Venezuela, but the underparts are more deeply suffused with buff, and the light stripes on the pileum, nape, and upperparts average heavier, and deeper buff. (Thirteen specimens examined.)

Range.—Known only from the type-locality, but probably ranging westward to the Rio Negro and eastward for an indefinite distance, on the north bank of the Amazon.

Remarks.—Messrs. Griscom and Greenway, who handled these specimens, referred them without comment to *polystictus*, but more careful comparison shows that they differ appreciably from that form, as it is represented by a series from Venezuela and French Guiana, in the respects pointed out above. They form a connecting link, in fact, between *polystictus* and *guttatoides*, and come from the region between the respective ranges of these forms. As a rule, however, French Guiana forms usually range unchanged to the Amazon at Obidos.

Xiphorhynchus triangularis triangularis (Lafresnaye).

Of our series of twenty-seven specimens, all but four come from Venezuela, and should therefore represent *hylodromus* Wetmore (1939, 2). Even with his type-series before me, I have great difficulty making out this form. Four specimens from Las Ventanas, Santander, Colombia, which may be considered to represent true *triangularis*, are scarcely separable, in my opinion. The light spotting of the underparts is perhaps a little less dense, but the difference is very slight, and I would question the validity of *hylodromus*. However, in the Western Andes of Colombia there lives a population about whose distinctness there can be no question. Let it be called, therefore,

Xiphorhynchus triangularis distinctus, subsp. nov.

Ten specimens: Heights of Caldas, Bitaco Valley, and La Cumbre, Colombia.

Type, No. 67,543, Collection Carnegie Museum, adult male; Bitaco Valley, Colombia, July 6, 1918; M. A. Carriker, Jr.

Subspecific characters.—Similar to *Xiphorhynchus triangularis triangu-*

laris (Lafresnaye) of the Eastern Andes of Colombia, but general coloration darker; upperparts between orange citrine and medal bronze (instead of citrine); rump and upper tail-coverts heavily shaded with argus brown; wings externally much darker (more rufescent, less olivaceous); tail bay (instead of auburn); underparts darker olive, the throat deeper buffy; and under tail-coverts less rufescent.

Range.—Subtropical Zone, Western (and Central ?) Andes of Colombia.

Remarks.—Chapman had some specimens of this species from the Western Andes, but could "detect practically no racial variation," except that birds from the "Central and Western Andes may average slightly more rufescent above" (1917, 420). But with smoothly and uniformly made-up skins available for comparison, the difference between birds from the Eastern Andes on the one hand and those from the Western Andes on the other is obvious, and it is too great to ignore, as Hellmayr and other authors have done.

The range of this form approximates that of *æquatorialis* of the lower levels (Tropical Zone) in this region, but there is no reason to suppose that they intergrade, and I consider them specifically distinct.

Xiphorhynchus pardalotus caurensis, subsp. nov.

Sixteen specimens: La Lajita, Rio Mocho, El Llagual, and Rio Yuruan, Venezuela.

Type, No. 32,306, Collection Carnegie Museum, adult male; Rio Mocho, Rio Caura, Venezuela, November 23, 1909; M. A. Carriker, Jr.

Subspecific characters.—Similar to *Xiphorhynchus pardalotus pardalotus* (Vieillot) of French Guiana, but general color of upperparts more rufescent, less olivaceous, and buffy streaks of upper- and underparts narrower and less pronounced.

Range.—Southern Venezuela, from the Rio Caura east to the Guiana frontier.

Remarks.—It is not strange that the geographical variation in this species has been overlooked, since satisfactory series for comparison are wanting in most collections. But with the specimens above listed, and a fine series (thirty-two skins) from French Guiana as well, it is at once obvious that they represent two different races. In the nominate form the upperparts (in fresh plumage) may be described as medal bronze of Ridgway, while in the Venezuelan form it is nearer Dresden brown. The underparts differ in a corresponding manner; the streaking on both the

upper- and underparts differs as aforesaid; it is less strongly marked in the Venezuelan race.

Xiphorhynchus elegans ornatus Zimmer.

Four specimens: São Paulo de Olivença, Brazil.

These were handled and listed by Zimmer (1934c, 7-10). They belong to a form closely allied to *elegans*, but in my opinion not conspecific with *spixii*, which form occurs, however, on the east bank of the Rio Tapajóz. That *ornatus* is not conspecific with *juruanus*, as it is given by Zimmer, is proved by the fact that they both occur at the same place—São Paulo de Olivença. Zimmer actually lists them thus, but suggests that one of them must have been taken "near?" that place. This is not the case. Specimens of both forms were actually taken on the same date, and Mr. Klages assures me that they came from precisely the same collecting-station. This circumstance definitely disposes of the case of *ornatus* and *juruanus*, and by implication that of *elegans* and *spixii* also. Even Hellmayr, who always tried to unite related forms as conspecies wherever possible, could not see his way clear to do so in these cases, and neither can I.

Xiphorhynchus obsoletus multiguttatus (Lafresnaye).

Twenty-three specimens: Hyutanahan, Nova Olinda, and Arimã, Brazil.

Rio Purús specimens are referred to typical *obsoletus* by Count Gyldenstolpe (1945, 141), but I do not agree to this disposition. Since our ten specimens from São Paulo de Olivença and Tonantins compare favorably with Ecuadorean specimens of *X. obsoletus palliatus*, I would refer the Rio Purús birds to *multiguttatus*, described from Fonteboa. The two races are easily separable in series from each other, and from *obsoletus*.

Xiphorhynchus necopinus (Zimmer).

Of this species we have thirty-one specimens, from the following localities in Brazil: Santarem, Villa Braga (Rio Tapajóz), Hyutanahan, Nova Olinda, Arimã (Rio Purús), São Paulo de Olivença, Caviana, Islands near Manacapurú, and Rio Manacapurú (Rio Solimoës). In addition I have examined six specimens from the American Museum collection which were listed by the original describer. Our specimens indicate that the range of this form is actually more extensive than he suspected. Moreover, I am convinced that the resemblance, close as it is, between *necopinus* and *Dendroplex picus* is superficial and fortuitous, so to speak, and not indica-

tive of congeneric affinity. Zimmer suggested that it might become necessary to submerge *Dendroplex* under *Xiphorhynchus*. I propose instead to retain *Dendroplex* for *D. picus* and its allies, and to transfer *necopinus* to *Xiphorhynchus*, where it undoubtedly belongs. Santarem specimens of *necopinus* appear to be slightly smaller and duller than the others; however, I do not venture to separate them. We have two young birds (April 2), with dark-colored bills.

Dendroplex picus rufescens, subsp. nov.

Sixteen specimens: Santarem, Villa Braga, Itaituba, and Apacy, Brazil.

Type, No. 75,252, Collection Carnegie Museum, adult male; Villa Braga, Rio Tapajóz, Brazil, December 1, 1919; Samuel M. Klages.

Subspecific characters.—Similar to *Dendroplex picus picus* (Gmelin) of the Guianas and adjacent parts of Brazil, but underparts more rufescent, less brownish, and light streaks on upper- and underparts wider and more extended posteriorly. Similar also to *D. p. kienerii* (Des Murs) of the middle Amazon, Rio Purús, etc., but averaging less rufescent below and rather more rufescent above; markings on the underparts finer and less extensive; size smaller. Wing (type), 101; tail, 86; bill, 30.

Range.—Certainly known only from the Rio Tapajóz (both banks), but probably ranging eastward to the island of Marajó and westward towards the Rio Madeira.

Remarks.—With the series before me I have no alternative but to describe this race, although neither Zimmer nor Griscom and Greenway considered it tenable. The characters it shows are in part those given by Zimmer for his race *duidæ*, but direct comparison with the latter eliminates the possibility of identity therewith. The general color of the posterior underparts in the present form is tawny olive; in true *picus* they are considerably duller and more brownish in tone (near Saccardo's umber). In the color of the underparts in general this race is intermediate between *picus* on the one hand and *kienerii* on the other. There is some variation it is true, but the general difference is too great to overlook. In any event, the form is as readily recognizable as are the races of *Xiphorhynchus obsoletus*. The exact limits of its range, however, must be determined from examination of specimens. In this connection it may be noted that specimens from Caviana (opposite Manacapurú on the middle Amazon) are clearly referable to *kienerii*. From this we may infer that *rufescens* does not reach the Rio Madeira on the west; the form occurring on that stream is probably *kienerii*.

Dendroplex picus dugandi Wetmore and Phelps.

I had identified all our specimens of *Dendroplex* from the Santa Marta region of Colombia as *D. picirostris*, but without seeing the type or topotypes of that form. It was no surprise, therefore, when Messrs. Wetmore and Phelps described the bird of northern Colombia as a new race, *dugandi*. The surprise came when I discovered that while they considered specimens from the southwestern part of the Santa Marta region to be *dugandi*, they referred our birds from Bonda, Mamatoco, etc., to *picirostris*. I have again gone over our series very carefully, and can find no justification for dividing it up in such fashion. As I see it, all birds from the Santa Marta region proper belong to one and the same race, which I would call *dugandi*. They have been compared directly with eight specimens of *picirostris* from Riohacha (the type-locality) and vicinity, in the Goajira Peninsula. The difference is striking, and *dugandi* is an excellent race, but the describers failed to state that their comparisons were made with topotypical material. In all our specimens the white of the underparts is much more restricted than in *picirostris;* the bill, too, is shorter. Two specimens from Dibulla show intermediate tendencies.

Lepidocolaptes layardi duidæ Zimmer.

One specimen from Tonantins, Rio Solimoës, belongs to this race, which is known to reach the upper Rio Negro. The specimen in question compares favorably with six of *duidæ* in the American Museum.

Lepidocolaptes layardi madeiræ (Chapman).

Four specimens: Santarem, Villa Braga, Mirituba, and Arimã, Brazil.

Hellmayr handled these specimens some years ago, and noted his identifications on the labels; they are duly listed by him (1925, 327). Griscom and Greenway, however (1941, 214), set his work aside, and argued that the Rio Tapajóz must be the demarcation line between the respective ranges of *layardi* and *madeiræ*. The specimens before me do not at all support this view. They show that *madeiræ* is found on both banks of the river, and not just on the west bank alone. These specimens agree with each other, and differ from five skins of typical *layardi* from Benevides (near Pará) in just the way that Chapman claims. Incidentally, I am of the opinion that *layardi* should be kept specifically separate from both *fuscicapillus* and *albolineatus*, from both of which it differs by valid characters.

Lepidocolaptes angustirostris certhiolus (Todd).

In describing this form some years ago I compared it with *bivittatus*, from which it differs as I said. It is actually a form intermediate between *bivittatus* and *angustirostris*—rather nearer the latter, but lighter rufous above, and not so heavily streaked below. The indications are that it has a rather restricted range—a consideration that may account for the difficulty some authors find in recognizing it.

Campylorhamphus procurvoides successor, subsp. nov.

Nineteen specimens: Islands near Obidos, Hyutanahan, Nova Olinda, Arimã, São Paulo de Olivença, and Caviana (opposite Manacapurú), Brazil.

Type, No. 92,371, Collection Carnegie Museum, adult male; Nova Olinda, Rio Purús, Brazil, August 3, 1922; Samuel M. Klages.

Subspecific characters.—Similar to *Campylorhamphus procurvoides probatus* Zimmer of the Rio Tapajóz region of Brazil, but general coloration more rufescent, less brownish, and pale streaking of the upper- and underparts heavier. Similar also to *C. procurvoides multostriatus* (Snethlage), but general coloration more rufescent, pale streaking less pronounced, and pileum brownish rather than blackish.

Range.—Brazil, south of the Amazon, and west of the Rio Madeira; reappearing on the islands near Obidos.

Remarks.—This is the undescribed race referred to by Zimmer (1934a, 11) in discussing a single specimen from Teffé. This specimen, courteously sent me for examination, fits right in with the above series. Count Gyldenstolpe (1945, 142) also had but a single specimen from the Rio Juruá, which he was unable to place. With the good series of specimens now available it is obvious that they represent a race which is fully as well differentiated as any of its conspecies. Much to my surprise I find that six specimens from islands in the Amazon near Obidos belong to this same form, although we have one specimen of true *procurvoides* from Obidos itself.

Glyphorynchus spirurus, subsp.?

Four specimens: Manacapurú and Rio Manacapurú.

These resemble *G. spirurus castelnaudii*, but are paler above and rather more extensively streaked below. They do not exactly fit in any of the

described races. I sent them to Mr. John T. Zimmer for his opinion, and he writes as follows:

"The *Glyphorynchus* offer a problem. In the abdominal streaking they are most like *spirurus* and some of my specimens from Faro are very like them in other respects, although the average Faro bird agrees too well with the Guianan to suggest any real separation there. Your birds undoubtedly are paler-backed than almost all the series of *spirurus*.

"I have extremes of *castelnaudii* with about as much streaking on the belly as your 98,522 and the lighest extreme of that form at hand is lighter than your darkest specimen, but again the average is darker than in your birds. Your 105,489 and 98,522 could be lost in the series of *castelnaudii*, but the other two would stand out by reason of their ventral streaks, not by other characters.

"I would expect my birds from Muirapinima (west bank of the lower Negro) to agree with your Manacapurú birds, but two of them are darker above and one of these darker ones is the only one of the four that has any noticeable belly streaks and not very much at that. On the whole they probably are best kept in *rufigularis*, where I first placed them.

"It looks possible, therefore, that the Manacapurú population is not to be matched exactly by any of the named forms, unless you have more from there less well marked than these."

However, I do not venture to describe the Manacapurú bird at this time; it would only complicate the definition of the ranges of the allied forms. In this connection I might call attention to *G. spirurus inornatus*, described by Zimmer and restricted by him to the west bank of the Rio Tapajóz. We have four skins of this race from the west bank of this stream (Villa Braga, Apacy), but these can be matched by others from the east bank. To my eye the Rio Tapajóz series of *Glyphorynchus* cannot be divided on this basis at all; it is all one race. It was compared primarily with *castelnaudii*, from which it differs as was said. As a matter of fact, however, it is much more closely related to *cuneatus*, from which it differs only in the slightly warmer brown shade of the underparts, apparent in series.

Glyphorynchus spirurus subrufescens, subsp. nov.

Twelve specimens: Murindó, El Tambo, Andagoya, Potedó, and Malagita, Colombia.

Type, No. 66,470, Collection Carnegie Museum, adult male; Potedó, Chocó, Colombia, May 2, 1918; M. A. Carriker, Jr.

Subspecific characters.—Similar to *Glyphorynchus spirurus sublestus* Peters, but smaller; general coloration more rufescent, less brownish; and streaked area on breast less extensive.

Range.—Valleys of the Rio Atrato (except lower part) and of the Rio San Juan, western Colombia.

Remarks.—These birds would be referred to *sublestus* by Peters (1929, 443) and by Zimmer (1934d, 5), but they certainly differ from a specimen from the lower Atrato (Soatatá), which in its turn closely resembles a series examined from eastern Panama (American Museum). The peculiarities of the western Colombia bird would scarcely be remarked unless a series was available—a circumstance which probably accounts for the fact that thus far they have gone undetected. The richer general coloration of this population and the restriction of the breast markings are obvious when series are compared. Seven adult males average: wing, 68 mm.; tail, 62.7; bill, 12. Ten males of *sublestus* from Panama and Costa Rica: wing, 74; tail, 70; bill, 13.4. Costa Rican birds may be regarded as intermediate between *sublestus* and *pectoralis*. Birds from the region around the Gulf of Maracaibo in Venezuela may be separable as still another subspecies.

Sittasomus griseicapillus viridior, subsp. nov.

Six specimens: Palmarito and Rio Quiser, Bolivia.

Type, No. 80,141, Collection Carnegie Museum, adult male; Palmarito, Rio San Julian, Chiquitos, Bolivia, May 22, 1918; José Steinbach.

Subspecific characters.—Similar to *Sittasomus griseicapillus viridis* Carriker of the montane region of Bolivia, but general coloration much lighter, more yellowish green, and the remiges more rufescent.

Range.—Chiquitos region of eastern Bolivia.

Remarks.—This remarkable new race adds another to those hailing from this particular region. It is well marked, and is perfectly distinct from *viridis*, of which we have nine specimens from various localities in the mountains and foothills of Bolivia. The upperparts are buffy citrine, and the underparts are similar but paler; the primaries externally are Sudan brown, and the secondaries are Sanford's brown. All the characters of *viridis* are carried a step further in the present race.

Sittasomus amazonus sordidus, subsp. nov.

Five specimens: El Llagual and Rio Yuruan, Venezuela.

Type, No. 33,807, Collection Carnegie Museum, adult male; Rio Yuruan, Venezuela, March 25, 1910; M. A. Carriker, Jr.

Subspecific characters.—Similar to *Sittasomus amazonus amazonus* Lafresnaye, but somewhat smaller, and general coloration duller; upperparts with a wash of antique brown; primaries edged externally with Dresden brown (instead of buckthorn brown or dull grayish brown); underparts (near) deep olive gray (instead of deep grayish olive); under tail-coverts amber brown (instead of ochraceous tawny). Wing (type), 82; tail, 69; bill, 16; tarsus, 17.

Range.—Venezuela, from the Rio Caura east to British Guiana.

Remarks.—The characters of this race, although perfectly obvious upon comparison, are not easy to formulate. Hellmayr (1925, 259) referred birds from Venezuela to *amazonus* without hesitation, but our series from that region, although small, is definitely distinct. The underparts almost entirely lack the greenish shade so characteristic of *amazonus;* instead they are dingy grayish brown. Comparison has been made with specimens from the upper Amazon, which are believed to correctly represent *amazonus* (described from Peru).

Dendrocincla merula obidensis, subsp. nov.

Type, No. 83,250, Collection Carnegie Museum, adult female; Obidos, Brazil, December 31, 1930; Samuel M. Klages.

Subspecific characters.—Similar to *Dendrocincla merula merula* of French Guiana, but larger, and chin-spot paler buffy.

Measurements.—One male: wing, 108; tail, 76; bill, 25; tarsus, 25. Two females: wing, 102, 113; tail, 78, 80; bill, 24.5, 28; tarsus, 25.

Range.—Brazil, north of the Amazon (Obidos; Faro).

Remarks.—With only one specimen at the time, Zimmer (1934a, 15) was unwilling to describe this race, but now that we have two more (both from Obidos), closely matching the first specimen, there can remain no good reason for refusing to recognize it by name. It is very distinct by reason of its larger size. The wings of French Guiana specimens of true *merula* run 92, 99, 100; the tails, 65, 66, 67. Except for the slightly paler chin-spot, there is no difference in coloration.

Dendrocincla meruloides neglecta, subsp. nov.

Twenty-one specimens: Nova Olinda, Arimã, São Paulo de Olivença, Tonantins, opposite Tonantins, Manacapurú, and Rio Manacapurú, Brazil.

Type, No. 96,388, Collection Carnegie Museum, adult male; São Paulo de Olivença, Brazil, April 10, 1923; Samuel M. Klages.

Subspecific characters.—Similar in general to *Dendrocincla meruloides phœochroa* von Berlepsch and Hartert of the Orinoco Valley, Venezuela, but decidedly larger; upperparts slightly darker, more olivaceous; and underparts slightly paler (less rufescent) brown.

Measurements.—Ten males: wing, 108-114 (average, 111.6); tail, 86-96 (91.5); bill, 28-31 (30.2); tarsus, 22.5-27 (25). Eight males of *D. m. phœochroa:* wing, 100-110 (103); tail, 78-95 (84); bill, 27-30 (28); tarsus, 22-25 (23.5).

Range.—Valley of the Amazon (both banks), above the Rio Negro, and south to include the lower Rio Purús. Rio Madeira and upper Amazon records probably belong here.

Remarks.—In working out this form it became necessary to examine and compare the other members of the *fuliginosa-meruloides* group, of all of which we have an ample series. My conclusions differ from those of Zimmer (1934a, 18-20), in that I recognize two species instead of uniting them all under one. With the nominate race *fuliginosa* I would range *rufo-olivacea* and *atrirostris* as conspecies. These agree in having the bill dark-colored (the maxilla at least), the throat with distinct mottling or barring, and the breast with fine buffy streaks. The buffy postocular stripe is usually well marked. These three races are readily distinguishable from each other by their different general coloration. *D. fuliginosa atrirostris* was originally described from Bolivia, but its range was extended to the west bank of the Rio Tapajóz by Zimmer (1934a, 19) and by Griscom and Greenway (1941, 219). There are indications that the birds of these two respective regions are not precisely the same, but into this point I do not care to go further at present.

Under the second species, *meruloides*, I would range, besides the nominate race, *phœochroa*, *lafresnayei*, *christiani*, *ridgwayi*, and the new form I am describing herewith. In these forms the bill tends to be lighter-colored, although in the northern races, *christiani* and *ridgwayi*, it is almost as dark as in *atrirostris*. The underparts are almost unicolored, only the throat being paler than the rest. The breast is without pale streaks, and the throat is either plain or else with very faint and narrow indications of cross-barring—not at all like it is in the *fuliginosa* group. The pale postocular stripe is restricted and indistinct, and sometimes wanting. I am satisfied that these two groups represent two specific types, even though at present I have no proof that they occur together at any one place. It is hard to believe that the new race has not been taken by other collectors, but if so it must have been misidentified, or confused with

phæochroa. It is nevertheless perfectly distinct from the latter, as shown by a comparison in series.

Incidentally, I find that *D. meruloides christiani* of western Colombia is an easily recognizable race when smoothly and uniformly made-up specimens are used for comparison; in coloration it is intermediate between *lafresnayei* and *ridgwayi*, but separable from both.

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ART. 3. A REVIEW OF THE HYDNACEÆ (FUNGI) OF WESTERN PENNSYLVANIA

By LeRoy K. Henry

(Plates 1-2)

The family Hydnaceæ or tooth-bearing fungi belong to that class of basidiomycetes which bear their spores upon downward directed teeth, spines, warts, or folds. They vary in habit from resupinate, through laterally sessile to upright forms with distinct stem and cap. The resupinate plants are often inconspicuous and this may account for their scarcity in herbarium collections. The upright plants with fleshy or leathery stems and caps and the large, laterally sessile, fleshy forms are more readily seen and recognized. These fungi grow in a variety of habitats such as, on the ground in leaf mold, on decaying wood, and on injured areas of living trees.

I have included here the intermediate genera *Irpex* and *Phlebia* which grade into the Polyporaceæ by having the hymenium more or less poroid in the young stage of development.

This review is based upon the specimens in the Herbarium of the Carnegie Museum which have been collected in western Pennsylvania.

As the eastern boundary of western Pennsylvania, I have arbitrarily chosen the eastern borders of Potter, Clinton, Centre, Huntingdon, and Fulton counties. The initials following the collection data are to be interpreted as follows: L.K.H.—L. K. Henry; O.E.J.—O. E. Jennings; D.R.S.—D. R. Sumstine; M.B.K.—Marie B. Knauz; H.S.W.—H. S. Wieand. The numerals following the author's initials are his field numbers.

Synopsis of the Genera of Hydnaceæ

I. Fruiting-body absent.

A. Clavate spines attached directly to the substratum; on wood and bark..... *Mucronella*

II. Fruiting-body present

A. Fruiting-body resupinate.

1. Hymenium borne on variable spines, conical, awl-shaped, or cylindrical, typically divided; sporophore membranaceous, floccose, crustaceous, or rarely waxy; cystidia present; on wood..... *Odontia*

Date of Issue July 30, 1948.

2. Hymenium borne on long awl-shaped spines; sporophore floccose, fleshy or waxy; no cystidia; on wood..... *Mycoacia*
3. Hymenium borne on short, blunt, hemispherical or cylindrical warts, sometimes awl-shaped and fragile; sporophore membranaceous, soft crustaceous or waxy..... *Grandinia*
4. Hymenium borne on spines, soft, conical to awl-shaped; sporophore soft floccose, dark colored; on wood.... *Caldesiella*

B. Fruiting-body resupinate to reflexed to pileate.

1. Hymenium borne on low, elongated folds; sporophore fleshy-waxy..... *Phlebia*
2. Hymenium borne on blunt, often flattened and branched teeth; sporophore fleshy-tough..... *Radulum*
3. Hymenium borne on spines; sporophore consisting of branched processes in a coarse brownish tomentum..... *Gloiodon*
4. Hymenium borne on long, pendant, awl-shaped spines; sporophore tuberculiform or much branched, fleshy or subfleshy; on wood..... *Hericium*

C. Fruiting-body substipitate or sessile, reflexed and broadly attached; coriaceous to subfleshy; on wood.

1. Hymenium borne on round or flattened spines.. *Steccherinum*
2. Hymenium at first poroid, breaking up into irregular, flattened teeth..... *Irpex*

D. Fruiting-body generally pileate and centrally stipitate.

1. Sporophore fibrous, tough, often composed of two layers of different texture; dark colored; terrestrial..... *Calodon*
2. Sporophore fleshy, white to pinkish-cinnamon; terrestrial. *Dentium*
3. Sporophore fleshy to subfleshy, generally dark colored; on wood..... *Hydnum*

KEY TO CALODON

I. Pileus single or confluent, up to 12 cm. in diameter, brownish in center and depressed, tomentos, azonate to subzonate, with a broad whitish marginal zone; texture duplex, the outer layer soft and felty, the inner hard, compact and woody, extending down into the stipe as a core; odor fragrant in drying; spines awl-shaped, round, 2-4 mm. long, white when fresh, becoming grayish-brown when dry..... *C. amicus*

I. Pileus and spines darker in color.

A. Pileus convex to plane, azonate, finely tomentose, subrotund to irregular, 2-12 cm. in diameter; texture duplex, consisting of two thick layers, a soft, spongy outer layer and a hard, compact inner layer continuing into the stipe as a core; stipe bulbous at base; spines decurrent, 1-6 mm. long, awl-shaped, round, acute, color of pileus..... *C. velutinus*

B. Pileus thin, centrally depressed to infundibuliform, distinctly zoned, usually light colored at margin to pecan brown at center; texture more or less homogeneous, tough, fibrous; stipe short and broad with a spongy, bulbous base, colored like the pileus; spines decurrent, 1-3 mm. long, slender, round, color of pileus..... *C. zonatus*

C. Pileus more rigid, thicker, less zonate and rougher than in *C. zonatus;* not exuding a reddish liquid if bruised when fresh..... *C. scrobiculatus*

KEY TO HERICIUM

I. Sporophore a solid or porous body, laterally attached, bearing on the lower part soft, fleshy, white spines, 1-4 cm. long and more or less coalesced at base. *H. Erinaceus*

I. Sporophore soft, fleshy, whitish, consisting of a mass of branched processes.

A. Intricately branched and anastomosing; spines 1-6 mm. long, uniformly distributed on the under side of the branches..... *H. laciniatum*

B. Several main branches, relatively short and stout, from which arise short, slender, terminal branches; spines 5-15 mm. long, arising in terminal clusters or on short lateral spurs..... *H. coralloides*

KEY TO HYDNUM

I. Pileus inherently scaly, light brown to fawn; stipe tapering to a small white root; teeth up to 2 mm. long..... *H. Underwoodii*

II. Pileus not scaly, smooth to pubescent or felted, young teeth violet. *H. fuligineo-violaceum*

III. Pileus distinctly scaly, dark brown, thick; stipe thick, stout, base not tapering and of same color as pileus; teeth up to 1 cm. long when mature. *H. imbricatum*

IV. Pileus densely tomentose or strigose-hairy, tan or yellow..... *H. cristatum*

V. Pileus smooth, blackish-green; stipe of same color..... *H. atroviride*

KEY TO IRPEX

I. Sporophore resupinate, cinnamon to dark brown..... *I. cinnamomeus*

II. Sporophore reflexed, whitish..... *I. mollis*

KEY TO MYCOACIA

I. Sporophore adnate to the substratum, waxy, bright yellow, with a strong odor of bitter almonds when fresh; spines 4-10 mm. long, in nodules or singly. *M. setosa*

II. Sporophore separable from the substratum, fleshy-membranaceous, yellow to chrome orange when fresh, margin fibrillose with orange, rhizomorphic strands; spines 1-4 mm. long, occasionally confluent..... *M. fragilissima*

III. Sporophore adnexed to the substratum by a loose, white, floccose layer; hymenial layer waxy and drab to brownish in color, not completely covering the floccose layer, its spines 6 mm. long..... *M. Himantia*

KEY TO ODONTIA

I. Teeth very short, granular, confluent; on conifers..... *O. abieticola*

II. Teeth fine, awl-shaped; often with 2-3 points, scarcely distinct. . *O. fusco-atra*

KEY TO PHLEBIA

I. Sporophore usually resupinate, waxy-soft, flesh colored to bright red, margin fimbriate to dentate-radiate; hymenium red to reddish-brown, with radiating folds..... *P. radiata*

II. Sporophore usually reflexed, coriaceous, rust-brown, drying darker, somewhat tomentose, zonate; hymenium smoky-purplish, undulate, rugose, subradiating..... *P. strigoso-zonata*

KEY TO RADULUM

I. Sporophore waxy-fleshy, edge white, membranaceous-cottony. . *R. orbiculare*

II. Sporophore crustaceous-waxy, edge white, villose-floccose..... *R. quercinum*

KEY TO STECCHERINUM

I. Fruiting-body resupinate to reflexed or entirely pileate and laterally sessile, fibrous, tough; upper surface of pileus soft, tomentose, zoned, buff; hymenial surface pinkish-cinnamon to vinaceous-cinnamon, with a whitish, or pubescent margin; spines up to 2 mm. long, slender, awl-shaped, round, angular or flattened..... *S. ochraceum*

II. Fruiting-body distinctly pileate or rarely reflexed.

A. Sporophore tough, fibrous, consisting of many sessile, horizontal, imbricated and confluent pilei; single pilei 3-15 cm. wide, 2-15 cm. long; fibrous and pubescent on upper surface, white at first, drying wrinkled and ochraceous-buff; spines 6-18 mm. long, slender, round, pointed, white, becoming reddish to brown on drying..... *S. septentrionale*

B. Sporophore soft, fibrous-fleshy, juicy when fresh and containing a milky, sticky sap; pilei sessile, solitary to imbricate, often arising from a resupinate base; single pilei up to 15 cm. wide and 8 cm. long, densely fibrous or hairy on upper surface, whitish at first, becoming light buff to liver brown in drying; spines 1-6 mm. long, slender, round, pointed, tawny..... *S. pulcherrimum*

C. Sporophore fibrous, subfleshy to tough, usually laterally stipitate, but occasionally eccentric or sessile with abortive or fully developed, kidney-shaped pilei arising from the upper surface of the lower ones; surface of pilei finely pubescent, dull cinnamon-buff, faintly zoned toward the margin; spines 1-3 mm. long, slender, round, angular or flattened, whitish at first, becoming pinkish in drying and finally russet..... *S. adustum*

ENUMERATION OF SPECIES

Caldesiella ferruginosa (Fries) Sacc.

Armstrong County: near Leechburg, D.R.S. *Allegheny County:* Frick Park, Pittsburgh, D.R.S. *Mercer County:* Transfer, D.R.S. *Westmoreland County:* Idlewild Park, Ligonier, D.R.S.

Calodon amicus Quel. (Plate 1, fig. 1)

Armstrong County: Kittanning, D.R.S. *Bedford County:* Sulphur Springs, D.R.S. *Fayette County:* Ohiopyle, D.R.S.; near Somerfield, D.R.S. *Venango County:* 1 mi. n. of Lisbon, H.S.W.

Calodon scrobiculatus (Fries) Quel. (Plate 1, fig. 2)

Beaver County: Temple Hollow woods, west edge of Aliquippa, L.K.H., 2915. *Centre County:* Woodward, D.R.S.; Poe Paddy Park, M.B.K. *Clarion County:* near Clarion, D.R.S.; Cook Forest, D.R.S. *Fayette County:* Ohiopyle, D.R.S.; near Somerfield, D.R.S. *Venango County:* near Emlenton, M.B.K. *Westmoreland County:* Forbes Forest, 3 mi. s.e. of Rector, M.B.K.

Calodon velutinus (Fries) Quel.

Armstrong County: Kittanning, D.R.S. *Clarion County:* near Clarion, D.R.S. *Crawford County:* French Creek near Cochranton, H.S.W. *Fayette County:* Ohiopyle, D.R.S. *Westmoreland County:* near Mellon Estate, 6 mi. s.e. of New Florence, D.R.S. *Venango County:* 1 mi. n.e. of Lisbon, H.S.W.

Calodon zonatus (Fries) Quel.

Armstrong County: Kittanning, D.R.S. *Erie County:* Weiss Library woods, near Erie, O.E.J. *Fayette County:* Ohiopyle, O.E.J.; near Somerfield, D.R.S.

Dentium repandum (Fries) S. F. Gray

Allegheny County: 1 mi. west of Mt. Nebo. *Armstrong County:* Kittanning; across Big Buffalo Creek from W. Winfield. *Bedford County:* Sulphur Springs. *Butler County:* Little Buffalo Creek near Monroe Station; Watson's Run, 2 mi. s. of Leasuresville; Little Connoquenessing Creek, 3 mi. n.e. of Harmony; near Slippery Rock. *Cameron County:* along Route 872, 10 mi. s. of Sinnemahoning. *Centre County:* near Rebersburg; Woodward. *Clarion County:* Cook Forest. *Clearfield County:* State Game Lands, No. 34, s. of Medix Run. *Erie County:* Weiss Library woods, s.w. of Erie. *Fayette County:* Ohiopyle. *Forest County:* Cook Forest. *Somerset County:* near Buckstown; 3 mi. w. of Berlin. *Venango County:* 1 mi. n. of Lisbon. *Westmoreland County:* Shades Ravine, 2 mi. e. of Trafford; Forbes Forest, 3 mi. s.e. of Rector; Mellon Estate, 6 mi. s.e. of New Florence.

Gloiodon strigosus (Fries) Karst. (Plate 2, fig. 2)

Armstrong County: near Leechburg, D.R.S. *Centre County:* in Poe Paddy Valley, M.B.K.

Grandinia Brinkmanni (Bres.) Bourd. & Galz.

Allegheny County: Frick Park, Pittsburgh, D.R.S.

Hericium coralloides Scop. (Plate 1, fig. 3)

Allegheny County: Frick Park; near Sewickley. *Armstrong County:* Kittanning. *Butler County:* Cook Forest; near Clarion. *Elk County:* south of Kane. *Lawrence County:* Muddy Creek Falls, near mouth of Muddy Creek. *Mercer County:* 2 mi. n.e. of Grove City. *Potter County:* near Carter Camp. *Venango County:* 1 mi. n.e. of Lisbon; Little Scrubgrass Creek, n.e. of Sutton's Mills. *Westmoreland County:* near Kiski campus, Saltsburg.

Hericium erinaceus (Fries) Pers. (Plate 1, fig. 4)

Allegheny County: Tom's Run back of Dixmont; Frick Park; Allegheny Cemetery; Thornburg; along Washington Blvd., East Liberty district, Pittsburgh; Herron Hill, Pittsburgh. *Beaver County:* 2 mi. west of Beaver. *Butler County:* Little Buffalo Creek at Monroe Station; Iron Bridge, Big Buffalo Creek. *Bedford County:* near Bedford. *Fayette County:* Ohiopyle; Cranberry Glade Run, n. end of Wharton Township. *Lawrence County:* Muddy Creek Falls at mouth of Muddy Creek. *Potter County:* near Carter Camp. *Washington County:* along Buffalo Creek near junction with Buck Run. *Westmoreland County:* near Edgecliff; Idlewild Park near Ligonier; near Waterford; n.w. of Saunders.

Hericium laciniatum (Leers) Banker

Allegheny County: 2 mi. due east of Upper Talleycavey; Turtle Creek; Frick Park; 4 mi. east of Monongahela; near Sewickley; Fallen Timber Hollow opposite Sutersville. *Armstrong County:* near Leechburg. *Beaver County:* Beaver Falls. *Bedford County:* Sulphur Springs. *Butler County:* near Saxonburg; 2 mi. s. of Leasuresville; 4 mi. n.e. of Harmony. *Crawford County:* Conneaut Lake. *Mercer County:* 2 mi. n.e. of Grove City. *Potter County:* near Carter Camp. *Somerset County:* near Jennerstown; near Buckstown.

Hydnum atroviride Morgan

Fayette County: Ohiopyle, D.R.S.

Hydnum cristatum Bres.

Fayette County: Ohiopyle. D.R.S.

Hydnum fuligineo-violaceum Kalch.

Fayette County: Ohiopyle; fits description except for small size.

Hydnum imbricatum (L.) Fries

Centre County: Woodward; Pleasant Gap, D.R.S. *Fayette County:* Ohiopyle, O.E.J.; near Somerfield, D.R.S.

Hydnum Underwoodii Banker

Erie County: Weiss Library woods, 8 mi. s.w. of Erie, O.E.J. *Fayette County:* Ohiopyle, O.E.J.

Irpex cinnamomeus Fries

Allegheny County: Coraopolis; North Park. *Armstrong County:* Kittanning. *Bedford County:* Sulphur Springs. *Centre County:* Woodward; Reitz Gap. *Clearfield County:* State Game Lands, No. 34, s. of Medix Run. *Erie County:* Presque Isle. *Fayette County:* Killarney Park, s. of Normalville. *Somerset County:* near Jennerstown. *Westmoreland County:* Forbes Forest, 3 mi. s.e. of Rector; Seward; Youngstown; Jones' Mills; Derry; Laurel Ridge, 1 mi. e. of Kregar.

Irpex mollis B. & C. (Plate 2, fig. 1)

Allegheny County: Frick Park, Pittsburgh. Armstrong County: Kittanning. *Butler County:* Nixon Station on Butler Short Line, 4 mi. n.e. of Harmony. *Erie County:* Presque Isle. *Fayette County:* Ohiopyle. *Mercer County:* Blacktown. *Westmoreland County:* Ligonier; Derry; Mellon Estate, 6 mi. s.e. of New Florence; near South Greensburg.

Mucronella calvum A. & S.

Allegheny County: Frick Park, Pittsburgh, D.R.S.

Mycoacia fragillissima (B. & C.) Miller

Allegheny County: near Sardis; Sandy Creek. *Armstrong County:* Kittanning; near Ford City. *Bedford County:* Sulphur Springs. *Butler County:* near Zelienople; near Butler. *Centre County:* Penn's View. *Washington County:* along Raccoon Creek 2 mi. above Murdocksville. *Westmoreland County:* Latrobe; Jones' Mills.

Mycoacia Himantia (Schw.) Miller

Allegheny County: Sandy Creek; Coraopolis; along Route 910, 3 mi. s.e. of Bakerstown. *Armstrong County:* Kittanning. *Butler County:* Saxonburg; near Culmerville. *Crawford County:* Pymatuning Swamp at Hartstown. *Cambria County:* Cresson. *Fayette County:* Ohiopyle. *Somerset County:* near Jennerstown. *Washington County:* along Raccoon Creek above Murdocksville. *Westmoreland County:* Kingstown; near Saltsburg.

Mycoacia setosa (Pers.) Donk

Armstrong County: Kittanning, D.R.S. *Westmoreland County:* Idlewild Park near Ligonier. D.R.S.

Odontia abieticola B. & C.

Allegheny County: Nadine, D.R.S., determined by S. H. Jackson. *Clarion County:* near Clarion, D.R.S.

Odontia fusco-atra (Fries) Bres.

Allegheny County: Frick Park, Pittsburgh, D.R.S.

Phlebia radiata Fries

Allegheny County: near Sewickley; near Bellevue; Frick Park, Pittsburgh. *Armstrong County:* Kittanning; near Leechburg. *Butler County:* near Saxonburg; near Slippery Rock; near Butler; Nixon Station on Butler Short Line; near Zelienople; 4 mi. n.e. of Harmony. *Clarion County:* near Clarion; Cook Forest. *Crawford County:* near Hartstown. *Lawrence County:* at mouth of Muddy Creek. *Somerset County:* Kooser State Park. *Potter County:* near Carter Camp. *Venango County:* near Lisbon. *Westmoreland County:* Waterford; along Conemaugh River opposite Saltsburg.

Phlebia strigosa-zonata Schw.

Clarion County: near Clarion, D.R.S. *Elk County:* near Kane, D.R.S.

Radulum orbiculare Fries

Butler County: near Slippery Rock, D.R.S. *Clarion County:* near Clarion, D.R.S. *Centre County:* Woodward, D.R.S.

Radulum quercinum Fries

Centre County: Woodward, D.R.S.; State Game Lands, No. 33, along Port Matilda-Philipsburg Road, L.K.H., 5034.

Steccherinum adustum (Schw.) Banker (Plate 2, fig. 3)

Allegheny County: Frick Park, Pittsburgh; Power's Run opposite Verona; along Beaver Grade Road near Montour Run. *Armstrong County:* Kittanning. *Beaver County:* across Ohio River from Ambridge. *Bedford County:* Sulphur Springs. *Butler County:* Slippery Rock; 4 mi. n.e. of Harmony. *Centre County:* 10 mi. s. of State College. *Clarion County:* near Leeper. *Elk County:* near Kane. *Fayette County:* Ohiopyle; Killarney Park, s. of Normalville. *Lawrence County:* Slippery Rock Creek above Wurtemberg. *Mercer County:* Transfer. *Somerset County:* near Somerset; Haines; near Trent. *Venango County:* 1 mi. n. of Lisbon. *Westmoreland County:* Mellon Estate, 6 mi. s.e. of New Florence; Forbes Forest, 3 mi. s.e. of Rector; Shades Ravine, 2 mi. e. of Trafford.

Steccherinum ochraceum (Fries) S. F. Gray

Allegheny County: Frick Park, Pittsburgh; Guyasuta Hollow at Aspinwall; near Wildwood; ½ mi. s. of Smithdale; along Route 910, 3 mi. s.e. of Bakerstown; Powers Run opposite Verona. *Armstrong County:* Kittanning; near Leechburg. *Bedford County:* Sulphur Springs. *Butler County:* near Zelienople; along Watson's Run, 2 mi. s. of Leasuresville. *Cambria County:* Cresson. *Cameron County:* along Route 872, 10 mi. n.e. of Sinnemahoning. *Centre County:* State Game Lands, No. 33, 3 mi. s.e. of Philipsburg. *Lawrence County:* Slippery Rock Creek at Kennedy's Mills; near Wesminster College, New Wilmington. *McKean County:* Kane; Tionesta Tract near Brookston. *Somerset County:* near Buckstown on *Fomes fomentarius;* near Somerset. *Venango County:* 1 mi. n.e. of Lisbon. *Washington County:* near New Eagle; above Raccoon Creek 1½ mi. s. of Murdocksville. *Westmoreland County:* Shades Ravine, 2 mi. e. of Trafford; Idlewild Park near Ligonier; near New Florence; along Conemaugh River across from Saltsburg; Lynn Run, 3 mi. s.e. of Rector; along Route 80, 10, mi. w. of Saltsburg.

Steccherinum pulcherrimum (B. & C.) Banker

Allegheny County: Frick Park, D.R.S.; Pittsburgh; near Sandy Creek, L.K.H. *Armstrong County:* Kittanning, D.R.S. *Westmoreland County:* near New Kensington, M.B.K.

Steccherinum septentrionale (Fries) Banker (Plate 2, fig. 4)

Cambria County: Cresson, D.R.S. *Erie County:* near Erie, J. H. Miller. *Mercer County:* no locality given, H.S.W. *Somerset County:* near Buckstown, O.E.J.

SUMMARY

A generic key and descriptive keys to thirty-two species of Hydnaceæ have been provided. *Grandinia Brinkmanni*, *Hydnum atroviride*, *H. cristatum*, *H. fuligineo-violaceum*, *Mucronella calvum*, and *Odontia fusco-atra* are represented by one collection of each.

Gloiodon strigosus, *Hydnum Underwoodii*, *Mycoacia setosa*, *Odontia abieticola*, *Phlebia strigosa-zonata* and *Radulum quercinum* were each collected in two different localities.

All species collected from three or more localities, and yet not plentiful enough to be considered as common, have been designated by including the collector's name or initials after the locality.

Out of a total of thirty-two counties in western Pennsylvania, no collections of Hydnaceæ have been obtained from Blair, Clinton, Fulton, Huntingdon, Indiana, Jefferson, and Warren counties.

In order to obtain a more complete record of the distribution of the Hydnaceæ in western Pennsylvania collections are needed from these counties and additional collections from the southeastern and northeastern counties of western Pennsylvania.

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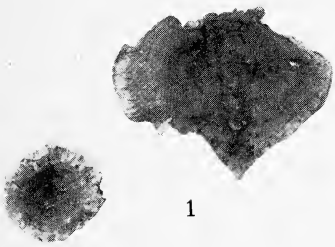
EXPLANATION OF PLATE 1

FIG. 1. *Calodon amicum* Quel. X 3/7.
FIG. 2. *Calodon scrobiculatus* (Fries) Quel. X 3/7.
FIG. 3. *Hericium coralloides* Scop. X 1/3.
FIG. 4. *Hericium erinaceus* (Fries) Pers. X 5/12.



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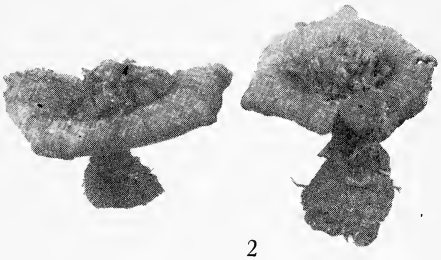

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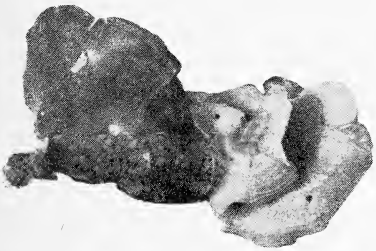
EXPLANATION OF PLATE 2

FIG. 1. *Irpex mollis* B. & C. X 2/5.
FIG. 2. *Gloiodon strigosus* (Fries) Karst. X 3/5.
FIG. 3. *Steccherinum adustum* (Scho.) Banker X 1/2.
FIG. 4. *Steccherinum septentrionale* (Fries) Banker. X 2/5.

1

2



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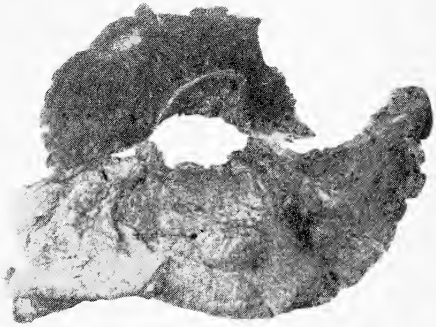

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ART. 4. CRITICAL REMARKS ON THE OVEN-BIRDS

By W. E. Clyde Todd

Like the Wood-hewers or Dendrocolaptidæ, to which they are closely allied, the Oven-birds or Furnariidæ are wholly neotropical and largely South American in their distribution. As yet their classification cannot be said to be absolutely settled, and some genera, notably *Asthenes* and *Cranioleuca*, are composed of diverse elements. The group as a whole is much more difficult to study than are the Tree-creepers; racial differences, when present, are often obscured by seasonal, sexual, and age variations, and large series are indispensable in working out the taxonomy. The Carnegie Museum collection has 3,286 specimens of Oven-birds, representing 245 species and subspecies. For the loan of additional specimens of certain forms needed for comparison I am deeply indebted to the authorities of the U. S. National Museum, the Academy of Natural Sciences of Philadelphia, the Museum of Comparative Zoölogy, and in particular the American Museum of Natural History. In the present paper descriptions of eight apparently new races are presented, together with some critical notes and remarks on the taxonomy of certain other forms.

As in other papers by the writer, all measurements are in millimeters, and that of the bill is for the exposed culmen. The names of colors are taken mostly from Ridgway's "Color Standards and Color Nomenclature." Most of the localities appearing in the text were listed in an earlier paper by the writer, on Hummingbirds (Annals Carnegie Museum, Vol. 29, 1942, pp. 365-370).

Furnarius torridus Sclater and Salvin.

Mr. Zimmer (1936a, 4) has discriminated this form from *F. tricolor*, with which Hellmayr (1925, 20) had confused it. I would call the upperparts of *torridus* Sanford's brown (not chestnut), and those of *tricolor* raw sienna to Mars yellow. We have specimens of both forms from São Paulo de Olivença.

Furnarius leucopus exilis Todd.

Hellmayr (1925, 22) after examination of von Pelzeln's type of *F. longirostris*, found that *F. agnatus* of Sclater and Salvin is a synonym of the other—a wholly unexpected development. He doubted if two races occurred in the region, and relegated my *exilis* to synonymy. After com-

sued October 15, 1948

paring our series of the latter (twenty-four specimens) with eight specimens from the Goajira Peninsula (U. S. National Museum), I find that *exilis* is a barely recognizable race, distinguishable only by its slightly deeper general coloration and (average) shorter bill. Our single specimen of *longirostris* from Rio Hacha is exceptionally pale. But if, as Mr. Peters suggests (in *litt.*), birds from Rio Aurare, Venezuela, are the same as those from the Santa Marta region, then Cory's name *venezuelensis*, based on the former, would naturally have priority. The easiest way out of the dilemma is to follow Hellmayr in recognizing only one form from northern Colombia and Venezuela.

Cinclodes fuscus oreobates Scott.

Although in 1922 I took a different view, I am now inclined to follow Hellmayr in reducing *oreobates* to a subspecies of *fuscus*. Greatly to my surprise I find no difference between Santa Marta specimens and those from the Eastern Andes of Colombia (Lagunillas, Rio Negro), whereas the bird from the Venezuelan Andes is clearly distinct (*heterurus* von Madarasz).

The Northern Races of Synallaxis albescens.

Hellmayr, writing in 1925, recognized four races of *Synallaxis albescens* in northern South America and one additional race in Costa Rica. To *S. a. albigularis* Sclater he assigned an immense range, from Guiana, northern Brazil, and most of Venezuela, west to Peru, Ecuador, and Colombia. *S. a. josephinæ* Chubb (1919) and *S. occipitalis* von Madarasz (1903) were considered to be synonyms. *S. a. nesiotis* Clark (1902), a "rather unsatisfactory race," was restricted to Margarita Island, Trinidad, and the coastal region of northeastern Venezuela. *S. a. perpallida* Todd (1916), originally described from the Goajira Peninsula, was extended to cover the region south to Maracaibo. Birds from western Colombia and Panama were assigned to *S. a. hypoleuca* Ridgway (1909), and those from southwestern Costa Rica to *S. a. latitabunda* Bangs.

Chapman was the next author to make a critical study of this group (1931, 88-91). He showed very clearly that Sclater's *albigularis* had nothing to do with *S. albescens*, but belonged to a perfectly distinct species—a conclusion which I have independently verified after examination of our series. He revived Chubb's *josephinæ* for the Roraima bird, and suggested that the bird from northwest Venezuela would have to be called *occipitalis*,

instead of *albigularis*. Also, he intimated that my *perpallida* might be the same as the latter.

Now comes Zimmer (1936b, 12-18) with further additions and refinements. He describes a new race, *trinitatis*, with a range extending from Trinidad through northeastern Venezuela to the Orinoco Valley. The bird from eastern and western Colombia he calls *insignis*, subsp. nov. He restricts *nesiotis* to Margarita Island and the mainland opposite. He takes *occipitalis* for the bird of the Merida region (the type-locality), but includes specimens from Caracas under the same name. He identifies specimens from an intermediate locality in Venezuela, however, as *perpallida*, and he questions the pertinence of Ridgway's name *hypoleuca* for the Panama bird.

Examination of our series of specimens has led me to somewhat different conclusions in certain respects. Insofar as *josephinæ* is concerned, I have nothing to offer, as this form is unrepresented in our collection. Otherwise, however, we have a good series from Venezuela and Trinidad. Comparing birds from the latter locality with three specimens in fresh plumage (U. S. National Museum) of *nesiotis* from Margarita Island, I cannot verify any of the distinctions which Zimmer seeks to make for his proposed new race *trinitatis*, although he claims that it is "very distinct." Moreover, birds from La Cumbre de Valencia, Tocuyo, and Guarico, Venezuela, so far as I can see, are not definitely separable. The last two localities are in the same region from which Zimmer records specimens of *perpallida*. Obviously, Zimmer could not have seen true *perpallida*, or he would not have so identified them. Five specimens from the Santa Marta region of Colombia, which at one time (following other authors) I called *albigularis*, are close counterparts of these Venezuelan specimens. A series from the north coast of Venezuela (from Carabobo to the Cumaná region) is not different either. In short, I can find no valid grounds for recognizing more than one race from Trinidad, Margarita Island, the Orinoco Valley and north coast of Venezuela, and the Santa Marta highlands of Colombia. For this form I adopt the oldest name, *nesiotis* Clark—type-locality Margarita Island.

Synallaxis albescens occipitalis von Madarasz, from the Merida region of Venezuela, is not represented in our collection, but four topotypical specimens have been available for examination through the courtesy of the American Museum of Natural History. It proves to be an easily recognizable race by reason of its darker general coloration. The forehead is blackish, with no grayish shade. Its range appears to be restricted to the higher

elevations of the Andes of Merida. At lower elevations it is represented by other races, *nesiotis* and *insignis*. The latter is the form of the Andean region of Colombia, and inhabits the Tropical Zone of that country on either side of the Andean ranges and in the Magdalena Valley. Specimens from western Colombia are slightly different, as Zimmer points out, and approach Central American birds in some respects. Zimmer refers a specimen from Calamar, on the Caribbean coast of Colombia, to *insignis*. I have examined this specimen; it is grayish above like the interior form, but our specimens from Calamar and from the north coast in general obviously represent a different race, which I propose to call

Synallaxis albescens littoralis, subsp. nov.

Twenty-five specimens: Fundación, Calamar, Turbaco, Cartagena, Puerto Zapote, Lorica, Monteria, and Soatatá, Colombia.

Type, No. 52,654, Collection Carnegie Museum, adult male; Lorica, Rio Sinu, Colombia, February 23, 1916; M. A. Carriker, Jr.

Subspecific characters.—Similar in general to *Synallaxis albescens insignis* Zimmer of the Andean region of Colombia, but tail shorter, upperparts more brownish, less grayish; and underparts averaging paler, with less grayish wash. Wing (type), 57; tail, 70; bill, 11.5; tarsus, 19.

Range.—Caribbean littoral of Colombia.

Remarks.—In describing his new race *insignis* Zimmer (1935b, 3; 1936b, 16-18) noted that "birds from the lower Magdalena river are somewhat more grayish on the back." I have seen ten specimens from this region; to my eye they are inseparable from the rest of the series of *insignis;* at any rate, they seem distinct from the Caribbean coast race. The latter is a short-tailed, brownish-backed bird by comparison. It differs from *hypoleuca* of Panama in its darker-colored underparts, paler wing-coverts, and particularly in its less developed (more restricted) crown-patch. Mr. de-Schauensee (1945, 8) suspected the distinctness of Soatatá birds.

Synallaxis albescens perpallida Todd

This form is the one that inhabits the Arid Tropical Zone of the Goajira Peninsula, and ranges southward to Maracaibo and across to the eastern shore of the Gulf of the same name. It is a small, pale race, markedly whiter below than either *nesiotis* or *littoralis*. As already noted, Zimmer's reference of certain Venezuelan specimens to *perpallida* is questionable.

Synallaxis albescens hypoleuca Ridgway.

Zimmer discounts *hypoleuca*, and states that "skins from Santiago, only a little southwest of Natá [the type-locality], are inseparable from Costa Rican examples." I am at a loss to understand this dictum, since I find that these same specimens, agreeing as they do with the type, are definitely distinct from six Costa Rican specimens in our collection by reason of their whiter underparts, with paler flanks. Our Costa Rican birds came from Boruca (the type-locality of *latitabunda* Bangs), Paso Real de Terraba, and Buenos Aires. Such being the case, I cannot at all follow Zimmer in considering the two one and the same form. Just where *hypoleuca* and *littoralis* meet remains to be determined.

Synallaxis albescens griseonota, subsp. nov.

Two specimens: Santarem, Brazil.

Type, No. 72,311, Collection Carnegie Museum, adult male; Santarem, Brazil, April 25, 1919; Samuel M. Klages.

Subspecific characters.—Similar to *Synallaxis albescens inæqualis* Zimmer, but upperparts more grayish, less brownish, and pileum and wing-coverts paler rufous.

Range.—Rio Tapajóz region of Brazil.

Remarks.—In addition to the above I have examined two specimens from Lago Grande in the collection of the Museum of Comparative Zoölogy. These four specimens as a group are easily separable from a series of *inæqualis* from French Guiana by the characters above specified. It so happens that *inæqualis* was described from the south bank of the Amazon (Villa Bella Imperatriz), but French Guiana birds handled at the same time were considered to be identical.

Synallaxis cabanisi obscurior, subsp. nov.

Six specimens: Tamanoir, French Guiana.

Type, No. 61,152, Collection Carnegie Museum, adult male; Tamanoir, Mana River, French Guiana, May 2, 1917; Samuel M. Klages.

Subspecific characters.—Resembling *Synallaxis cabanisi macconnelli* Chubb of Roraima, British Guiana, but general coloration darker and grayer; underparts dull neutral gray, the flanks with a slight brownish wash (instead of hair brown to drab); upperparts more grayish, less brownish; and size smaller.

Measurements.—Three males: wing, 56, 58, 59; tail, 61, 67, 68. One female: wing, 56; tail, 61.

Range.—French Guiana.

Remarks.—This new race has been compared only with *macconnelli* of Roraima, which form is said to be very close to *cabanisi* (*fide* Hellmayr). The smaller size and grayish general coloration set it off as an easily separable race. No form of this species, so far as I know, has ever been attributed to French Guiana, so that the present record involves a considerable extension of range.

Synallaxis propinqua von Pelzeln.

A single specimen from Pied Saut, Oyapock River, French Guiana, March 18, 1918, agrees well with specimens from eastern Ecuador in the collection of the American Museum of Natural History. This constitutes a new record for French Guiana.

Synallaxis cinnamomea Lafresnaye.

Eight specimens: El Cauca, La Palmita, and Pueblo Nuevo, Colombia.

These appear to be the first definite locality records for this species, heretofore known only from "Bogotá" skins. Two young birds are included (August 2 and 19). Further comparisons convince me that this form differs enough from the Venezuelan *bolivari* to merit rank as a distinct species. Nowhere, so far as known, do these two forms approach each other geographically; there is a wide gap between their respective ranges.

Certhiaxis cinnamomea albescentior, subsp. nov.

Twenty-four specimens: El Trompillo, Venezuela.

Type, No. 46,905, Collection Carnegie Museum, adult male; El Trompillo, Carabobo, Venezuela, May 12, 1914; Samuel M. Klages.

Subspecific characters.—Similar to *Certhiaxis cinnamomea fuscifrons* (von Madarasz) of northern Colombia and adjacent parts of Venezuela, but underparts whiter, with less buffy wash; upperparts and wings externally deeper rufous; and brown frontal areas averaging more restricted.

Range.—Known at present only from the type-locality.

Remarks.—In this series, taken from May 11 to 22, there is great uniformity of coloration. As a series it is readily separable from another of

fuscifrons by the above characters, although occasional odd specimens might be hard to place, taken by themselves. The deeper rufous coloration of the upperparts and the general whiteness of the underparts stand out well by comparison. So far as I am aware this species has not been recorded from the north coast proper, but Sclater cites a record from the "Plains of Valencia" (Proc. Zool. Soc. London, 1869, 252); doubtless it pertains to the present form.

This form has not been compared with *orenocensis* Zimmer, in which, however, the forehead is said to be merely a little paler rusty than the crown—not the case with the present series.

Pseudocolaptes boissonneautii boissonneautii (Lafresnaye).

Twenty-seven specimens: Paramo de Rosas, La Cuchilla, and Heights of Tabay, Venezuela; Las Ventanas, Ramirez, La Pica, Peña Blanca, and Bitaco Valley, Colombia.

A remarkable feature about this species is the sexual difference in the size and shape of the bill. In the male the bill runs 19-21 mm., and the culmen is more or less curved downwards. In the female the bill is from 24.5 to 26.5 mm., and the culmen is straighter. What is the significance of this difference?

After examining and comparing the above series I fail utterly to make out the proposed race *meridæ* of Hartert and Goodson. Hellmayr (1925, 177) admits it without question, but I cannot verify a single one of the characters he specifies. The streaking on the crown, the mottling on the underparts, and the yellow tinge on the throat and malar region are all variable quantities both in Eastern Andean and in Venezuelan birds. A single specimen from Bitaco Valley has the squamation below more distinct, and the tail darker rufous. It would represent *oberholseri* of Cory—if this is a valid race.

Philydor erythrocercus suboles, subsp. nov.

Nine specimens: Tonantins, Brazil.

Type, No. 96,926, Collection Carnegie Museum, adult male; Tonantins, Rio Solimoës, Brazil, June 23, 1923; Samuel M. Klages.

Subspecific characters.—Similar to *Philydor erythrocercus erythrocercus* (von Pelzeln) of the Guianas and northern Brazil, but upperparts more rufescent, less olivaceous; underparts paler, with less yellowish wash.

Range.—Presumably the north bank of the upper Amazon in Brazil.

Remarks.—In Brazil, south of the Amazon, there is only one race of *Philydor erythrocercus*, *P. e. lyra* Cherrie, which ranges from Maranhão westward into Peru. On the north bank of the Amazon we have typical *erythrocercus* coming in from the Guianas, and extending as far up the river as Faro (at least). Still farther up, at Tonantins, we find the species represented by a perfectly distinct race, characterized by rufescent (medal bronze) upperparts and Dresden brown wing-edgings, while the yellowish wash on the underparts is restricted mostly to the throat. It is readily distinguished from *lyra* by the duller and paler color of the underparts, with no buffy suffusion whatever, and by the more olivaceous, less brownish wing-edgings. Some of our specimens of *lyra* from São Paulo de Olivença and the Rio Purús are almost as pale below, but they show a slightly buffy wash, and the wing-edgings are not at all the same. The new race has nothing to do with *P. subfulvus* of eastern Ecuador, with which it has been directly compared. I doubt if the two are even conspecific.

Automolus infuscatus purusianus, subsp. nov.

Thirty-eight specimens: Hyutanahan, Nova Olinda, and Arimã (Rio Purús), São Paulo de Olivença and Caviana (Rio Solimoës), Brazil.

Type, No. 87,395, Collection Carnegie Museum, adult male; Hyutanahan, Rio Purús, Brazil, January 19, 1922; Samuel M. Klages.

Subspecific characters.—Similar to *Automolus infuscatus paraensis* Hartert of the region south of the Amazon and east of the Rio Madeira, but larger; upperparts more rufescent, less olivaceous by comparison; and forehead more decidedly tinged with rufescent. Similar also to *A. infuscatus infuscatus* (Sclater) of the north bank of the middle and upper Amazon, but upperparts not quite so rufescent; and pileum more distinctly streaked or squamate. Wing (type), 96; tail, 76; bill, 22; tarsus, 20.5.

Range.—Brazil, south of the Amazon, and west of the Rio Madeira.

Remarks.—Hellmayr (1925, 213) referred birds from the Rio Purús to *infuscatus*, as also did Gyldenstolpe (1945, 158). Zimmer (1935a, 15) remarks that in Peru the birds from both banks of the Amazon are alike, so that the question of the exact type-locality of *infuscatus* is of no great importance. This is fortunate, since in western Brazil the birds from opposite banks of the Amazon are certainly not alike. Zimmer refers birds from Teffé to *infuscatus*, which would by implication fix that name on our birds from Manacapurú and São Paulo de Olivença. With good series from both banks available, there is no difficulty in discriminating between

them. The new race is intermediate in its color characters between *infuscatus* and *paraensis*. It has the striated pileum of the latter, but approaches the former in the rufescence of the upperparts. I find that our Caviana birds (from east of the Rio Madeira) are somewhat intermediate, but are perhaps best referred here.

Automolus melanopezus (Sclater).

Four specimens: Hyutanahan (Rio Purús), Brazil.

These specimens agree with the description of this species; I have found no others for comparison. The record involves a considerable extension of the known range.

Automolus pallidigularis pallidigularis Lawrence.

Eleven specimens: El Cauca, El Tambor, Soatatá, and Murindó, Colombia.

Chapman says that this form is unknown in western Colombia, so that our specimens are the first recorded from this region. The specimens have been compared with a series from Panama (the type-locality) in the Biological Survey collection, and found to be indistinguishable therefrom.

I hold that this form should be kept specifically separate from *A. ochrolæmus*.

Sclerurus rufigularis furfurosus, subsp. nov.

Four specimens: Obidos, Brazil.

Type, No. 83,826, Collection Carnegie Museum, adult female; Obidos, Brazil, December 30, 1920; Samuel M. Klages.

Subspecific characters.—Similar to *Sclerurus rufigularis fulvigularis* Todd of the Guianas and eastern Venezuela, but general coloration lighter in tone; upperparts Brussels brown (instead of argus brown); upper tail-coverts argus brown (instead of auburn); buffy color of throat and breast less intense; and posterior underparts Dresden brown (instead of Prout's brown).

Range.—Known at present only from the type-locality, but probably ranging farther west on the north bank of the Amazon (to the Rio Negro?).

Remarks.—Our Obidos specimens above listed were identified by Hellmayr as *fulvigularis*, but they differ consistently from a series of eleven specimens of that form in the respects pointed out above, and in my

judgment they represent a valid race of somewhat restricted distribution The Rio Negro probably separates the range of the present form from that of the one now to be described as

Sclerurus rufigularis brunnescens, subsp. nov.

Eight specimens: Tonantins, Manacapurú, and Rio Manacapurú, Brazil.

Type, No. 97,394, Collection Carnegie Museum, adult male; Tonantins, Rio Solimoës, Brazil, July 21, 1923; Samuel M. Klages.

Subspecific characters.—Similar to *Sclerurus rufigularis fulvigularis* Todd, but general coloration deeper, more brownish, less rufescent.

Range.—North bank of the Amazon, west of the Rio Negro.

Remarks.—This race varies away from *fulvigularis* in a direction opposite to that of *furfurosus.* It is deeper brown than the former; this is particularly pronounced on the underparts and wing-edgings. The rusty buff wash on the throat and breast is about the same in both. The wing-edgings may be described as raw umber in the present form, Prout's brown in *fulvigularis. S. r. brunnescens* is much duller- and darker-colored than true *rufigularis* from the south bank of the Amazon.

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ART. 5. SPHOENOGNATHUS CURVIPES (COLEOPTERA; LUCANIDAE), A NEW SPECIES FROM BOLIVIA.

By Bernard Benesh
North Chicago, Illinois

During a visit to the Carnegie Museum, a small series of a Lucanid of doubtful status attracted my attention. After further study, I am convinced that the insect is new to science, which I propose to describe in the subjoined short diagnosis, under the specific name

Sphoenognathus curvipes, sp. nov.

Male: subparallel, depressed, golden-brown, æneous; head, pronotum, and venter, with dense, fulvous pubescence.

Head transverse-quadrate, broader than long, produced in front and truncate, rugose, antero-laterad angles oblique, subacute, sides emarginate and narrowing gently to base; anteocular area elevated; from base of the mandibles to vertex of the head, a broad V-shaped depression; eyes large, convex, completely divided by the canthus. Mandibles longer than the head, porrect, trigonate, incurved in apical third, acute, inner margin with several unequal ill-defined teeth; upper ridge bending outward in basal third, thence diagonally to exterior margin; inner margin and the ridge darker (nearly black); inner area rugose, lateral granulate; basal half (dorsad and ventrad) covered with long fulvous pubescence. Antennæ slender, piceous; scape club-shaped, slightly bent, nitid, posterad pubescent, distinctly shorter than the clava and twice as long as the funicle; funicle of three segments, first segment subglobose (pear-shaped), second similar and one quarter longer than the first, third regularly dilated from base to apex and one-eighth shorter than the second; clava of six segments, rufous, subopaque, first five segments of equal length, anterad lobate, terminal of irregular shape and twice as long as the preceding, with anterior margin feebly lobed by a longitudinal impression; funicle and bases of first three segments of clava nitid, sparsely setose.

Pronotum twice as broad as long, anterad sinuate, antero-laterad angles obtuse, sides diverging diagonally to center, center rounded to posterior, basal angles oblique-truncate, base nearly straight, margin elevated; disc with a median longitudinal canaliculation, subrugose, glabrous, antero-laterad area irregularly depressed and densely clothed with whorls of fulvous pubescence; sides with a deep marginal pit.

ssued November 3, 1948.

Scutellum broad, rounded. Elytra nearly parallel, broadest beyond the middle, posterior regularly rounded, alutaceous, strongly æneous, minutely punctured with remote punctures (not discernible by naked eye), humeri rounded, suture and declivity with sparse, short, grayish pubescence.

The space between the thorax and elytra covered by dense pubescence, partially hiding the scutellum, which is destitute of clothing (in *lindeni* pubescent.)

Beneath, rufous, with head, pro-, meso-, and meta-sternum covered with long fulvous pubescence; abdominal segments granulose, with short prostrate grayish pubescence.

Legs: femora stout, remotely punctured, posterior and lower areas pubescent; tibiæ strongly curved, anterior nude, intermediate and posterior pubescent; anterior tibiæ distad with broad furcation and an ill-defined denticle near the center; intermediate with one small spine near the apical fourth, posterior spineless; tarsi piceous, setose beneath; claws large, simple.

Female: robust, convex, broader than the male, darker (chestnut-brown to piceous), nitid, without the æneous luster typical to the male; antennæ stouter, clava more compact than in the male, and as long as the funicle and scape combined; elytra covered throughout with sparse grayish pile; tibiæ less arcuate and more massive, anteriors with a broad furcation and two lateral subequal spines, intermediate with a single spine in apical third (more pronounced than in the male), posterior unarmed.

Beneath, darker (nearly black), with pro-, meta-, and mesosternum strongly tinted with green, aureous, femora purplish; pubescence less dense and shorter.

PRINCIPAL DIMENSIONS

(In millimeters)

	Length ♂	×	Width ♀
Head	3 x 5.9		2.0 x 5.75
Mandibles	3.5		2.25
Prothorax	5 x 10.0		5.25 x 11.0
Elytra	16 x 12.0		17.0 x 13.0

Types: ♂ and ♀, Incachaca, Bolivia, alt. 2,500 M., Collector Jose Steinbach, Acc. 6373, Collection of the Carnegie Museum.

Paratopotypes: ♂ and ♀, in the writers collection and that of the Carnegie Museum.

Allied to *S. lindeni* Murray[1], from which it may be readily separated by the peculiar antennæ, arcuate tibiæ (in *lindeni* apparently doubly bent, *e.g.*, in-, ex-, and incurved), uniformly rounded elytra (in *lindeni* each elytron is rounded) and other characters.

My thanks are due to Dr. A. Avinoff, and to Dr. George Wallace of the Carnegie Museum, for the privilege of examining and reporting on these insects, as well for the generous contribution to my reference collection of the paratopotypes, which greatly enhance my meager series of neotropical Lucanidæ.

[1] Murray, Andrew: New Coleoptera from the Andes (Edinburgh New Philosophical Journal), 1857, 5: 221-226, pl. 3, figs. 1, ♂; 2, ♀.

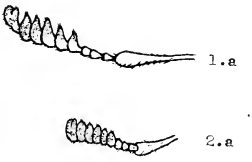
EXPLANATION OF PLATE I

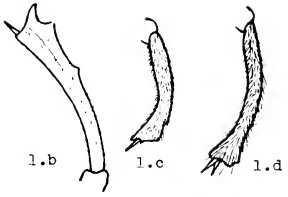
Sphoenognathus curvipes, sp. nov.

FIG. 1. Male. Head. 1. a antenna, 1. b anterior tibia, 1. c intermediate tibia, 1. d posterior tibia.

FIG. 2. Female. Head. 2. a antenna, 2. b anterior tibia, 2. c intermediate tibia, 2. d posterior tibia.

FIG. 3. *Sphoenognathus lindeni* Murray. Tracing of Murray's original figure, enlarged 2 ×. Anterior tibia (3), and intermediate tibia (3. a), ♂.


1.a
2.a


1.b
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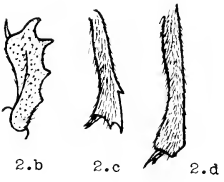
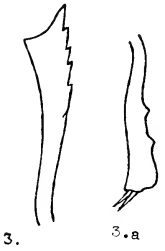
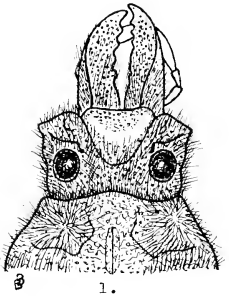
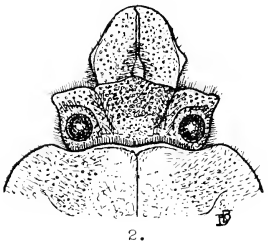
1.d


2.b
2.c
2.d


3.
3.a


1.


2.

ART. 6. TAXONOMY AND DISTRIBUTION OF THE GENUS *PIERELLA* (LEPIDOPTERA)

By F. Martin Brown[1]
Colorado Springs, Colorado

These large dark-winged satyrids are found in the deep tropical rain forest. A few of the species stray into the subtropical forest but their true home is hot and humid. There they flit along the trails and slip into the protection of the thickets at the slightest alarm. Their lazy flight would make them easy to capture in any other environment. When they settle, the cryptic markings on the underside of the wings afford them ample protection from all but the keenest eyes.

Genus Pierella, Westwood, 1851

The first member of the genus to be described was *lena*, by Linneaus in 1767. Since then over thirty forms have been named. The authors of the earliest species included them in the genus *Papilio*. Huebner used *Oreas* in 1807 and Godart used *Satyrus* in 1823. Neither of these names are available. In the *Genera of Diurnal Lepidoptera*, 2:365, 1851, Westwood proposed *Pierella* as a subgenus, "Section 2, *Haetera* Fabricius." In this he placed the species then known. Herrich-Schaeffer (*Prodromus* 1:55, 1864) was the first to use *Pierella* as the name of a full genus. He has been followed by all except Hewitson, Erichson and Felder who rigidly adhered to *Haetera*.

In 1868, Butler (*Ent. Mo. Mag.* 4:195) specified *nereis* Drury as the type of *Pierella*. This was a particularly happy selection since that species was figured by its author and thus there can be no question as to what the name stands for.

[1] During 1940 and 1941 I prepared several papers based upon my collections made in Ecuador during 1938 and 1939. This series, of which this will be the sixth paper, was interrupted by the war. Upon returning to my laboratory in the summer of 1946, I decided to continue with the Neotropical Satyrids but to enlarge the scope of the papers. This is the first of the enlarged papers.

During the preparation of this paper the following men and museums have given me advice and loaned me material: Mr. William P. Comstock and Dr. Charles D. Michener at the American Museum of Natural History, Mr. Richard D. Fox formerly at the Reading Public Museum and now at the Carnegie Museum, the late Capt. Roswell C. Williams of the Academy of Natural Sciences, Philadelphia, and Dr. William C. Field at the United States National Museum. Without their aid this study could not have been made.

Issued December 8, 1948.

The genus *Pierella* may be described as follows:

Head: The antennae are rather stout with clubs only slightly heavier than the shafts. They range in length from about two-thirds to the same length as the cell of the forewing, and consist of 48 (*rubecola*) to 66 (*nereis*) joints.

The eyes are glabrous.

The palpi are large: the distal joint the shortest, the middle joint the longest (*see* fig. 1650 a).* In *nereis* the proportions are about 23:110:40; in *hyalinus* 20:108:37; and in *lesbia* 30:110:40.

Thorax: The male prothoracic legs have a single tarsal joint, a little longer than either the tibia or femur (*see* fig. 1650 b). The female prothoracic legs have a tarsus made up of five joints, the basal one being longer than the combined length of the others (*see* fig. "♀ lena"). The second most distad joint is the shortest. The mesothoracic and metathoracic legs are perfectly normal in both sexes. The legs bear no spurs.

The tegulae are large. There is a long spur sweeping backward from the body (*see* fig. 1651 c).

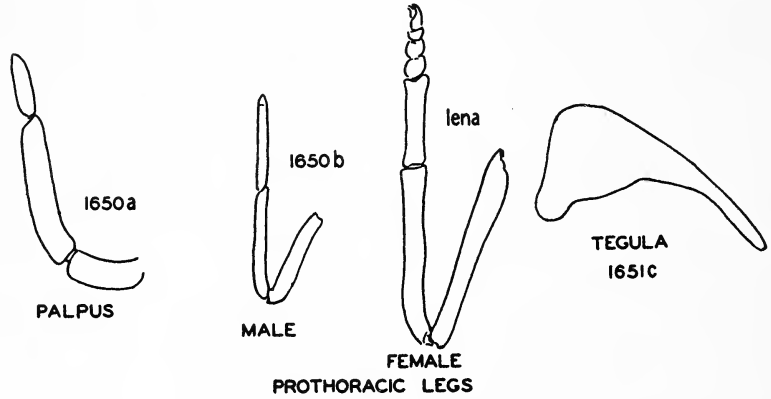


FIG. 1. Appendages of head and thorax.

The venation of the forewings: The basal portions of Sc, Cu, and A_2 are inflated. The radial is five branched; R_1 and R_2 arise before the end of the cell. The origin of R_2 is closer to that of R_1 than to the end of the cell. M_1, R_{3+4+5} and the UDC are conate or nearly so. The origin of R_3 is variable but usually about half-way from the end of the cell to the apex. There is a spur on A_2 that arises just beyond the end of the swelling

*The figure numbers used refer to the serial numbers of my dissections.

and is sharply recurved. There are three strong recurrent veins in the cell. Another trace lies between Cu_2 and A_2 (*see* fig. 1651 a).

The venation of the hindwings: The Sc and R_s are free at the base. The Sc is sharply angled at the origin of H. The H is a short straight spur. M_3 and Cu_1 branch from a common vein well beyond the end of the cell. The UDC is shorter than the MDC which is about equal to the weak LDC in length. The LDC meets the Cu_s just beyond the origin of the Cu_2 (*see* fig. 1651 b).

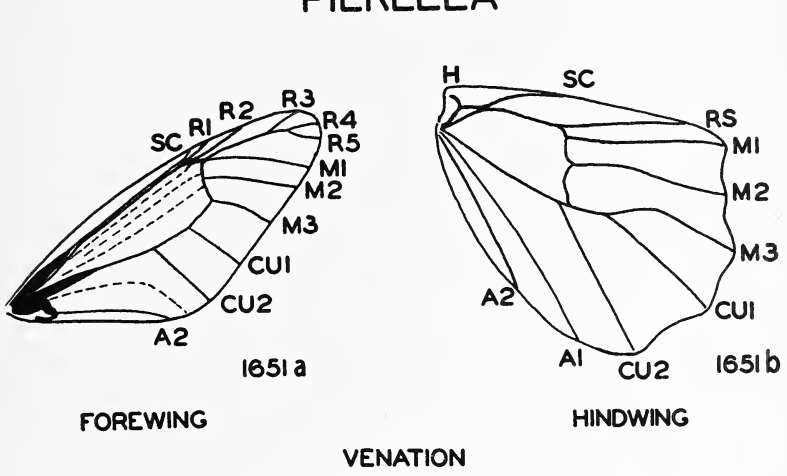


FIG. 2. Venation in *Pierella*.

The scalation of *nereis* is weak. In all other species it is normal.

Male Genitalia: The tegumen is subtriangular in shape, usually about half the total dorso-ventral dimension of the genitalia in depth and varying from less than to more than that in anterior-posterior dimension. The subuncal processes that are usually present on the *Satyridae* are absent.

The uncus is simple, slender and curved, and from just short of to equal to the anterior-posterior dimension of the tegumen.

The vinculum is slender (rather broad in *nereis* and *hortona*) and almost as long as the depth of the tegumen.

The saccus is slender and about as long as to a little longer than the vinculum.

The annuli are less than half as long as the vinculum and are lanceolate.

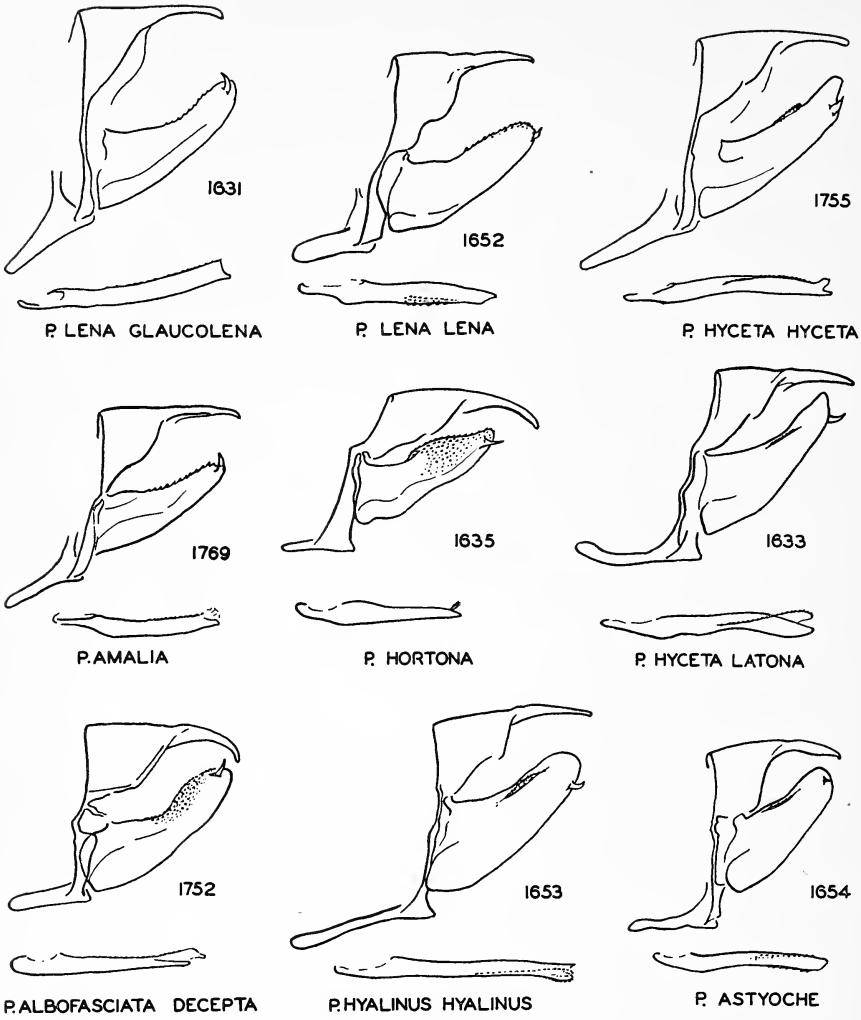


FIG. 4. Male genitalia of *Pierella*.

P. lena glaucolena	1631	Rio Jondachi, E. Ecuador, 800 m., Nov. 1939, *F.M.B.*
P. lena lena	1652	Bartica, British Guiana, *A.M.N.H.*
P. hyceta hyceta	1755	Arima, Rio Purús, Brazil, November 1922, *C.M.*
P. amalia	1769	Macayacu, Colombia, March 1946, *A.M.N.H.*
P. hortona	1635	Rio Jondachi, E. Ecuador, Nov. 1939, *F.M.B.*
P. hyceta latona	1633	Puyo, E. Ecuador, 1000 m., Dec. 1938, *F.M.B.*
P. albofaciata decepta	1752	Rio Japacani, E. Bolivia, Sept. 1914, Paratype in *C.M.*
P. hyalinus hyalinus	1653	Cayenne, French Guiana, December 1903, *A.M.N.H.*
P. astyoche	1654	Kamadusa, British Guiana, October 1922, *A.M.N.H.*

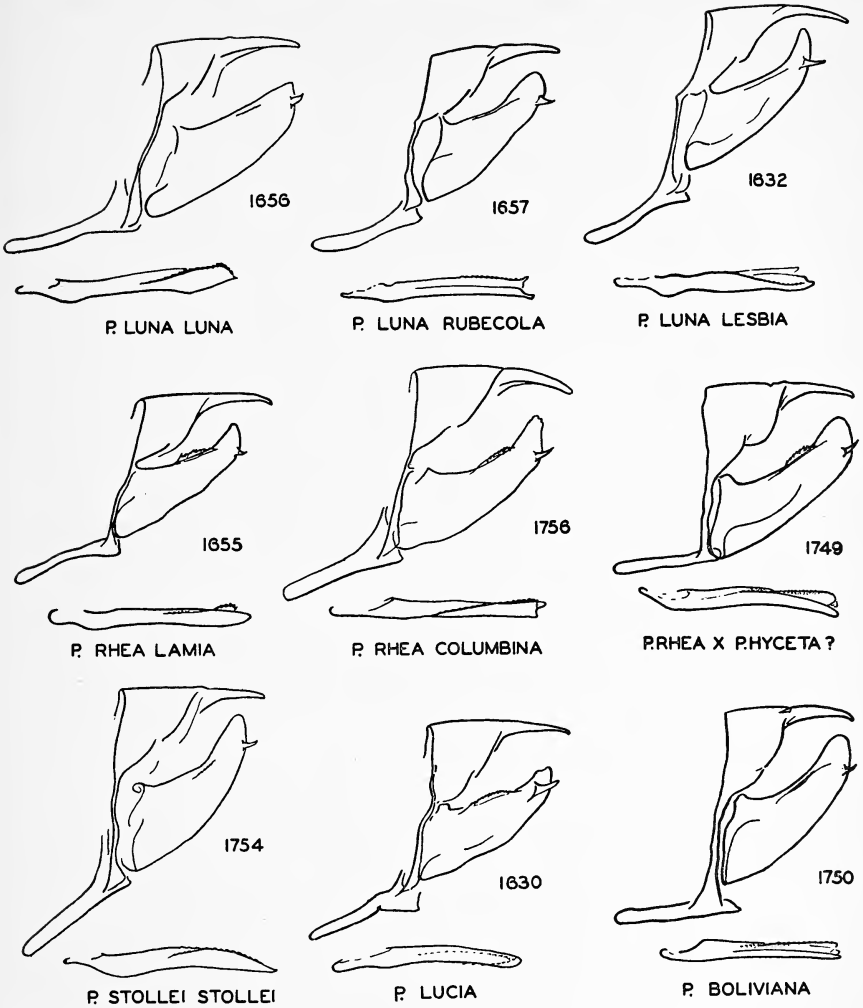


FIG. 5. Male genitalia of *Pierella*.

P. luna luna	1656	Barro Colorado, Canal Zone, March 1926, *A.M.N.H.*
P. luna rubecola	1657	Tezonapa, Vera Cruz, Mexico, *A.M.N.H.*
P. luna lesbia	1632	No data, *A.M.N.H.*
P. rhea lamia	1655	Para, Brazil, *A.M.N.H.*
P. rhea columbina	1756	"Colombia," *A.M.N.H.*
P. rhea x *P. hyceta* ?	1749	Arima, Rio Purús, Brazil, September 1922, *C.M.*
P. stollei stollei	1754	Munez Freire, Espiritu Santo, Brazil, *C.M.*
P. lucia	1630	Canelos, Eastern Ecuador, December 1938, *F.M.B.*
P. boliviana	1750	Rio Japacani, Eastern Bolivia, August 1913, *C.M.*

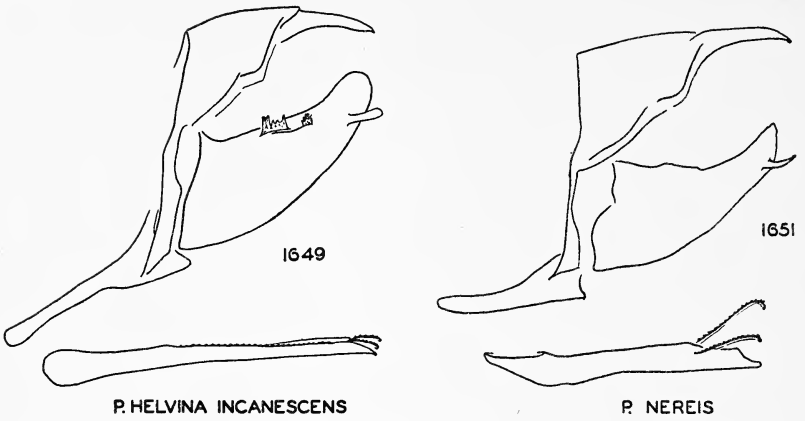


FIG. 3. Male genitalia of *Pierella*.

P. helvina incanescens 1649 "Guatemala," *A.M.N.H.*
P. nereis 1651 "Brazil," *A.M.N.H.*

NOTE: The four digit number following the name is the serial number of the dissection and is to be found on both the specimen and the mounted dissection. These are deposited at the museum indicated by the initials following the locality data.

The valves are lobate to subtriangular. They are always armed with a heavy distal spine (digitate process in *helvina*). The dorsal margin may be simple or toothed. A sub-dorsal comb frequently is present (absent in *luna*, *nereis*, and *hortona;* most highly developed in *incanescens*). The valves show good specific characters.

The aedaeagus is more or less straight and heavy. It is of uniform diameter except in *hortona* where it is markedly tapered. It is variously armed with cornuti which seem to be torn loose during copulation. This organ is of some use for separating species.

REMARKS

In recent years the named forms of *Pierella* have been distributed among twelve or thirteen "species." I am inclined to believe that there are fewer biologic species than this in the genus. Until the life histories of the various named forms that compose the bulk of this genus are known, the true number of species will remain in doubt. The male genitalia indicate that there are either several groups of very closely related species or several species that have developed ecological subspecies. This is

particularly true of those members of the genus found in the Amazon basin.

The development of the pattern on the wings has been fully studied and discussed by Schwanwitsch (*Zeit. Wiss. Biol.*, Abt. A., 10:433-532, 1928). On the basis of these studies those species included in Division B in this paper probably represent the most primitive forms. The present distribution of the various forms within the genus does not wholly support this thesis if primitive forms are considered to be peripheral. The present distribution seems to indicate that the genus antedates the Andean uplift and that at that time the genus ranged across the area affected. Those species now found west and north of the Andes in South America are apparently derived from the Central American progenitors. There are no members of the genus found in the West Indies[2] (excepting Trinidad).

The following key, based on color pattern refers to acceptable taxonomic species.

A KEY TO THE SPECIES OF PIERELLA

Reference is made in this key only to species. Methods for separating the subspecies and forms will be found in the discussion of each species in the genus.

1a. Underside: a dark-bordered light transverse band on BOTH WINGS ..... 3. Division A (p. 56)
b. : three dark transverse lines on the HINDWING ..... 2.
2a. Upperside: forewing with a blue spot or a white spot on the discocellulars. ..... 12. Division C (p. 80)
b. : no such band or spot ..... 9. Division B (p. 70)

DIVISION A

3a. Upperside: distal portion of the hindwing with an ochraceous area. ..... *nereis* (p. 57)
b. : not so ..... 4.
4a. Upperside: hindwings with red markings ..... *helvina* (p. 57)
b. : no red markings or at most only a rusty flush on the hindwings. 5.
5a. Hindwing: the margin of the wing deeply excavated anterior to M_3. ..... *hyalinus* (p. 62)
b. : lacking this excavation ..... 6.
6a. Upperside: a large white spot at or near the margin of the hindwing ..... 7.
b. : no such spot, at most only small interneural white spots ..... 8.

[2] Series of *P. hyalinus*, *lena*, and *lamia*, in the Mengel Collection at the Reading (Pennsylvania) Public Library and Museum, are ticketed "Bath, Jamaica." The Mengel Collection contains many specimens with obviously incorrect data so I do not consider these specimens as West Indian in origin.

7a. Upperside: white spot on hindwing touches or almost touches the margin. *lucia* (p. 69)
b. : the white spot separated from the margin by about ½ the diameter of the spot..... *amalia* (p. 68)
8a. Upperside: three transverse rows of blue spots, sometimes white centered or whitish on the hindwing..... *lena* (p. 65)
b. : no such series..... *astyoche* (p. 69)

DIVISION B

9a. Upperside: two large black submarginal ocelli at the inner angle of the hindwing (rarely up to five, then the specimen is from northern Central America) ..... *luna* (p. 78)
b. : four or five submarginal ocelli on the hindwing (rarely three, then from S. Brazil or Bolivia)..... 10.
10a. Upperside: hindwing with large ochraceous or reddish brown areas. *hyceta* (p. 76)
b. : no such areas..... 11.
11a. Upperside: basic color greyish faun..... *stollei* (p. 73)
b. : basic color dark grey brown or blackish..... *rhea* (p. 71)

DIVISION C

12a. Underside: transverse light band on the forewings crossed by a similar band at the discocellulars..... *albofaciata* (p. 82)
b. : transverse light band only slightly enlarged at discocellulars. *hortona* (p. 80)

DIVISION A

Characteristics: There is a distinct, narrow, light band with dark marginal lines across the underside of both wings. A third dark line crosses both wings basad of the light band.

I. The *nereis* group.

Characteristics: There is a brightly colored, transverse band across the limbal area of the upperside of the hindwings.

This group contains two species, *nereis* the genotype, and *helvina*. The former has a bright ochraceous patch on the upperside of the hindwings, the latter a red patch. The two species are strictly congeneric. No other species in the genus is so closely related to the genotype as is *helvina*. These species occupy widely separate ranges. *P. nereis* is restricted to southeast Brazil and *helvina* to Central America and that part of South America west and north of the Andes.

1. **Pierrella nereis** (Drury)

Original description: 1782, *Illustr. Exot. Ent.*, pl. 35, f. 2, 3.

Earliest figure: in original description.

Other figures:[3] 1835, Lucas, *Lepid. Exot.*, pl. 8a, f. 1. 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 42, line d.

Material seen: 17♂♂, 3♀♀.

Range: S.E. Brazil in the rain forest.

This species is distinctive and quite constant in its appearance. Nowhere does it seem to be common. Most of the specimens seen came from Petropolis, Sta. Caterina, and Rio de Janeiro.

2. **Pierella helvina**

This is a plastic species. It is quite probable that no two local populations are alike. This poses a taxonomic quandary. To dignify each of those populations with a varietal name would obscure the apparent development that is in progress in the species. If and when the genetics of the species are studied, there will be time enough for further additions to the nomenclature. There are three reasonably well established foci of development, each with a basic form distinguishable from the other two. These occupy different geographic areas but are only partially isolated. The numbers of specimens seen, from a large number of stations, have been by no means sufficient to do more than sketch the relationships of the forms. Unfortunately the species seems to center in the worst possible areas as far as disease and the ease of travel is concerned. At least one collector has lost his life in search of butterflies in those regions.

The species has not been found in the basins of the Orinoco and Amazon Rivers. Typical *helvina helvina* is found in northern Colombia. West of the Andes, from the Rio Guayas in Ecuador to the Canal Zone, the race found is *helvina ocreata*. The Central American form is *helvina incanescens*. The latter is considered a full species by Weymer (*Seitz's Macrolepid.*, 5:176-179, 1911) and Gaede (*Lepid. Cat.*, 29:422, 1931). Of these subspecies, *ocreata* is the most distinctive and the most variable.

The subspecies may be separated on the following bases:

a. Those specimens having considerable white on the colored band across the upperside of the hindwings are *ocreata;*

b. those specimens with no white in the colored band on the hindwings, with the red extending to or about to the costal margin

[3] All species are figured in Schwanwitsch, *Zeit. Wiss. Biol.*, Abt. A., 10:433-532. 1928. No specific citations are made to these.

and with little more than a trace of white submarginal spots in M_2-M_3 and M-$_3$-Cu_1 are *helvina;*

c. those specimens with no white on the colored band on the hindwings, with the red usually extending no further toward the costal margin than M_1 and with well-developed submarginal spots in M_2-M_3, M_3-Cu_1 and occasionally in Cu_1-Cu_2 are *incanescens.*

2a. **Pierella helvina helvina** (Hewitson)

Original description: 1860, *Exot. Butt.*, 2: *Haetera*, pl. 1, f. 4.

Earliest figure: in original description.

Other figures: 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 42, line d.

Material seen: 14 ♂♂, 10 ♀♀.

Range: In tropical rain forests of northern Colombia, especially east of the Rio Cauca, and west of the Cordillera Oriental.

P. h. helvina is the most stable of the three races of the species. The forewing generally exhibits an ocellus in M_1-M_2, and white spot in R_5-M_1, M_2-M_3 and M_3-Cu_1; the latter mark is the least constant. The hindwing bears an ocellus in M_1-M_2, and white spots in R_5-M_1 and traces of white spots in M_2-M_3 and M_3-Cu_1. The extent of the red on the hindwings is somewhat variable, on the majority of specimens it reaches or almost reaches the costal margin. On a few specimens it does not quite reach M_1 and in this respect these specimens resemble *incanescens.*

2b. **Pierella helvina incanescens** Godman & Salvin

Original description: 1877, *Proc. Zool. Soc. London*, p. 61.

Earliest figure: 1880[4], Godman & Salvin, *Biol. Cent.-Amer., Rhop.*, 3: pl. 6, f. 5, 6.

Other figures: 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 42, line d. 1925, Schwanwitsch, *Entomologist*, 58: 266.

Material seen: 25 ♂♂, 11 ♀♀.

Range: In the tropical rain forests of Central America from Guatemala to Chiriqui, Panama.

This subspecies is a little more variable than *h. helvina.* As has been pointed out, some authors take the position that it is a separate species from *helvina.* I can find no support for this view. The anatomy of the

[4] Dates used for Cramer, *Pap. Exot.* and Godman & Salvin, *Biologia*, are according to Brown: *Ann. Ent. Soc. Amer.*, 34:127-138, 1941.

two forms clearly indicate a single species and the wing pattern of each varies toward that of the other.

The forewing of *incanescens* is marked like that of *helvina*. The hindwing exhibits a tendency toward a well-developed submarginal series of white spots. Only traces of this series are found on *helvina*. The red on the hindwing is expanded toward the inner margin. As a result of this expansion a black line perpendicular to the inner margin appears in the red between Cu_2 and A_1. This line is rarely absent or obscure on *incanescens* and rarely visible on *helvina*.

A pair of unusually small specimens of this race was collected by Schaus on the Rio Sixaola in south-eastern Costa Rica near the Panama border. The red on the hindwings is limited anteriorly as on *incanescens* and posteriorly as on *helvina*. Such limitation is more like the pattern of *helvina* than *incanescens*. The submarginal row of white spots is well developed and places the specimens in the subspecies *incanescens*. Curiously the male displays a white spot in Cu_1-Cu_2, usually found only on females and the female lacks this spot!

These two specimens might be included under Niepelt's form *costaricana* (*Int. Ent. Zeit.*, 21:50, 1927) described from Turrialba, C.R. This name was applied to specimens that resemble *helvina* in the extent of the red markings on the hindwings. The types and all specimens that I have seen come from the valley of the Rio Reventazón where they fly with typical *incanescens*.

2c. **Pierella helvina ocreata** Godman & Salvin

Original description: 1868, *Ann. & Mag. Nat. Hist.*, (4) 2:143.

Earliest figure: 1880, Godman & Salvin, *Biologia Cent.-Amer., Rhop.*, 3: pl. 6, f. 7-9.

Material seen: 3 ♂♂, 6 ♀♀.

Range: In the tropical rain forests from the Canal Zone eastward through the Isthmus of Darien and then south along the coast to the Rio Guayas, Ecuador, west of the Cordillera Occidental.

This race is highly variable. It may be recognized always by the white area in the colored band on the upper-side of the hindwings. The other markings are much like those found on *helvina* and *incanescens*.

The males that I have seen are all alike, the females are each different from the others. These represent various degrees and combinations of three lines of variation:

a. replacement of the ocellus on the forewings by a white spot;

b. a color change of the submarginal spots from white to red;

c. restriction of the red area in the colored band on the hindwing.

This tendency to vary has lead so far to the proposal of four varietal names. Without doubt at least as many more will be proposed! The Panamanian specimens that I have seen are reasonably constant. I am inclined to believe that the race has invaded the South American part of its range in recent geologic times and is responding to new environmental pressures. I believe that every female from the Pacific coast of Colombia that has reached Germany has been dubbed with a separate varietal name!

The currently named varieties are these:

♀ f. **hymettia** Staudinger, (*Exot. Tagf.*, 1:220, 2: pl. 77, 1888) from "Choco, Colombia" represents all three changes noted above. It is the most divergent from the "normal" of all of the so-far named varieties.

♀ f. **werneri** Hering and Hopp, (*Iris*, 39:191, 1925) from Rio Micay, Choco, Colombia, and ♀ f. **johnsoni** Talbot, (*Bull. Hill Mus.*, 4:196, 1930-32) from Torqueral, N. Colombia, demonstrate the reduction of red on the hindwings. On *werneri* the white extends posteriorly to M_2; on *johnsoni* beyond that nervule. These two names should be considered synonyms.

f. **pacifica** Niepelt, (*Int. Ent. Zeit.*, 17:137, 1924) from Pacifico, S. Colombia, partially demonstrates the change from white to red submarginal spots. Some of the spots are red, and some red, centered with white.

For the benefit of those with limited material, the following analysis of minor variations among the three races is presented:

a. On the forewing there is an apical submarginal row of spots, usually four in number. The spot in M_1-M_2 is variable:

1. on *helvina* it is small, black, and surrounded by a narrow brown iris;
2. on *incanescens* it is large, black, and surrounded by a narrow grey iris;
3. on *ocreata* it is variable in size, black and surrounded by a narrow brownish grey iris. Among the females there is a tendency toward the development of a white spot rather than an ocellus. One in the U. S. National Museum has a normal spot on the right wing and just a few white scales on the left wing. Forms *hymettia*, *werneri*, and *pacifica*, each has a white spot in this position.

b. On the hindwings there always are at least two spots flanking the ocellus:
   1. on *helvina* the posterior of these two spots is obsolescent;
   2. on *incanescens* there are four or five spots, two anterior to and two or three posterior to the ocellus;
   3. on *ocreata* there are always two and often three spots: The variable spot is in M_2-M_3.

c. Some forms have the posterior part of the red on the hindwing extended and show a black line in this red:
   1. on *helvina* and *ocreata* this line, when present, extends from A to Cu_1;
   2. on *incanescens* this line is almost always present and extends from A to Cu_2 and thence along that nervule to the margin.

d. The anterior extension of the red on the hindwing is variable:
   1. on *helvina* the red usually extends to the costal margin, where it is heavily dusted with dark brown scales: there is no white in the band;
   2. on *incanescens* the anterior margin of the red varies between M_2 and R_S: there is no white in the band;
   3. on *ocreata* there is white anterior to the red: the boundary for the two colors lies between M_1 and Cu_1: it lies near M_1 on *hymettia* and *pacifica*, near M_2 on *werneri*, near M_3 on *ocreata* and near Cu_1 on *johnsoni:* the anterior margin of the white is usually the costa where it is obscured by brown scales.

e. The posterior terminus of the red on the hindwing is,
   1. on *helvina* and *ocreata* anterior to A, occasionally at Cu_2, and the inner margin of the colored band lies at or close to the end of the cell;
   2. on *incanescens* almost always at A, and the inner margin is well outside the cell.

II. The *hyalinus* group.

Characteristics: The upperside of the hindwings have a submarginal series of spots or ocelli and lack a brightly colored transverse band.

Weymer in *Seitz's Macrolepidoptera* (5:177, 1911) and Gaide in *Lepidopterorum Catalogus* (29: 421-423, 1931) recognize only three taxonomic species in this group. There are really five co-equal taxonomic units when the anatomy of the forms is considered. All of these are confined to

the tropical rain forests east of the Andes. They are rarely found above 1000m. On the basis of the collections thus far made, the center for these species is the middle Amazon basin. In the triangle between Manaos, Brazil; Iquitos, Peru; and Leticia, Colombia; all five species are found.

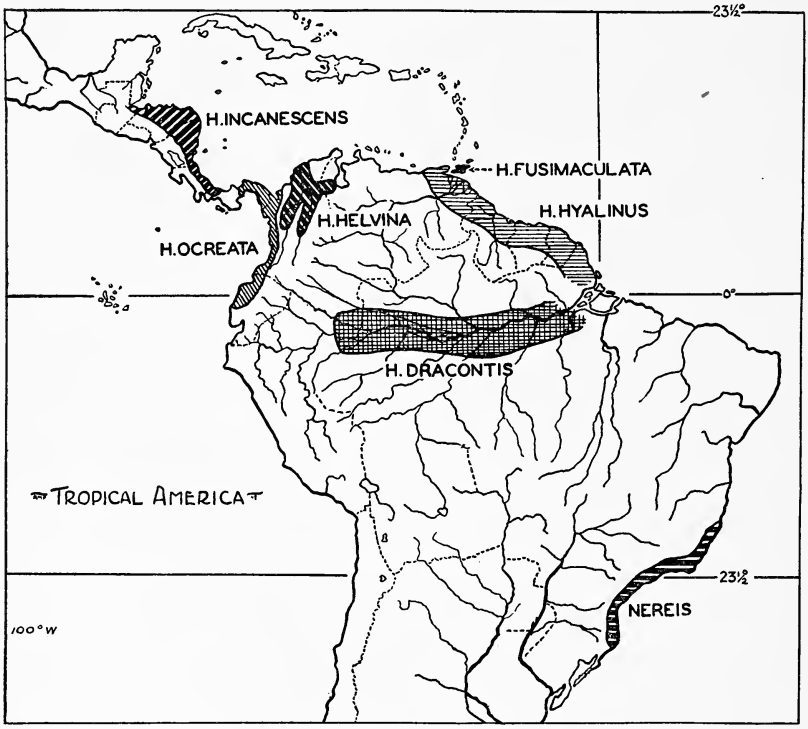


FIG. 6. Ranges of *Pierella nereis*, *helvina*, and *hyalinus*.

3. Pierella hyalinus

This species is usually cited under Huebner's name, *dracontis*. It forms a rather weak connecting-link between the *nereis*-group and this group of species. It is easily recognized by its abberant wing-form. The margin of the hind-wing anterior to M_3 is "excavated." This "excavation" is an exaggeration of the angular shape of the hindwing of *helvina*. There are two subspecies found on the continent of South America. Typical examples of these are readily identified but there is a broad zone where the two meet in which all sorts of intermediates fly. A third subspecies is

confined to the island of Trinidad and is a continuation of the variation shown by the more northeastern mainland race.

The three races are recognizable by the following characteristics:

1. *hyalinus* has light, metallic blue spots on the upperside of the hindwings. Several of these spots are fused to adjacent spots in the same series on the males. Such fusion occurs much less frequently among the females.
2. *dracontis* has deep, blue spots on the upperside of the hindwings. These spots are well defined and separate. The ground color of the wings tends to be much darker on this race than in either of the others.
3. *fusimaculata* has light, almost silvery, blue spots on the upperside of the hindwings. These spots are frequently fused and the three series in turn tend to fuse. Fusion reaches a higher degree among the females than among the males. This is contrary to the condition in *hyalinus*.

A short series of specimens of *h. hyalinus* in the Academy of Natural Sciences at Philadelphia have labels "San Juan Evangelista, Vera Cruz, Mexico." I have examined numerous collections made in the state of Vera Cruz, some from San Juan Evangelista and have not seen this species among them. Hoffman's list of Mexican Butterflies (*Annales Inst. Biol.*, 11:666, 1940) does not mention the species from Mexico. Godman and Salvin in the *Biologia* do not record the species from anywhere in Central America.

3a. **Pierella hyalinus hyalinus** (Gmelin)

Original description: 1788-91, *Syst. Nat.*, I, 5:2259.

Earliest figure: 1780, Cramer, *Pap. Exot.*, 4:5, pl. 291A, B (♀) as *lena*.

Other figures: (1813) Huebner, *Samm. Exot. Schmett.*, pl.83 (♀) as *lena*. 1835, Lucas, *Hist. Nat. Lepid. Exot.*, pl. 79, f. 3 as *lena*.

Material seen: 32 ♂♂, 11 ♀♀.

Range: The rain forests of the three Guianas, Venezuela primarily in the Orinoco basin, and adjacent parts of N.E. Brazil, in the region north of the Amazon.

This form has long been considered among *nomina incognita*. Masson and Weymer used it in *Lepidopteren Stubel's Reise*, p. 87, for *h. dracontis* and Kaye used it in *Trans. Ent. Soc. Lond.*, 1904, p. 179, for the specimens he had from Trinidad. Kaye's use of the name for what I call *fusimaculata* may invalidate my name in the view of some taxonomists. However,

Gmelin's specimens in all probability come from the Guianas and it is for that form of the species that I retain *hyalinus*.

The Orinocan-Guiana specimens of the species are recognizable by the lighter color of the blue spots on the upperside of the hindwings and by the tendency toward fusion of these spots on the males. The tendency toward fusion is greatly reduced among the females of *hyalinus*. The few specimens that I have seen from the coastal area of Brazil, north of the Amazon, are intermediate to *hyalinus* and *dracontis*.

3b. **Pierella hyalinus dracontis** Huebner

Original description: 1816, *Verz. bek. Schmett.*, p. 53.

Earliest Figure: (1851) Westwood. *Gen. Diurn Lepid.*, 2: p. 62, f. 2 as *lena*.

Other figures: 1888, Staudinger. *Exot. Tagf.* 2, pl. 77.

Material seen: 14 ♂♂, 7 ♀♀.

Range: Amazon basin, especially south of the Amazon River and west of the Rio Negro. Very rarely found upstream from the "fall line." The westernmost specimens that I have seen with wholly reliable data come from Leticia, Colombia.

The race is darker and has smaller, better-defined, blue spots on the hindwings than either of the other races. The maximum reduction in size of the blue spots occurs around São Paulo de Olivença in the southwestern part of the range of the race. A female, with no definite locality, in the collection of the Carnegie Museum has the limbal and discal row of spots on the hindwing white instead of blue.

Weymer (*Seitz's Macrolepidoptera*, 5:177, 1911) validated the Staudinger manuscript name *extincta* for a minor variation of this race. The name applies to those specimens on the underside of which the transverse light band of the forewing is broken into two or more fragments.

3c. **Pierella hyalinus fusimaculata,** subsp. nov.

This race from the island of Trinidad is more closely related to *hyalinus* than to *dracontis*. The upperside of the hindwings of the species exhibits three rows of pale blue spots, submarginal, limbal, and discal. On typical *dracontis* the spots composing each row and the rows themselves are clearly defined and isolated. On *hyalinus* the spots are larger and less well-defined than in *dracontis*. There is a tendency toward fusion of the spots in each row, especially in the males. On *fusimaculata* the spots of each

row, except the terminal spots, are fused and on many specimens, especially females, the rows of spots are partially fused. Some specimens demonstrate this to so high a degree that the hindwing appears to be silvery blue with a dark base. On the most completely fused specimens of *hyalinus* that I have seen, there is a large dark area between the limbal and discal rows between M_3 and Cu_2. On *fusimaculata* this dark area is reduced to two interneural spots, M_3-Cu_1, and Cu_1-Cu_2.

Holotype: ♂, Hololo Rd., St. Ann's, Trinidad, Aug. 16, 1933 (Pinckus), Carnegie Museum.

Allotype: ♀, Arima, Trinidad, (E.W. Rorer), U. S. Nat. Mus.

Paratypes: 1. ♂, same data as holotype; 2. ♀, same data as holotype; 3. ♀, same locality as holotype, Aug. 12, 1933; 4. ♀, Tacariqua, Trinidad, XL. 32 (Katwara) Carnegie Museum; 5. ♀, Carenage, Trinidad, Aug. 12, 1909 (Carricker), Carnegie Museum; 6. ♂, St. Ann's, Trinidad, Feb. 28, 1933 (Pinckus), Carnegie Museum; 7. ♀, St. Ann's, Trinidad, March 7, 1933 (Pinckus), Carnegie Museum; 8. ♀, St. Ann's, Trinidad, March 4, 1933 (Pinckus), Carnegie Museum; 9. ♀, Lady Charwell's Rd., St. Ann's, Trinidad, April 21, 1933 (Pinckus), Carnegie Museum; 10. ♀, same as 9, March 4, 1933; 11. ♂, Carenage Trinidad, Aug. 14, 1909 (Carricker), Carnegie Museum; 12. ♂, same as 11, Aug. 18. 1909; 13. ♀, same as 12, Aug. 18, 1909; 14. ♀, Port of Spain, Trinidad LV. 33 (Pinckus), Carnegie Museum; 15. ♀, Mt. Taber, Trinidad, (Netting) Carnegie Museum; 16. ♀, Tondes Amande Rd., St. Ann's, Trinidad, March 12, 1933 (Pinckus), Carnegie Museum; 17. ♂, Sta. Cruz Valley, Trinidad, March 29, 1929 (Huntington), Am. Mus. Nat. Hist.; 18. ♀, Trinidad, Reading Public Museum.

4. Pierella lena

This species and the preceding one were confused for many years by the older students of butterflies. Cramer, Huebner, Lucas, and Hewitson, all figured *hyalinus* forms as *lena*. Beginning with Hewitson's *Exotic Butterflies* and Butler's "catalogues" the species has been properly recognized. The species resembles *hyalinus* in pattern but the hindwing is rounded and not excavated as is that of *hyalinus*.

The species flies throughout the tropical rain forest area of South America, east of the Andes. There are two well-defined races that. anatomically at least, are approaching independence as taxonomic species, One of these, *glaucolena*, produces a form, *brasilensis*, that approaches the other, *lena*. Unfortunately the name *brasilensis* antedates *glaucolena*.

A fourth named form, *amalia*, has been considered a member of this species-complex. I believe this form to have equal claim with *lena* to specific standing and treat it as such.

The two races differ from each other in the blue spots on the hindwings. These are white-centered on *lena* and solid blue on typical *glaucolena*.

4a. **Pierella lena lena** (Linnaeus)

Original description: 1767, *Syst. Nat.*, XII:487.

Earliest figure: 1779, Cramer, *Pap. Exot.*, 3: pl. 198 f, D. E.

Other figures: 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 42, line e.

Material seen: 53 ♂♂, 49 ♀♀.

Range: Tropical rain forests of lower Rio Orinoco, the Guiana and the eastern half of the Amazon basin, westward to around Santarem.

Specimens from Mengel's collection in the Reading Public Museum are labelled from "Muzo, Colombia," "Bath, Jamaica," and "Port-of-Spain, Trinidad." The Jamaican data is certainly incorrect and the other two localities are very doubtful.

This race is reasonably constant. About fifty percent of the specimens seen bear on the forewings a black dot in M_1-M_2 flanked by white dots in the adjoining interspaces. This marking is constant among the females and occurs occasionally on the males. The white spots composing the inner two rows of spots on the hindwings are very rarely circled with blue. The sex patch on the inner margin of the hindwings of the males is almost invariably wholly yellow in *lena lena*.

4b. **Pierella lena brasilensis** (Felder)

Original description: 1862, *Wein. Ent. Mon.*, 6:126. There is no published figure of this form.

Material seen: 30 ♂♂, 12 ♀♀.

f. **glaucolena** Weymer

Original description: 1911, *Seitz's Macrolepid.*, 5:177.

Earliest figure: 1911, Weymer, l.c., pl. 42, line e.

Material seen: 47 ♂♂, 27 ♀♀.

Range: P. brasilensis is found in the rain forests of the southwestern part of the Amazon basin extending into Bolivia, usually not found above 600m. The form *glaucolena* has a greater range northward into Colombia and ranges higher into the Andean foothills to a little above 1000m.

It is unfortunate that the name *brasilensis* antedates and must take precedence over *glaucolena* as the name of the race. The latter insect is the more typical of the two forms and has by far the greater range.

The decoration of the upperside of the hindwings of *brasilensis* approaches that of *lena*. However the "white spots" on *brasilensis* are better described as blue spots with white centers while those on *lena* rarely show the slightest trace of blue at the periphery. The black dot practically universal in its occurrence in M_1-M_2 on the forewing of female *lena* and less frequently on males, occurs only cocasionally on *brasilensis* and then only on females. On *glaucolena* this spot is invariably white on the males and usually so on the females. The flanking dots of white found on *lena* are absent or obsolete on *glaucolena*. The male sex patch on *glaucolena* is frequently dark brown with a yellow border. This condition is more often found on specimens from the eastern part of the range than from the western. On these the inner and outer zones on the underside are more nearly concolorous.

The form *brasilensis* is further differentiated from *lena* by often having a powdering of blue scales at the base of the hindwings. There are occasionally small interneural marginal spots on the forewings of the females. The underside of *brasilensis* is intermediate to *lena* and *glaucolena*, less contrasting than the former and more so than the latter.

The three forms fly together in the vicinity of Ariã on the Rio Purús in the southern drainage of the Amazon.

A striking variant of *glaucolena* occurs across the central part of the range of this form.

f. **obsoleta** forma nova

This is a form in which the tendency of form *glaucolena* is carried almost to completion. The blue spots on the upper-side of the hindwings are obsolescent. On the holotype the marginal and submarginal rows of spots are lacking and those composing the limbal and discal rows of spots are reduced to a few bluish purple scales. The basic color of the wings is darker than usual. On the underside the markings are partially obscured by dark scales.

Holotype: ♂, Nova Olinda, Rio Purús, Brazil, May 1922 (S. M. Klages), Carnegie Museum.

Three other specimens before me approach this form. Two are from the collections of the Carnegie Museum, one purchased by Holland from Staudinger in 1885 and the other caught by Klages at São Paulo de

Olivença in January, 1923. The other is in my own collection. MacIntyre caught it on Dec. 12, 1938, at Canelos on the Rio Bobonaza in eastern Ecuador. On these the marginal series of spots is missing, the submarginal series faintly present, the limbal spots reduced and the discal spots obsolescent. The under surfaces are much more normal, being only a little darker than is usual in *glaucolena*.

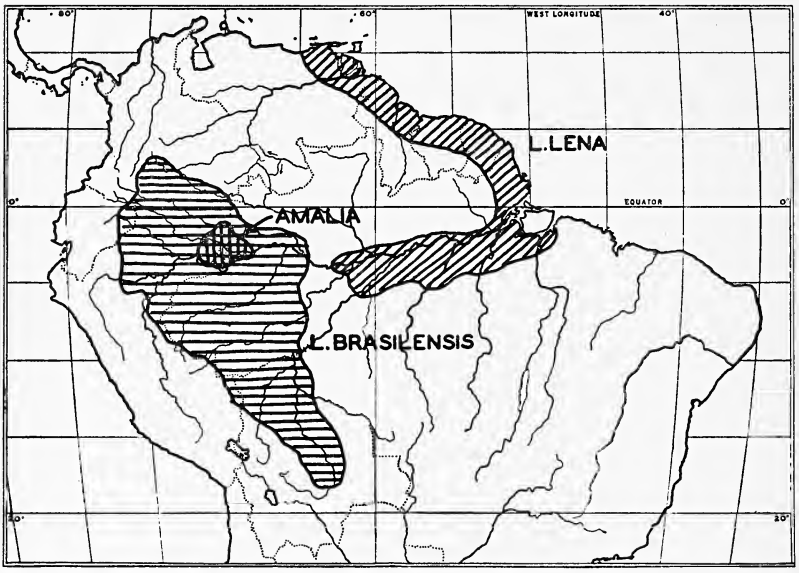


FIG. 7. Ranges of *Pierella lena* and *amalia*.

5. **Pierella amalia** Weymer

Original description: 1885, *Stettiner Ent.* Zeit., 46:285.

Earliest figure: 1860, Hewitson, *Exot. Butt.*, 2: Haetera 1, f. 2. as *lena var.*

Other figures: 1888, Staudinger, *Exot. Tagf.*, 2: pl. 77 as *leucospila.* Also in volume 1:220.

Material seen: 1 ♂, 1 ♀.

Range: The tropical rain forest on the upper Amazon. All specimens have come from the region west of Pebas and north of the Rio Marañon.

It is probable that this rare insect is not a race or form of *lena* as it has been considered ever since Hewitson first figured it in 1860. Its restricted range falls within the range of the western races of *lena*. It has

been taken in company with *glaucolena*. I believe that *amalia* is a "recently" established species formed from a mutant of ancestral *lena*.

The male genitalia are very much like those of *lena*. The most noticeable differences are at the distal end of the valve. This area is truncate with a strongly toothed margin in *amalia*. The figures show this and the other more subtle differences.

P. amalia and the following species, *lucia*, resemble each other in having a large white patch on the outer half of the upperside of the hindwing. This patch is well basad of the outer margin on *amalia* and touches or almost touches the outer margin of the wing on *lucia*.

6. **Pierella lucia** Weymer

Original description: 1885, *Stettiner Ent. Zeit.*, 46:285.

Earliest figure: 1860, Hewitson *Exot. Butt.*, 2: *Haetera* 1, f. 5. as *astyoche var.*

Other figures: 1888, Staudinger, *Exot. Tagf.*, 2: pl. 77, as *albomaculata* (also in volume 1:129). 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 42, line e.

Material seen: 36 ♂♂, 15 ♀♀.

Range: The tropical rain forests of the upper Amazon, westward from Pebas into S.E. Colombia, E. Ecuador, and N.E. Peru, rarely above 700 m altitude.

Previous students of this genus have followed Hewitson and considered *lucia* to be a race or form of *astyoche*. It is sufficiently different in pattern and anatomy to rank as a taxonomic species in this genus.

This species seems to be much more abundant south of the Rio Marañon than north of the river. This is probably an illusion caused by the wealth of material in the Bassler collections at the American Museum of Natural History. The zone in which this species flies is in general very poorly represented in collections. Every large collection that I have examined from within the range of this species contains specimens of *lucia*.

7. **Pierella astyoche** (Erichson)

Original description: 1848, in Schomburgk's *Reisen Br. Guayana*, 3:599.

Earliest figure: 1851, Doubleday and Hewitson, *Gen. Diurn. Lepid:* pl. 62, f. 1, as *larymna* (also on p. 365).

Other figures: 1911, Weymer, in *Seitz's Macrolepid.*, 5: pl. 42, line e.

Material seen: 22 ♂♂, 28 ♀♀ (and material in U. S. Nat. Mus.).

Range: Wherever there is tropical rain forest, in the whole of the Amazon basin below 700m., and in the Guianas.

There is very little variation in this species. That which does occur is of very minor importance. The three apical spots on the upperside of the forewing all tend to be white on Guiana specimens while the majority of the Amazonian specimens have a small ocellus in one of the interspaces. Specimens from around São Paulo de Olivença, Brazil, at Arimã on the Rio Purús, and on the lower Rio Ucayali in Peru, are darker than usual and the white spots on the hindwings are reduced, occasionally they are obsolete.

The bluish sheen seen on the hindwings in a certain light is more common on Guiana and upper Amazon material than on lower Amazon specimens.

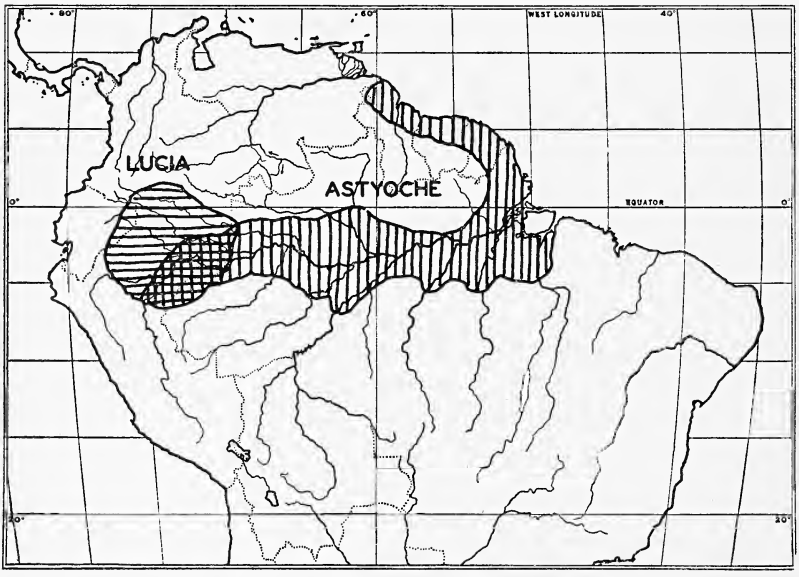


FIG. 8. Ranges of *Pierella lucia* and *astyoche.*

DIVISION B

Characteristics: The undersides of both wings are marked with three almost parallel straight dark lines. There is no marked dilution of the base color between the outer two lines as there is on species of Division A.

III. The *rhea* group.

Characteristics: the same as for the division.

The species of this group have the greatest range of the various groups. Schwanwitsch considers the patterns of these species to be the most primitive. These two items suggest that the species of the *rhea* group may represent the stock from which the genus has developed. One species, *luna*, is found from Mexico south into Ecuador and eastward to the Guianas. The others are all restricted to the region east of the Andes.

Except in the cases of *rhea*, *lamia*, and *chalybaea*, I agree with Weymer in his grouping the forms in species-complexes. I believe that the three forms named are members of a single species. This taxonomic species, *rhea*, is very confusing and probably deserves more thorough study than I have given it. I did not see enough material from the eastern part of the range.

8. Pierella rhea

Five names have been applied to forms of this species. Only one of these names is a strict synonym, *dindymene* Cramer, 1779, is the same insect as *lamia* Sulzer, 1776.

The characteristics that I have selected to use for separating the four named forms are these:

a. *rhea* has the uppersides of the forewings and hindwings more or less concolorous and no steely blue reflections on the hindwings. There are well-developed ocelli on the hindwings.

b. *lamia* has the hindwings darker than the forewings, especially toward the outer margin and there is usually a steely blue reflection on the basal part of the hindwings. There are well developed ocelli on the hindwings.

c. *chalybaea* is like *lamia* but the steely blue reflections cover almost the entire hindwings and the submarginal ocelli appear as white dots, the iris being obscured by the dark margin.

d. *columbina* is like *chalybaea* but generally lacks the broadly developed steely blue gloss.

I have found no populations that are really pure. The tendency is for Guiana material to be *lamia*, lower Amazonian, especially north of the river to be *rhea*, Middle Amazonian, especially south of the river to be *chalybaea*, and material from above "fall-line" from Colombia to Bolivia to be *columbina*. I have a feeling that *rhea* and *lamia* are forms of one

subspecies or two poorly-differentiated ones and that the same is true of *chalybaea* and *columbina*. I shall treat these forms as such until proven wrong.

There is a specimen in the collection of the Carnegie Museum that is very puzzling. It was taken by S. M. Klages at Arimã on the Rio Purús in west-central Brazil in November, 1922. It looks like a *rhea*-form with a flush of dull reddish brown on the upperside of the hindwings. It appears as one might expect a natural hybrid between *rhea* and *hyceta*. The male genitalia bears on the dorsal margin of the valves a strongly developed comb as in *rhea*. The valves themselves are much more "rectangular" than in any *rhea* specimens that I have examined. Some future worker with more material than I have seen will have to decide what to do taxonomically with this specimen.

8a. **Pierella rhea rhea** (Fabricius)

Original description: 1775, *Syst. Ent.*, p. 467.

Earliest figure: 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 43, line a.

Material seen: 4 ♂♂, 1 ♀.

Range: The tropical rain forests of the Amazon east of Santarem, Brazil.

f. **lamia** (Sulzer)

Original description: 1776, *Gesch. Ins.*, pl. 18, f. 1.

Earliest figure: in original description.

Other figures: 1779, Cramer, *Pap. Exot.*, 3: pl. 198. f. F, G as *dindymene*. 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 43, line a.

Material seen: 8 ♂♂, 7 ♀♀.

Range: The tropical rain forests of the Orinoco basin, the Guianas, and the northern part of the Amazon basin.

This race is characterized by having distinct ocelli on the hindwings. These are white pupilled and have black irises. The hindwings of f. *lamia* are darkest on the margin but not so deeply colored as to obscure the iris of the ocelli. This form differs from *rhea* in having a steely blue gloss on the hindwings, at least at the base.

There are specimens of *lamia* in the Mengel collection labeled "Bath, Jamaica," "Cristobal Colon, Panama" and "Coachi, Colombia." The Jamaica and Panama data I consider false, the Colombian record very doubtful.

8b. **Pierella rhea chalybaea** Godman

Original description: 1905, *Trans. Ent. Soc. Lond.*, p. 185. There are no published figures.

f. **columbina** Krueger

Original description: 1925, *Ent. Rundschau*, 42: 17.

Material seen: chalybaea 18 ♂♂, 7 ♀♀ ; intermediate 31 ♂♂, 12 ♀♀ ; *columbina* 6 ♂♂, 2 ♀♀ .

Range: The tropical rain forests of the southern and western Amazon basin.

These two forms blend so completely that the majority of the specimens that I have seen can be placed in either category. Generally specimens from east of the Rio Huallaga are closer to *chalbyaea* than to *columbina*. They show more of the blue gloss on the hindwings the farther east the habitat. Those from west of the Rio Huallaga progressively approach close to *columbina* the higher the altitude of the habitat. I have seen good *columbina* from Colombia, Ecuador, Peru, and Bolivia, and good *chalybaea* only from Brazil and Peru.

The blue gloss on typical *chalybaea* is almost silvery. The gloss when noticeable on *columbina* has purplish lights. Most specimens of *columbina* lack some of the ocelli toward the anal angle and the iris are totally obscured on those present. Most specimens of *chalybaea* show all of the ocelli and there is usually a faint trace of the iris.

9. **Pierella stollei**

This recently discovered species of *Pierella* seems to differ from *rhea* sufficiently to be accorded good standing. Miranda-Ribiero in describing the species likened it to *astyoche*. A careful reading of his description seems to identify a single pair in the Carnegie Museum collections. These prove to be more closely related to *rhea*. My remarks about *stollei* are based upon these specimens. A long series of an unnamed Bolivian *Pierella* is apparently a western race of the species. I have called these *boliviana*.

This species resembles *luna* and *hyceta* in having a strong green iridescence on the cell of the forewing on the upperside. The iridescent area on *stollei* is very large and almost covers the entire wing. The females of *stollei* are unique in having a rather broad and sharply defined dark margin on the upperside of the forewing. The race *boliviana* has the iridescent

patch on the males restricted to the cell and immediately adjacent areas and the females lack the sharply defined dark margin on the forewings.

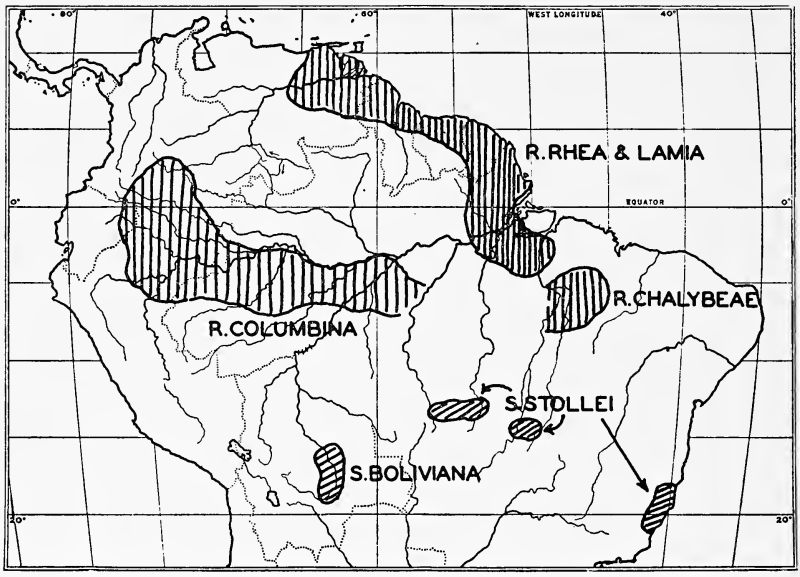


FIG. 9. Ranges of *Pierella rhea* and *stollei*.

9a. **Pierella stollei stollei** Miranda-Ribiero

Original description: 1931, *Bol. Mus. Nac. Rio de Janiero*, 7:32. No figure has been published.

Material seen: 1 ♂, 1 ♀.

Range: Southeastern Brazil, probably in wooded areas of the tropical savannahs.

Only five specimens of this form are known to me: two cotypes from Jamary, Matto Grosso, one cotype from Rio Tapajóz, and the above pair from Munez Freire, Espiritu Santo. The two specimens that I have seen differ from the original description in one point. They are dull grey-brown while the types are described as olive-brown ("castanho olivaceo").

9b. **Pierella stollei boliviana,** subsp. nov.

Upperside: dull grey-brown; a greenish iridescent patch on the cell of the forewings of the males extending marginad: hindwings darker toward the margin, very rarely with the barest hint of bluish gloss. The

apex of the forewing bears up to three minute, white points between R_{4+5}-M_1, M_1-M_2, M_2-M_3. The complete series is rare in males and more common in females. A series up to five submarginal ocelli on the hindwings: R_s-M_1 small, sometimes only a white point, occasionally absent; M_1-M_2 largest of all, white with a broad black iris; M_2-M_3 usually absent, when present a white point with or without a narrow black iris; M_3-Cu_1 second largest rarely absent, white with a broad black iris; Cu_1-Cu_2 small, usually present, white with a broad black iris, rarely lacking the white pupil. The usual dark lines for the *rhea* group are present on the forewings and the hindwings. The innermost line is broken in the cell on the forewing and faint on the hindwing. The middle line emerges from the cell of the forewing at or near the origin of Cu_2 and crosses the hindwing outside of the origins of M_1 and Cu_2. The outermost line is the heaviest and runs from near the origin of R_{4+5} to the inner margin close to the inner angle on the forewing, and on the hindwing from directly below the termination on the forewing to near the terminus of A_1.

Underside: Pale brown occasionally with a slight purplish tinge, irrorate with darker brown. The ocelli of the upperside are repeated as small, inconspicuous, white points. The lines on the upperside are repeated and in addition, on the forewings, there is a short line outside the cell that roughly parallels the discocellular nervules. There is a small, black spot in the base of the cell on the forewing and two, sometimes three, in the base of the cell of the hindwing. There is another basal spot on the hindwings between Cu_s and A_1 and a spot on the weak *ldc*.

There is a small dark-centered sex patch on the males between A_1 and A_2.

The margin of the hindwing is rounded and undulate.

Holotype: ♂, Rio Yapacani, 600m. E. Bolivia (Steinbach), Sept., 1915.

Allotype: ♀, same data.

Paratypes: 1-5. ♂♂, same data; 6. ♀, same data; 7-10. ♀♀, same locality, March, 1915; 11. ♂, same locality, Feb., 1915; 12. ♀, same locality, Feb., 1915; 13-23. ♂♂, same locality, Aug. 1913; 24-25. ♀♀, same locality, Aug. 1913.

Additional specimens used but not labelled "paratype" are: 3 ♂♂, 3 ♀♀, Rio Surutu, 350m., E. Bolivia (Steinbach), March to April, 1915; 6 ♂♂, 3 ♀♀, Buena Vista, Prov. Sara, 400m., E. Bolivia (Steinbach) March, 1921, May and June, 1915; 8 ♂♂, 4 ♀♀, Prov. Sara, 450m., E. Bolivia (Steinbach) May, 1910; 3 ♀♀, Portachuelo, Rio Palmatillas, E. Bolivia (Steinbach) April, 1915.

10. **Pierella hyceta**

The western Amazon basin is the stronghold of this species. It ranges higher into the Andean foothills than do most species of the genus, occasionally being found as high as 1200m. There are two clearly defined races of the species. One of these, *latona*, with deep rust-red on the disc of the hindwings, is found in the foothills from Colombia to Bolivia. The other, *hyceta*, with ocher-yellow on the disc, is found at a lower altitude in a more restricted area in the central-eastern part of the range of the species. The foot-hill material may represent two races. I prefer to consider these specimens as a single race exhibiting a color cline from north to south. The northern form *latona* is less heavily marked on the hindwing than the southern form *cercye*. The racial name is *latona*[5] and *cercye* is here considered a form of it.

10a. **Pierella hyceta hyceta** (Hewitson)

Original description: 1860, *Exot. Butt.*, 2: (83), pl. *Haetera*, fig. 1.
Earliest figure: in original description.
Other figures: 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 43, line b.
Material seen: 6 ♂♂, 3 ♀♀.
Range: Rain forest of upper Amazon basin below the "fall line." (All specimens known to me are from below 300m.)

This form is relatively uncommon in the collections that I have seen. Bassler's extensive collection from the lower rivers in northern Peru contains a single specimen from Iquitos. The large collections made by Klages on the Rio Purús in Brazil, just east of the area collected in by Klug for Bassler, contain the rest of the material noted above.

10b. **Pierella hyceta latona** (Felder)

Original description: 1869, *Reise Novara, Lep.*, 3:459. No figure known to me.

[5] I am not sure of the date of publication of Hewitson's rare *Bolivian Butterflies* in which *cercye* was described. It must be later than 1869, the date of Felder's name *latona*, since it is based on Buckley's collection made early in the 1870's. The *Ent. Monthly Mag.*, 6:219, 1870, reports Buckley at a meeting of the Entomological Society of London on Jan. 3, 1870, after his first South American trip to Ecuador: *Ent. Mo. Mag.*, 9:65, 1874, states "Mr. Buckley, who has just been out to Bolivia for me———" W. C. H.

f. **cercye** (Hewitson)

Original description: (1870) *Bol. Butt:* 10.

Earliest figure: 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 43, line b.

Material seen: latona—7 ♂♂, 2 ♀♀; intermediate 21 ♂♂, 3 ♀♀; *cercye*—2 ♂♂, 1 ♀.

Range: Rain forests of the western Amazon basin above "fall line." (All specimens known to me come from between 700m. and 1200m.)

Typical *latona* is found from Colombia southward to the Rio Marañon. Typical *cercye* is found from Bolivia northward to the Sani Beni region of Peru. Intermediate specimens are found from the Rio Napo, Ecuador, south at least to the Rio Marañon in Peru.

The mahogany-red on the disc of the hindwings of *cercye* is darker than on *latona*. The dark border on the upperside of the hindwings of *latona* does not involve the row of ocelli; on *cercye* it engulfs these markings and

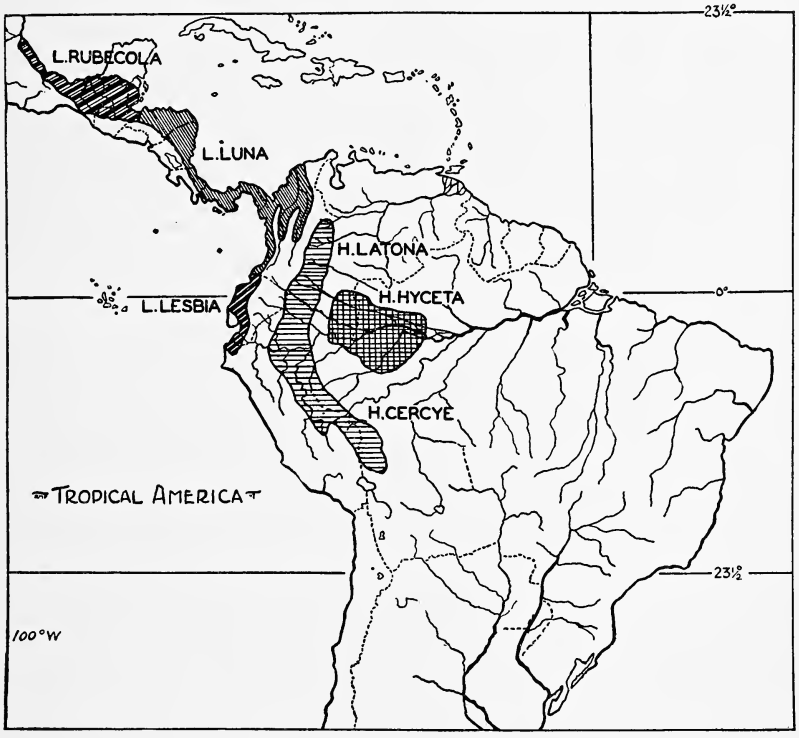


FIG. 10. Ranges of *Pierella hyceta* and *luna*.

obliterates some of them. The great majority of the specimens I have seen are neither typical *latona* nor *cercye* but are about half-way between the two of them. In the regions where *latona* and the intermediate to *cercye* fly, I have found that the intermediate forms are more common at the upper limits of the altitudinal range of the race, and *latona* more common in the lower altitudes. I suspect that the deepening of the color, etc., is a response to heavier rainfall.

11. **Pierella luna**

Pierella luna is the only species of this group that is found west of the Andes and in Central America. It resembles *hyceta* in general markings. The two species differ in the number of ocelli on the upperside of the hindwing, *luna* bearing two, rarely three, and *hyceta* four or five, rarely three. I am inclined to believe that the two groups of forms represent a single biologic species of the pre-Andean uplift era. I am not wholly convinced that they represent independent species today. The form *luna luna* probably resembles the ancestral form more closely than do any of the others. It is interesting to note that in Colombia this form tends to vary in the direction of the more brightly-colored race *lesbia* found in the equatorial forests and thus toward the "species" *hyceta*.

There are three easily recognized races of *luna*. The race *luna*, occupying the central part of the species-range has more or less concolorous wings. The northern race *rubecola* (*heracles*) from Mexico and Guatemala has a rusty flush on the hindwings. The southern race from western Ecuador and southwestern Colombia has a bright rust disc on the hindwings.

11a. **Pierella luna luna** (Fabricius)

Original description: 1793, *Ent. Syst.*, 3(1):109.

Earliest figure: 1850, Hewitson, *Exot. Butt.*, 2: *Haetera* 1, f. 3.

Other figures: 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 43, line a.

Material seen: 44 ♂♂, 13 ♀♀.

Range: In the tropical rain forests from eastern Honduras to northern Colombia; rarely found above 1000m.

Godman and Salvin described a form of this race as *pallida* (*Ann. Mag. Nat. Hist.*, (4) 2:142, 1868). Later in the *Biologia* they relegated this name to the synonymy of *luna*. In 1896, Oberthur described and figured an albinic specimen and dubbed it *albina* (*Etudes d'Ent.*, 20:32, pl. 2, f. 10). As has been noted above, some of the specimens of *luna* from

Colombia bear a dusting of rusty red scales on the upper side of the hindwing. This is most highly developed on females but also occurs on males. These specimens are not intergrades to *lesbia*. The general impression given by these specimens is of evolution toward a form similar to *rubecola*. I believe that the form is worth taxonomic recognition but name it with some misgivings.

f. **rubra** forma nova

A form of *luna luna* differing from typical specimens in this respect: the upperside of the hindwings bear a light dusting of rusty red scales.

Holotype: ♀, Quindio, Colombia (Fassl), Reading Public Museum.

Paratypes: 1. ♀, "Bogota," Colombia, Carnegie Museum; 2-3. ♂♂, "Colombia" (Ovalle), American Museum of Natural History; 4. ♀, same data as 2 and 3.

There is an interesting aberrant specimen in the collection of the Carnegie Museum. It is a male collected in May at Don Diego, Colombia. On it the middle dark line on the underside of the hindwing is irregular and shifted toward the outer line in the vicinity of the cell (see Schwanwitsch *loc. cit.* for a detailed discussion of such shifts).

11b. **Pierella luna rubecola** Godman and Salvin

Original description: 1868, *Ann. Mag. Nat. Hist.*, (4) 2:142.

Earliest figure: 1880, Godman & Salvin, *Biologia Cent-Amer., Rhop.*, 3: pl. 6, f. 10, 11.

Material seen: 7 ♂♂, 4 ♀♀.

Range: Tropical rain forests from Mexico southward to Honduras.

This race is often referred to as *heracles* Bdv. Boisduval's description was published in 1870 in his account of Lepidoptera received by him from M. d'Orza. Thus it is antedated two years by *rubecola*.

There is some variation in the row of ocelli on the upper side of the hindwing. Typical specimens show two white-pupilled black ocelli. Occasional specimens bear up to five, the anterior two being large, the others small. Some specimens have one, two, or three, white dots posterior to the normal complement of ocelli.

11c. **Pierella luna lesbia** Staudinger

Original description: 1888, *Exot. Tagf.*, 1:219.

Earliest figure: 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 43a.

Material seen: 12 ♂♂, 4 ♀♀.

Range: The tropical rain forests on the western slope of the Cordillera Occidental in Ecuador and S. Colombia.

The only Colombian specimens of which I know are Staudinger's type from the Rio San Juan and a female from "Colombia" in the Ovalle collection at the American Museum of Natural History. It appears to be common in Ecuador.

DIVISION C

Characteristics: The species that compose this division bear a pattern on the upperside that is abberrant to this genus. On the underside they are sufficiently close to the other species to be included in *Pierella*. Structurally this division is clearly *Pierella*. The division is characterized by bearing large blue or blue and white areas on the upperside of the hindwings and smaller areas on the forewings. Beneath, the characters of the two preceding divisions are combined. The forewing resembles Division A in that there is a light transverse band margined with dark lines. The hindwings are like Division B and bear three straight parallel dark lines.

IV. the *hortona* group.

Characteristics: those of the division.

The group is restricted to the western part of the Amazon basin in the tropical rain forests. Two species are generally recognized in the group, *hortona* and *albofaciata*. Typical specimens of these are easily recognized but each produces forms that approximate the other. It is quite possible that there is only one biologic species in this group. The two taxonomic species may be separated on the appearance of the underside. The outer part of the wings of *hortona* are essentially the same color as the basal part. These areas are strongly contrasting in *albofaciata* except among the males of the race *decepta* described below.

12. **Pierella hortona** (Hewitson)

Original description: 1854, *Trans. Ent. Soc. London*, (2)2:246, pl. 23, f. 1.

Earliest figure: in original description.

Other figures: 1888, Staudinger *Exot. Tagf.*, 2: pl. 77. 1911, Weymer, *Seitz's Macrolepid.*, 5: pl. 43 b.

f. **hortensia** (Felder)

Original description: 1862, *Wiener Ent. Mon.*, 6: 125. No figure known to me.

Material seen: 30 ♂♂, 9 ♀♀.

Range: The rain forest of the west-central Amazon basin from S. Colombia to N. Peru below 1100m. and eastward as far as the junction of the Rio Negro and Rio Amazon.

This species is quite variable, hardly two specimens being exactly alike. The variation shows two trends—one, toward elimination of the blue patch at the end of the cell on the upperside of the forewing, the other toward enlargement of the blue areas and replacement of the blue scales with white.

Typical *hortona* has a well-developed blue spot on the forewing and a larger one on the hindwing.

Typical *hortensia* has the spot on the forewing greatly reduced, on some specimens it is almost gone, and the spot on the hindwing contains a large area of white scales.

A third form with large white areas in the blue patches on both wings approaches *albofaciata* in the appearance of the upperside. I call this form *albopunctata*.

f. albopunctata forma nov.

This form differs from typical *hortona* in having a large white area within the sub-apical patch on the upperside of the forewings and a large white center to the blue area on the hindwings. It differs from *hortensia* in having a large colored area on the upperside of the forewings.

Beneath, this form is typical of *hortona* both in coloration and disposition of the dark lines in the apico-cellular area of the forewings.

Holotype: ♂, Upper Rio Huallaga, Peru (Klug) *ex* Bassler, f 6107, July 20, 1928, American Museum of Natural History.

Allotype: ♀, same data as holotype but caught on August 19, 1928.

Paratypes: 1. ♂, Juanguy, Upper Rio Huallaga, Peru, Nov. 1935, (Klug) *ex* Mengel, Reading Public Museum. 2. ♀, Rio Tsaya, Amazonas, Peru, Oct. 1927, (Klug) *ex* Mengel, Reading Public Museum. 3. ♂, Manacapuru, Brazil, Sept. 1925, (Klages) Carnegie Museum.

These three forms intergrade completely and have no definite geographic restrictions. The form *hortensia* tends to be more common in the northeastern part of the range, *albopunctata* in the southeastern part.

There are several other minor variations that do not warrant names. A good series in the Carnegie Museum indicates that a local form flies around São Paulo de Olivença on which the underside is materially darker than on specimens from farther west.

One of the differences between *hortona* and *albofaciata* is the presence, on the latter, of a bar across the costal end of the characteristic dark flanked light band on the underside of the forewing. This bar is light in color and flanked by dark lines. There is a specimen of *hortona* in the Mengel collection at Reading, taken by Klug at San Gabriel on the Upper Amazon in Brazil, which resembles *albofaciata* in this one respect.

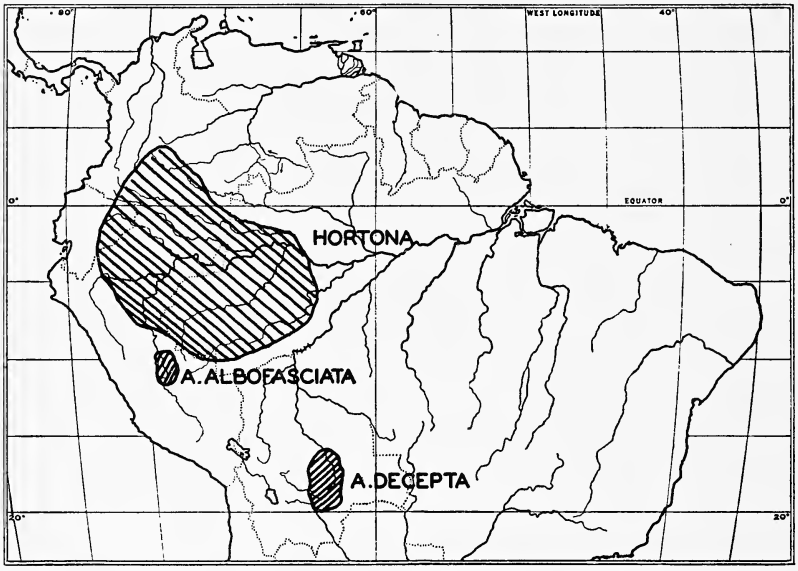


FIG. 11. Ranges of *Pierella hortona* and *albofaciata*.

13. Pierella albofaciata

This species from south of the Rio Marañon is much less frequently found in collections than is *hortona*. Its characteristics have been pointed out above. There are two races of the species, *albofaciata* from Peru and *decepta* from Bolivia. These are alike on the upper surface but differ materially on the underside.

13a. **Pierella albofaciata albofaciata** Rosenberg

Original description: 1913, *Trans. Ent. Soc. Lond.*, p. 678.
Material seen: 3 ♂♂, 2 ♀♀.
Range: Tropical rain forest of the tributaries to the Amazon in N. Peru.
On the underside of *albofaciata* the outer half of the wings is very dark

brown and the inner half dun-colored with a slight pearly luster. On the upperside there is a large rectangular white bar across the discocellular of the forewing.

13b. **Pierella albofaciata decepta** subsp. nov.

Upperside: like *albofaciata* in both sexes.

Underside: differs from *albofaciata* in these respects:

Male forewing: dilute dark brown marginad of the light transverse band and as a suffusion along the inner margin of that band; the basal half of the wing is a light sand color with a pearly luster; there are two black points in the cell.

Male hindwing: almost entirely of the light sand color with a strong pearly luster; the three dark lines are not strong, one crosses the wing through the middle of the cell, the middle one crosses just outside of the cell and the outer one passes through the sharp bend in M_3; costad of M_3 the outer line is suffused margined with dark brown; there is a series of minute black submarginal dots between the nervules from R_5 to Cu_2; there are black dots in the base of the cell and between Cu_1 and A_1 at the base.

Females approach the typical coloration of *albofaciata* on this surface: They are a little lighter and more pearly.

Holotype: ♂, Rio Yapacani, E. Bolivia, March 1915 (Steinbach), Carnegie Museum.

Allotype: ♀, the same data except caught in February 1915.

Paratypes: 1-2. ♂♂, same data, caught in August 1913. 3-5. ♂♂, same data, caught in September 1914. 6. ♀, same data, caught in February 1915.

CHECK-LIST OF THE GENUS PIERELLA.

1. *nereis* (Drury)
2. *helvina*
   - a. *helvina* (Hewitson)
   - b. *incanescens* Godman and Salvin
     - f. *costaricana* Niepelt
   - c. *ocreata* Godman and Salvin
     - ♀ f. *hymettia* Staudinger
     - ♀ f. *werneri* Hering & Hopp
     - ♀ f. *johnsoni* Talbot
     - f. *pacifica* Niepelt

3. *hyalinus*
   a. *hyalinus* (Gmelin)
   b. *dracontis* (Huebner)
      f. *extincta* Weymer
   c. *fusimaculata* Brown
4. *lena*
   a. *lena* (Linnaeus)
   b. *brasilensis* (Felder)
      f. *glaucolena* Weymer
         f. *obsoleta* Brown
5. *amalia* Weymer
6. *lucia* Weymer
7. *astyoche* (Erichson)
8. *rhea*
   a. *rhea* (Fabricius)
      f. *lamia* (Sulzer)
   b. *chalybaea* Godman
      f. *columbina* Krueger
9. *stollei*
   a. *stollei* Miranda-Ribiera
   b. *boliviana* Brown
10. *hyceta*
   a. *hyceta* (Hewitson)
   b. *latona* (Felder)
      f. *cercye* (Hewitson)
11. *luna*
   a. *luna* (Fabricius)
      ab. *albina* Oberthur
      f. *rubra* Brown
   b. *rubecola* Godman and Salvin
   c. *lesbia* Staudinger
12. *hortona* (Hewitson)
      f. *hortensia* (Felder)
      f. *albopunctata* Brown
13. *albofaciata*
   a. *albofaciata* Rosenberg
   b. *decepta* Brown

NOTES ON ECUADORIAN PIERELLA.

The species marked with an asterisk in the following list are here reported from Ecuador for the first time. The major portion of the Brown collection is now at the American Museum of Natural History.

*2c. **Pierella helvina ocreata** G. & S.

1 ♀, Hacienda Lorena, near Santa Domingo de los Colorados, 550m., Feb. 19, 1941 (D. B. Laddey) coll. F. M. Brown.

An abberant specimen of f. *pacifica* Niepelt that approaches ♀ f. *hymettia* Staudinger.

*4b. **Pierella lena brasilensis** Felder

1 ♂, Canelos, Oriente, 700m., Dec. 12, 1938 (W. C. MacIntyre), coll. F.M.B.

1. ♂, Rio Jondachi, near Archidona, Oriente, 800 m., Nov. 1939 (W.C.M.), coll. F.M.B.

1 ♂, Rio Toachi, Pichincha 800m., Nov. 1939 (W.C.M.), coll. F.M.B.

1 ♂, Puyo, Oriente, 1000m., Dec. 5, 1938 (F.M.B.), coll. F.M.B.

3 ♂♂, Sarayacu, Oriente, 500m. (Schaus) U.S.N.M.

1 ♂, Rio Arajuna, Oriente 1000m., April 27, 1941 (W.C.M.), coll. F.M.B.

The Rio Toachi record is very doubtful. MacIntyre purchased the material from a Quito bird collector who had visited both Rio Jondachi and Rio Toachi in November 1939. I firmly believe the specimen is from east of the Andes.

*6. **Pierella lucia** Weymer.

1 ♂, Canelos, Oriente, 700m., Dec. 12, 1938 (W.C.M.), coll. F.M.B.

2 ♂♂, Sarayacu, Oriente, 500m., (Schaus) U.S.N.M.

4 ♂♂, 1♀ Zumbi, Oriente, 700m., Oct. 28, 1911, Nov. 1941 (D.B.L.), coll. F.M.B.

*8b. **Pierrella rhea chalybaea** Godman

1 ♂, Rio Jondachi, near Archidona, Oriente, 800m., Nov. 1939 (W.C.M.), coll. F.M.B.

3 ♂♂, Sarayacu, Oriente, 500m.

These are typical f. *columbina* Krueger in darkness of color and disposition of ocelli; they tend to *chalybaea* in that there is a faint bluish gloss on the hindwings.

10. **Pierella hyceta latona** (Felder)

10 ♂♂, Puyo, Oriente, 1000m., Feb. 6, Dec. 1938 (F.M.B.), coll. F.M.B.

1 ♂, Rio Tutenongoza, Oriente, 800m., Feb. 10, 1939 (F.M.B.), coll. F.M.B.

1 ♂, 2 ♀♀, Huagra-yacu, Oriente, 900m., March 7, April 6, 1941 (W.C.M.), coll. F.M.B.

1 ♂, 1 ♀ Rio Arajuna, Oriente, 1000m., April 23-26, 1941 (W.C.M.), coll. F.M.B.

5 Hacienda La Mascota, Oriente, 1250m., (Coxey) A.N.S.P.

1 ♂, Rio Pastaza, Oriente, Oct. 1, 1936 (W.C.M.), U.S.N.M.

1 ♂, 1♀, Macas, Oriente, Jan. 26 (Feyer?), *ex* Mengel coll., Reading Public Museum.

1 ♂, Zumbi, Oriente 700m., Nov. 11, 1941 (D.B.L.), coll. F.M.B.

1 ♂, 1♀, Zamora, Oriente, 1000m., Dec. 20, 1941 (D.B.L.), coll. F.M.B.

3 ♂♂, "Pacific Slope" (E. W. Rorer), U.S.N.M.

Stübel collected this species at Pintuc (Puyo). These were reported as *cercye* by Weymer in his account of Stübel's collection. All of the Ecuadorian material with locality data except the Zumbi and Zamara specimens are intermediate to *cercye*. The three excepted specimens are typical *latona* as are the three "Pacific Slope" specimens in the U.S.N.M. I gravely doubt the veracity of that data. I know Mrs. Rorer and know that while living on the Pacific Slope, she frequently collected in the "Oriente." I feel sure that some slipshod preparator put a "Pacific Slope" label on the specimen without reference to Mrs. Rorer's locality data.

11c. **Pierella luna lesbia** Staudinger

1 ♂ Balzapamba, 630m., June 1938 (W.C.M.), coll. F.M.B.

1 ♂, Playas de Montalvo, 30m., April 1938 (W.C.M.), coll. F.M.B.

2 ♂♂, Santo Domingo de los Colorados, 500m., Dec. 12-19, 1940 (D.B.L.), coll. F.M.B.

1 ♀, La Lorena, 550m., Feb. 25, 1941 (D.B.L.), coll. F.M.B.

1 ♂, Rio Toachi, 800m., Sept. 1938 (W.C.M.), coll. F.M.B.

2 ♀♀, Palmar, 200m., March 31, April 15, 1941 (D.B.L.), coll. F.M.B.

1 ♂, Rio Maizito, near Palmar, 200m., May 7, 1941 (D.B.L.), coll. F.M.B.

Huigra, March 11 (S. N. Rhoads), A.N.S.P. and R. P. M.

3 ♂♂, Dos Puentes (Coxey) A.N.S.P.

Zaruma (*ex* Dognin) U.S.N.M.

Las Guayas (Rorer) U.S.N.M.

In addition to these specimens of the race *lesbia*, there are three specimens of the race *luna* in the Mengel collection at the Reading Public Museum. One of these is labelled "Guayaquil," the other two are labelled "Cuenca." The latter locality is certainly incorrect. I have collected in the Cuenca area and it is quite impossible that *Pierella* is to be found there. It is totally wrong for the genus climatically, being semi-arid and cool. The climatic conditions near Guayaquil are better suited to the genus. However the suitable areas there are well occupied by the race *lesbia*. Six excellent collectors, Rhoads, Rorer, Coxey, Laddey, MacIntyre and Feyer have collected in this region and have not turned up *luna* unless Feyer caught the Mengel specimen. Since Mengel's collection contains numerous mislabelled specimens I am inclined to doubt the validity of the Guayaquil label.

Dognin in his report of the lepidoptera from the environs of Loja did not report *lesbia*. He did report *hyceta*. There are no *hyceta* in that part of the Dognin collection at the U. S. National Museum. Possibly he misidentified the Zaruma specimen as *hyceta*.

*12. **Pierella hortona** (Hewitson)

1 ♂, 1♀, Canelos, Oriente, 800m., Dec. 12, 1938 (W.C.M.), coll. F.M.B.

2 ♂♂, Rio Jondachi, Oriente, 800m., Nov. 1939 (W.C.M.), coll. F.M.B.

1 ♂, Rio Tutenongoza, Oriente, 800m., Feb. 10, 1939 (F.M.B.), coll. F.M.B.

Hacienda La Mascota, Oriente, 1250m., (Coxey), A.N.S.P.

3 ♂♂, Sarayacu, Oriente, 500m., (Schaus) U.S.N.M.

1 ♂, Macas, Oriente, 1050m., (L. M. Higgins) U.S.N.M.

1 ♂, Macas, Oriente, (Feyer?) R.P.M.

1 ♂, "Ecuador" (*ex* Johnson), U.S.N.M.

These are typical *hortona* except the two from Macas and the "Ecuador" specimen which are *hortensia* (Felder).

ART. 7. THE LAND SNAILS OF WEST VIRGINIA

By Gordon K. MacMillan

(Plates 1-15)

PREFACE

The taxonomy of the species in this paper, especially of the family *Polygyridæ*, has been based entirely upon the character of the shell. This is in direct contrast with the system proposed by Dr. H. A. Pilsbry, Dr. H. B. Baker, and others, who are using anatomical characters of the animal as a criterion for classification. In view of this, much of the classification proposed by Dr. Pilsbry in "The Land Mollusca of North America (North of Mexico)", vol. 1, pt. 2, 1940, has not been followed entirely by the author.

In most cases the original description of each species and subspecies has been copied from the publication in which it appeared. Some of the earlier descriptions had been written in Latin or in Latin with an English description following. In this paper the English translations have been used in all such cases or the English description utilized when accompanied with the Latin one.

Many of the descriptions of the species and varieties of land snails contained in this article are adaptations or condensations from the original descriptions by the describers of the species. Much use was made of the parts of the "Manual of Conchology" and the volumes of the "Land Mollusca, etc.," which pertain to the fauna of West Virginia. Although these adaptations of Dr. Pilsbry and also those of Dr. H. B. Baker have not been acknowledged with each species, recognition of their use is made now. Conchologists will undoubtedly recognize in the descriptions of the species, some of the characteristic phraseology of Dr. Pilsbry.

In the extension and support of this work, Dr. and Mrs. Stanley T. Brooks have made extensive collections from the West Virginia line to the Great Smoky Mountains.

I extend my appreciation to Dr. Harald Rehder, of the United States National Museum, for his kindness in identifying the *Succinea* and in verifying those species that I had already named. I wish to thank the

Note: The term "land snails" used in the title of this paper, includes those terrestrial forms which possess a visible shell, but does not include the "slugs," which possess only the remnant of a shell under the skin in the region of the neck, or which have no shell at all. Perhaps a more technical title would have been the "terrestrial shell-bearing mollusca," since this includes all land forms with a shell, and still excludes the slugs.

Issued February 28, 1949.

officials of the West Virginia Academy of Science for their contribution to this work. Without their support much territory could not have been covered. I also wish to thank M. Graham Netting, Curator of Herpetology at the Carnegie Museum, and many contributors to the collections for their work and data.

The list of collectors and others who have contributed toward our knowledge of the mollusca of West Virginia follow. The initials after the locality at which the shells have been found, are those of the collector and reference to the following list will indicate his identity. These symbols are used throughout this paper.

AEO.....A. E. Ortmann
AFA.....A. F. Archer
CB.....C. Brown
CBW.....C. B. Wurtz
CC.....Crooke Collection (American Museum of Natural History)
CG.....Calvin Goodrich
CJG.....C. J. Goin
C&A.....W. J. Clench and A. F. Archer
EJC.....E. J. Court
FML.....F. M. Love
FRW.....F. R. Wilson
GB.....Grace Bogges
GEW.....G. E. Wallace
GHC.....G. H. Clapp
GKM.....G. K. MacMillan
GRH.....G. R. Hunt
GWT.....G. W. Tryon
HAP.....H. A. Pilsbry
HHS.....H. H. Smith
IHM.....I. H. Marshall
JHA.....J. H. Alexander
JPEM.....J. P. E. Morrison
LL.....Leonard Llewellyn
MCZ.....Museum of Comparative Zoölogy
MGN.....M. G. Netting
MSB.....M. S. Briscoe
MRS. GA..Mrs. G. Andrews
M&R.....G. K. MacMillan and N. D. Richmond
NDR.....N. D. Richmond
PCB.....P. C. Bibbee
PR.....Paul Ridgway
P&I.....H. A. Pilsbry and J. E. Ives
P&L.....W. M. Perrygo and C. Lingebach
RLF.....R. L. Fricke
UM.....University of Michigan
USFC.....United States Fish Commission
VS.....Victor Sterki
WJF.....W. J. Fox

Family HELICINIDÆ

The members of this family of snails are characterized by a shell that is globose, the base of which has a callus around the columella; while the columella is somewhat flattened and rather straight. The aperture is

triangularly semi-ovate and entire; the peristome is either simple, straight, or thickened, and often widely expanded, with or without teeth. The operculum is not spiraled and somewhat semi-oval, and is also membranous or testaceous.

This family is represented by only one genus and species in West Virginia, and is one of the two snails in that state which possesses an operculum.

Genus Hendersonia Wagner

Shell carinated, narrow and slowly increasing whorls, solid, striated, imperforate. Aperture small, semi-lunar; the peristome slightly reflected and thickened internally. Umbilicus covered by reflected peristome. Whorls 5½; suture scarcely indented.

Hendersonia occulta (Say)

(Plate 1, fig. 1)

Shell small, rather solid, low conical, acute at apex, cretaceous, obviously striated; spire of five nearly plane whorls, the last of which is angular at the periphery, and this angle continuing up the spire adjacent to the suture, makes it appear double; the aperture is small, semi-lunar; the peristome is scarcely reflexed, but is thickened internally; the columella is very short, and joins the peristome by a slightly waving curve, without forming an angle. Diameter 6, height 5 mm.

Type Locality: A rugged and abrupt "bluff," a half-mile below New Harmony, Indiana (Say, 1831).

Range: Pennsylvania to Minnesota, south to Missouri and Florida.

West Virginia Records

Grant County; Greenland Gap (NDR). *Greenbrier County;* Renick (GRH), Renick Valley (NDR). *Marion County;* Fairmont (NDR). *Mineral County;* Keyser (IHM). *Ohio County;* Wheeling (T. Bland). *Pendleton County;* Franklin (NDR) (GKM). *Wyoming County;* Oceana (M&R).

Remarks: This is the only species in the family *Helicinidæ* in the United States that is carinated and striated. Although it is found in this country east of the Rocky Mountains, its distribution is rather local and discontinuous.

Hendersonia occulta was first described from a fossil shell, being abundant in the loess formations of Iowa, Nebraska, Missouri, Illinois, and Indiana. In 1832, Jacob Green described a living species of *Helicina*,

which is called *rubella*. Some conchologists consider this a subspecies of *occulta*, and others a synonym of that species.

Family CIONELLIDÆ Kobelt

The shell is small or minute, imperforate, elongate, varying from ovate to turrite or subcylindric, thin, glossy, having little or no sculpture, and generally it is somewhat transparent. The apex is small and obtuse, embryonic whorl not differentiated from those following. Aperture ovate or piriform, simple. The columella is usually sinuate or truncate at the base. Outer lip not expanded, often thickened within.

Genus CIONELLA Jeffreys

The shell is oblong-conic or oblong-cylindric, imperforate, smooth and glossy, composed of from 5 to 7 slightly convex whorls. Aperture small, ovate, nearly vertical, toothless. Outer and basal lip arcuate, obtuse, thickened within by a callous rim which is continuous to the upper insertion; columella short, concave or straightened, very slightly sinuate at the base; parietal callus very thin throughout.

There is only one species represented in the fauna of North America. Although two forms of *Cionella lubrica* have been described, each of these is hardly distinguishable from the typical species.

Cionella lubrica (Mueller)

(Plate 1, fig. 4)

Shell small, thin, transparent, oblong-oval; epidermis smoky horn-color, smooth, very bright and shining; whorls 5 or 6, somewhat rounded, the last equalling two-fifths the shell's length, rounded at base; apex obtuse; suture somewhat impressed; aperture lateral, oval, its plane nearly parallel with the axis of the shell; peristome simple, thickened, often slightly rufous; umbilicus imperforate; columella obsoletely truncated at base. Length 6 mm.; diameter 2.5 mm.

Type Locality: Not designated. (Mueller, 1774).

Range: Newfoundland; Canada; Alaska; United States.

West Virginia Records

Boone County; Peytona (NDR) (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Barboursville (M&R), Ona (M&R). *Clay County;* Clay (GKM). *Doddridge County;* West Union (FRW). *Fayette*

County; Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Renick (GRH), Renick Valley (NDR), Ronceverte (GKM) (M&R), White Sulphur Springs (P&L). *Jefferson County;* Charles Town (MSB), Leetown (MSB), Harper's Ferry (MSB) (JPEM). *Kanawha County;* Hudnall (CBW). *Lewis County;* Jackson's Mill (GKM), Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R). *Logan County;* Blair (M&R), Sharples (M&R). *McDowell County;* Avondale (M&R). *Marion County;* Fairmont (NDR), High Point (NDR). *Mercer County;* Bluefield (M&R), Princeton (M&R), Speedway (M&R). *Mineral County;* Burlington (GKM). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (M&R), Sweetsprings (M&R). *Nicholas County;* Lockwood (GKM). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM), Marlinton (GKM), Mill Point (GKM). *Putnam County;* Poca (GKM). *Randolph County;* Huttonsville (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Upshur County;* French Creek (GKM). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (NDR). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Pineville (M&R).

Family Haplotrematidæ

Shell thin, widely umbilicated, depressed, striated or wrinkled, color pale yellowish or greenish yellow; whorls 4½ to 5, the last broad, depressed, and moderately deflected in front; the aperture is obliquely ovate, the peristome somewhat thickened or expanded, the margins approximating, and the basal shortly reflexed; the columella is entire.

Genus Haplotrema Ancey

The characters are the same as those of the family *Haplotrematidæ.* This genus is represented by only one species in West Virginia, although two forms, *major* and *minor,* have been recognized, but are distinguished from the typical species only by differences in measurements.

Haplotrema concavum (Say)

(Plate 1, figs. 2, 3)

Shell much depressed, suborbicular, horn-color or whitish, immaculate; volutions five, irregularly wrinkled across, more convex beneath; suture distinctly impressed; umbilicus very large, exhibiting all the volutions to the summit distinctly; aperture large, short; labrum towards the base very

slightly and inconspicuously reflected. Greatest width seven-tenths of an inch (21 mm.).

Type Locality: Not designated (Say, 1821).

Range: Quebec and Ontario, west to Minnesota, south to Arkansas and east to Georgia.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM), Shadyside (GKM). *Cabell County;* Bourboursville (NDR) (M&R), Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* (GEW) (GKM). *Doddridge County;* Sherwood (NDR), West Union (FRW). *Fayette County;* Clifftop (MRS. GKM) (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR), Petersburg (PR). *Greenbrier County;* Alderson (NDR) (GKM), Organ Cave (NDR), Renick Valley (NDR), Ronceverte (M&R), White Sulphur Springs (P&L). *Hampshire County;* Romney (GKM). *Hancock County;* Pughtown (LL). *Harrison County;* Bristol (NDR). *Jefferson County;* Bardane (MSB), Bloomery (JPEM), Bolivar (MSB), Charles Town (JPEM), Harper's Ferry (JPEM) (GWT), Key Gap (JPEM), Loudoun Heights (JPEM), Reedson (MSB), Shenandoah City (MSB). *Kanawha County;* Alum Creek (NDR), Charleston (GKM), Dunbar (GKM), Hudnall (CBW), St. Albans (UM), South Charleston (NDR). *Lewis County;* Jackson's Mill (GKM), Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR). *Logan County;* Blair (NDR) (M&R), Davin (NDR), Sharples (M&R), Slagle (CG). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR) (GRH), High Point (NDR), Jayenne (GRH), Midway (GRH), Mt. Harmony (NDR), Rivesville (NDR), Smithville (CBW). *Marshall County;* Bannon (NDR), Kent (NDR), Powhattan Point (FRW). *Mason County;* Leon (NDR), Point Pleasant (NDR) (CBW). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Spanishburg (M&R), Speedway (M&R). *Mineral County;* Burlington (GKM), Keyser (IHM). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Coopers Rock (CBW), Smithtown (NDR), Sturgisson (NDR). *Monroe County;* Alderson (GKM), Gap Mills (M&R), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (M&R), Waitesville (M&R). *Morgan County;* Berkeley Springs (NDR), Largent (NDR). *Nicholas County;* Craigsville (GKM), Lockwood (GKM), Richwood (NDR), Summersville (GKM), Swiss (NDR). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pendleton County;* Circleville

(NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (MGN) (NDR). *Pocahontas County;* Cass (MGN), Dunmore Spring (GKM), Greenbank (GKM), Hillsboro (NDR) (GKM), Marlinton (MGN) (GKM), Mill Point (GKM). *Preston County;* Cascade (NDR), Cranesville (MGN), Manheim (JHA), Terra Alta (MGN). *Putnam County;* Poca (GKM). *Raleigh County;* Daniels (M&R), Shady Springs (M&R). *Randolph County;* Cheat Bridge (GKM), Helvetia (VS), Huttonsville (MGN) (NDR). *Summers County;* Riffle (GKM), Talcott (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Tyler County;* Friendly (CBW). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (NDR) (M&R). *Wetzel County;* Silver Hill (NDR). *Wirt County;* (WJF). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Family Pomatiopsidæ Stimpson

Shell elongated, turreted, thin to thick, smooth, umbilicated; aperture expanded; peristome continuous, thin or slightly reflected; operculum corneous, subspiral, with spiral sculpture.

This, together with the *Helicinidæ*, are the only families of Gastropoda in West Virginia which possess an operculum. Only one genus and two species are found in the state.

Genus Pomatiopsis Tryon

The characters of the genus are the same as those of the family.

Although most of the representatives of this genus are aquatic, *P. lapidaria* and *P. prælonga* have been found in moist places and also on hillsides, sometimes as much as a hundred to two hundred feet from any body of water.

If the species of this genus are land snails, as many conchologists believe, they are the first of their kind which possess gills, the characters of freshwater gastropoda and not of the land snails, which breathe by means of lungs.

Pomatiopsis lapidaria (Say)

(Plate 1, fig. 5)

Shell elongated, turreted, color brownish-horn or chestnut; surface dull to shining; lines of growth crowded, slightly wrinkled in some specimens, rather fine; apex rounded, flattened, depressed; nuclear whorl not emergent; partly embraced by the second whorl; not much constricted by the suture, sculpture very finely granular, almost smooth; whorls 7, well

rounded, slowly and regularly increasing in diameter; suture deeply impressed; spire acute, about three times as long as the aperture; aperture elongate ovate, somewhat narrowed and angled above, rounded below, slightly expanded, somewhat purplish within; peristome simple or slightly thickened within, upper terminations connected on the parietal wall by a callus of greater or less thickness; umbilicus well marked, emargined by the inner lip which is slightly reflected over the umbilical region; base rounded. Length 7 mm., width 3.1 mm.

Type Locality: Not designated (Say, 1817).

Range: Quebec and Ontario; New York and New Jersey to Minnesota, south to Texas and Georgia.

West Virginia Records

Boone County; Peytona (M&R). *Calhoun County;* Grantsville (NDR). *Greenbrier County;* Renick (GRH), Ronceverte (M&R). *Kanawha County;* Alum Creek (NDR), Dunbar (GKM). *Lewis County;* Weston (GKM). *Logan County;* Sharples (M&R). *McDowell County;* Avondale (M&R), Panther (NDR) (M&R). *Marion County;* Fairmont (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Speedway (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monroe County;* Waitesville (M&R). *Wyoming County;* Oceana (M&R).

Remarks: P. lapidaria may be known by its elongated, brownish shell, convex and deeply sutured whorls, and the reflected rim of the aperture.

Habits: It is rarely found in water, but abundantly under wet leaves and in places subject to overflow from creeks and streams.

Pomatiopsis praelonga Brooks and MacMillan

(Plate 1, fig. 6)

Shell elongate, turreted, and narrow. Color brownish-horn. Surface somewhat shining and somewhat wrinkled, lines of growth very fine and hardly discernible. Apex slightly rounded, flattened; nuclear whorl emergent; sculpture worn and smooth. Whorls 8, somewhat rounded, slowly and regularly increasing in diameter. Suture deeply impressed. Spire acute, about three and a half times as long as aperture. Aperture ovate, somewhat narrowed and angled above, rounded below. Peristome thickened and extremities connected. Umbilicus well marked, ermargined by inner lip which is reflected over umbilical region. Base rounded. Length 7.5, width 2.25 mm.

Type Locality: Hillside, along Elk River, 1½ miles south of Clay, Clay Co., West Virginia.

Range: West Virginia Record; *Clay County;* Clay (GKM).

Remarks: This is a much longer and narrower species of *Pomatiopsis* than *lapidaria*. *P. prælonga* has a coarser sculpture, more thickened peristome, and much flatter whorls than *lapidaria*. In the number of whorls and the length of the shell, *prælonga* is much like *P. scalaris*, but it is much narrower. *P. prælonga* is an existing species while *P. scalaris* is a fossil shell from the loess of the Wabash River near New Harmony, Indiana.

Habits: P. prælonga was found under the dead fronds of ferns near the bases of plants, where the immediate hillside was rocky and covered with dead leaves.

Family Valloniidæ Pilsbry

Minute snails with perforate or umbilicate shells of few whorls, discoidal to ovate conic in shape, often with spaced cutical ribs, and without internal laminæ; the peristome either expanded, thickened, or simple, and toothless.

Genus Vallonia Risso

Shell minute, 1.8-3.5 mm. greater diameter, openly umbilicated, with flat or moderately elevated spire, colorless or yellowish to reddish horn-color, transparent or diaphanous, without bands or markings of any kind. Surface striated or with membranous ribs; whorls 3-4, rounded; aperture nearly circular or somewhat transversely elongate; peristome everted or straight, with or without a whitish lip.

The last whorl, in the majority of species, descends in front to the aperture, either as a whole or at the suture only, while the back of the whorl keeps straight to the very margin. Also in a number of species the last whorl ascends distinctly before it descends.

Vallonia pulchella (Mueller)

(Plate 1, fig. 7)

Shell widely umbilicated, depressed, slightly convex above, thin and transparent; epidermis colorless; whorls 3½-4, very minutely striated; the last large and spreading at the aperture like a trumpet; aperture orbicular, a little dilated; peristome much thickened, white, reflected, making nearly a continuous circle, ends approaching; umbilicus large, exhibiting all the volutions. Greater diameter 3, lesser diameter 2.5 mm.; height 1.5 mm.

Type Locality: Not designated (Mueller, 1774).

Range: Canada and the United States.

West Virginia Records

Greenbrier County; Ronceverte (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Aurora (Heideman), Bakerton (MSB), Bolivar (MSB), Charles Town (MSB), Engle (MSB), Harper's Ferry (NDR) (GWT) (EJC), Leetown (MSB), Meyerstown (MSB), Rippon (MSB), Silver Grove (MSB). *Marshall County;* Moundsville (VS). *Monongalia County;* Morgantown (HHS). *Monroe County;* Salt Sulphur Springs (NDR) (M&R), Union (GKM), Willow Bend (M&R). *Pendleton County;* Judy Gap (GKM).

Vallonia excentrica Sterki

(Plate 1, fig. 8)

Moderately umbilicated, the umbilicus elongate, rapidly widening for the last ⅓ whorl; slightly convex above; pale horn-colored, transparent or slightly opaque, with a somewhat fatty gloss, smooth or very finely and irregularly striate, smooth at the nucleus. Whorls 3-3½, rather rapidly increasing, with a moderately deep suture, the last comparatively large, well rounded, expanding towards the aperture, not descending in front. Aperture moderately oblique and inclined, forming five-sixths of a circle, subangular at the base, the umbilical margin somewhat protracted; peristome everted only in the inferior part, with a rather strong white lip, shining throughout the shell. Height 1.1, greater diameter 2.3, lesser 1.8 mm.

Type Locality: Quebec (Sterki, 1892).

Range: Canada, Maritime Provinces, Quebec, Ontario; New England States, New York and New Jersey to Indiana and Michigan.

West Virginia Records

Jefferson County; Aldridge (MSB), Bakerton (MSB), Bloomery (MSB), Duffield (MSB), Halltown (MSB), Harper's Ferry (EJC) (MSB), Kabletown (MSB), Kearneysville (MSB), Leetown (MSB), Mechanicstown (MSB), Middleway (MSB), Millville (MSB), Morgan Grove (MSB), Mt. Pleasant (MSB), Piperstown (MSB), Rippon (MSB), Shepherdstown (MSB), Silver Grove (MSB), Skeetersville (MSB), Summit Point (MSB), Uvilla (MSB). *Marshall County;* Moundsville (VS).

Remarks: This species is distinguishable from *pulchella* by its size, averaging a little smaller, by the somewhat elongated outline of the shell and umbilicus, the last whorl more expanding towards the aperture, the smaller and less elevated spire; the less deep suture; the peristome little and not abruptly everted.

Vallonia costata (Mueller)

(Plate 2, fig. 1)

Moderately umbilicated, more widely so for the last half whorl, depressed convex above, or nearly flat, grayish to light or reddish horn-colored, with rather regularly set membranous ribs and fine striae between them, nucleus with fine revolving lines. Whorls 3½, slightly flattened above and below the periphery, at the circumference somewhat angular, with a deep suture, rather rapidly increasing; the last whorl expanding to the aperture, shortly and moderately descending in front, more so at the suture than on the back. Aperture rather oblique and inclined, almost circular, a little flattened above, ends of margin much approximating, slightly protracted and auricled, connected by a thin callus; peristome strongly and abruptly everted, with a strong white lip. Height 1.1, greater diameter 2.5, lesser 2.1 mm.

Type Locality: Fridrichsdal, Denmark (Mueller, 1774).

Range: Canada; United States as far south as California, New Mexico, Kansas, and Virginia.

West Virginia Records

Jefferson County; Aldrich (MSB), Bakerton (MSB), Bloomery (MSB), Charles Town (MSB), Duffield (MSB), Engle (MSB), Halltown (MSB), Harper's Ferry (MSB), Jamestown (MSB) Kabletown (MSB), Kearneysville (MSB), Keystone (MSB), Leetown (MSB), Loudoun Heights (JPEM), Mechanicstown (MSB), Meyerstown (MSB), Middleway (MSB), Millville (MSB), Morgan Grove (MSB), Rippon (MSB), Shepherdstown (MSB), Skeetersville (MSB), Summit Point (MSB), Uvilla (MSB). *Monroe County;* Salt Sulphur Springs (NDR). *Pendleton County;* Franklin (NDR).

Remarks: Until recently *V. costata* had been considered a variety of *pulchella.* One of the main distinguishing features is the presence of very fine, raised revolving lines on the nuclear, or the 1½ embryonal whorls, while those of *pulchella* are smooth. The generally much more depressed spire, the deeper suture besides the rather flattened whorls above, the last whorl more rapidly expanding towards and descending to the aperture, especially at the suture, the more approximating margin rendering the aperture nearly circular, are sufficient to distinguish *costata* from *pulchella.*

Vallonia perspectiva Sterki

(Plate 2, fig. 2)

Shell small, with very wide perspective umbilicus, more widening for the last ½ whorl, flat, or a little elevated above, with rather dense, somewhat

regularly set, moderately strong membranous ribs (about 35 on the last whorl) and with finer striae between them; nucleus without revolving lines; pale-horn to colorless, thin, translucent; whorls 3½, gradually increasing, a little flattened above and below the periphery, with a deep suture, the last rounded, comparatively narrow, little expanding towards the aperture, rather rapidly descending; aperture very inclined and oblique, almost tangential, transversely ovoid or oblong; peristome continuous, shortly but not abruptly everted except near the suture, without (or with a very thin) lip. Diameter major 2, minimum. 1.7, altitude 0.7 mm.

Type Locality: Knoxville, Tennessee (Sterki, 1893).

Range: West Virginia and Kentucky to Iowa and Montana, south to Arizona and east to Alabama and Tennessee.

West Virginia Records

Grant County; Greenland Gap (NDR). *Greenbrier County;* Renick (GRH), Renick Valley (NDR). *Hampshire County;* Romney (GKM). *Jefferson County;* Bloomery (JPEM), Harper's Ferry (JPEM). *Pendleton County;* Franklin (NDR) (GKM). Judy Gap (GKM), Upper Tract (GKM). *Pocahontas County;* Greenbank (GKM).

Remarks: V. perspectiva cannot be mistaken for any other species except *parvula*, which it resembles in size, coloration, and the membranous ribs. But it is sufficiently distinguished by the wider umbilicus, the comparatively narrower last whorl, less expanding and descending to the aperture, which is smaller and not circular; the continuous peristome and the absence of a lip. It holds a singular position also among the species with strongly descending last whorl and transversely elongated aperture by the comparatively more distant and regularly standing membranous ribs, and its small size.

Family STROBILOPSIDÆ Hanna

Shell trochiform, dome-shaped or discoidal, umbilicate, of 4½ to 6 slowly enlarging whorls. The aperture is small, oblique, with armature of 2 or 3 parietal lamellæ and several deeply placed basal folds, all growing continuously from an early neanic stage. Peristome more or less thickened and expanded, the ends of the lip remote, joined by a parietal callus.

Genus STROBILOPS Pilsbry

The shell is small, perforate or umbilicate, trochiform to subdiscoidal, with rounded, angular, or carinate periphery, of 4½ to 6 closely coiled

whorls. Cavity of the last whorl is obstructed by two or three long parietal lamellæ, the upper one emerging to the edge of the parietal callus, the lower one weaker, emerging or immersed, the intermediate one when present, smallest and remote from aperture; a series of two or more short folds on the basal wall of the cavity deep within the last whorl. Peristome expanded; usually thickened, the insertion of the lip remote, connected by a parietal callus.

The members of this genus are characterized by the presence of the parietal lamellæ and basal folds, which separate them from all other shells in the North American fauna. These lamellæ and folds appear very early in the life of the shell, growing at the forward end of the shell and being absorbed behind.

Strobilops labyrinthica labyrinthica (Say)

(Plate 2, figs. 4, 5)

Shell conic, dark reddish-brown, body lighter; whorls 5 or 6, with conspicuous, elevated, equidistant, obtuse lines across, forming grooves between them; apex obtuse; lip reflected, rounded; pillar lip with a large lamelliform tooth, which appears to revolve within the shell parallel to the suture, a smaller raised line revolves nearer to the base within the shell, but becomes obsolete before it arrives at the pillar lip; umbilicus rather large. Breadth one-tenth of an inch. (2.5 mm.).

Type Locality: Not designated (Say, 1817).

Range: Quebec, Ontario, and Manitoba; eastern United States from North Dakota and Louisiana to Alabama and Maine.

West Virginia Records

Boone County; Peytona (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM). *Cabell County;* Barboursville (NDR) (M&R), Lesage (M&R), Ona (M&R). *Clay County;* Clay (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM), Renick (GRH), Renick Valley (NDR), Ronceverte (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Harper's Ferry (GWT) (CC), Shenandoah Junction (MSB). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW), South Charleston (NDR). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR). *Logan County;* Blair (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Glady Creek (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R), Speedway (M&R). *Monroe County;* Alderson (GKM),

Salt Sulphur Springs (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR). *Nicholas County;* Summersville (GKM). *Pendleton County;* Franklin (NDR) (GKM). *Pocahontas County;* Marlinton (GKM). *Putnam County;* Poca (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM) (M&R). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Remarks: S. labyrinthica has longer, more conspicuously unequal basal folds, the first two much longer than the others, and the series does not form an even curve as in *affinis;* the infraparietal lamella generally emerges more; the shell is smaller and generally less elevated and the spire is with a more strongly convex outline. The whole shell, and especially the last whorl is higher, the outline of the spire more convex, the basal folds are more numerous, the color is duller, and the shell is less transparent than in *S. œnea.*

Thomas Say mentioned no definite locality for this species in the description of the type specimen, but the four cotypes at the Academy of Natural Sciences of Philadelphia are labelled "Penna.; Hyde and Mason," and came probably from the immediate vicinity of Philadelphia, which place Dr. H. A. Pilsbry has selected as the type locality.

Habits: This shell is found under loose bark of logs, in half-decayed wood, among dead leaves, and in sod at the base of trees.

Strobilops labyrinthica parietalis Pilsbry

(Plate 3, fig. 1)

Similar to *S. labyrinthica* in the convexly conic, ribbed shell and weakly emerging infraparietal lamella, but the lamellæ penetrate more deeply, being two-thirds and three-fourths of a whorl long. There is a blunt columellar lamella and four basal folds, four within the side wall. The whole base is ribbed in some examples, or smoothish, nearly finally striate in others. Height 1.75, diameter 2.35 mm.

Type Locality: Ardsley, Montgomery County, Pennsylvania (Pilsbry, 1927).

Range: Pennsylvania, West Virginia, Tennessee, Florida, Alabama, and Louisiana.

West Virginia Records

Boone County; Peytona (GB). *Braxton County;* Gassaway (GKM). *Cabell County;* Ona (M&R). *Calhoun County;* Grantsville (NDR). *Grant County;*

Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM), Renick Valley (NDR), Ronceverte (M&R). *Hampshire County;* Romney (GKM). *Kanawha County;* Dunbar (GKM), South Charleston (NDR). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Sharples (M&R). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Mercer County;* Princeton (M&R). *Mingo County;* Williamson (M&R). *Monroe County;* Salt Sulphur Springs (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR). *Pendleton County;* Franklin (GKM). *Pocahontas County;* Marlinton (GKM). *Summers County;* Talcott (GKM). *Upshur County;* French Creek (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM) (M&R). *Wyoming County;* Baileysville (M&R).

Strobilops affinis Pilsbry

(Plate 3, figs. 2, 3)

The shell is convexly conic with obtusely angular periphery; the base moderately convex, becoming rather strongly so in its last third; glossy brown, with pale apex; narrowly umbilicate, contained about 7½ to 8 times in the diameter. There are 6 moderately convex whorls, increasing very slowly, the first two smooth, the rest sculptured with narrow, somewhat retractive ribs. The first half of the base is smooth, the ribs barely passing over the peripheral angle and reappearing within the umbilicus, but they continue weakly over the last half. The aperture is semi-lunar, oblique. Peristome is well expanded, thickened within, its face convex and fleshy-brown in color. Parietal callus moderately strong. The parietal lamella emerges to the edge of the callus and penetrates inward about two-thirds of a whorl. The infraparietal lamella is low and weak, deeply immersed, not visible in front or basal view. Interparietal lamella short and very weak. A third of a whorl within there is an oblique radial series of about 8 folds: a short low lamella on the columellar axis, followed by two folds larger and higher than the rest, and an oblique series running to the suture, composed of 4 to 7 short subsequent folds. Height 2.5, diameter 2.75 mm.

Type Locality: Not designated (Pilsbry, 1893).

Range: Canada; Maine to Minnesota, south to Texas, and east to Alabama and New Jersey.

West Virginia Records

Boone County; Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Fayette County;* Clifftop (GKM).

Grant County; Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Ronceverte (GKM) (M&R). *Hampshire County;* Romney (GKM). *Kanawha County;* Alum Creek (NDR), Charleston (GKM), Dunbar (GKM), Institute (GKM). *Lincoln County;* Myra (M&R), Sweetland (M&R). *Logan County;* Sharples (M&R), Stone Branch (NDR). *McDowell County;* Iaeger (M&R), Panther (M&R). *Mason County;* Leon (NDR). *Mercer County;* Princeton (M&R), Speedway (M&R). *Mingo County;* Williamson (M&R). *Monroe County;* Salt Sulphur Springs (M&R), Sweetsprings (M&R). *Morgan County;* Berkeley Springs (NDR). *Nicholas County;* Summersville (GKM). *Pendleton County;* Franklin (NDR) (GKM), Upper Tract (GKM). *Pocahontas County;* Marlinton (GKM). *Summers County;* Talcott (GKM). *Upshur County;* French Creek (MRS. GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Baileysville (M&R), Oceana (M&R).

Remarks: This shell is somewhat larger than *labyrinthica*, thinner, with the infraparietal lamella more deeply immersed and the baso-palatal folds less unequal, all being rather short and forming a regular curve across the base and up the outer wall. The outline of the spire is somewhat less convex than in *labyrinthica* but more convex than in *ænea.*

Strobilops aenea Pilsbry

(Plate 3, fig. 4)

The shell is narrowly umbilicate, the width of umbilicus contained about 6½ times in the diameter of the shell, low conic, with obtuse, rounded summit, the periphery distinctly but bluntly angular. The base is somewhat flattened below the periphery, elsewhere moderately convex. Whorls 5½, convex, slowly increasing, the first 1½ smooth, corneous, the rest dark brown with red-gold gleam; sculptured with narrow riblets which are somewhat oblique, retractive, rather fine and close. The base is smoothish, marked with growth-striæ only, except on its last third, where the riblets of the upper surface continue over the base. The aperture is semilunar, low but wide. Outer and basal lips brown, well expanded, somewhat thickened, the columellar margin dilated. The parietal lamella emerges to the edge of the parietal callus, penetrating inward a half-whorl. Infraparietal lamella weakly emerging. Midway between the lamellæ there is a very weak, low, deeply-placed interparietal lamella. These lamellæ are nodose far within, the nodes roughened, shortly prickly. The internal barrier, situated one-third of a whorl from the aperture, is radial, but slightly oblique; it consists of a short, weak columellar fold and four basal folds, visible through the shell; the second and fourth folds from the axis are long, the first short, the third fold weak or sometimes

wanting; there is no fold above the periphery. Height 1.5-2, diameter 2.4-2.75 mm.

Type Locality: Cazenovia, New York (Pilsbry, 1926).

Range: Massachusetts to Minnesota, south to Arkansas and Louisiana, east to Florida, and north to New Jersey.

West Virginia Records

Boone County; Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Ronceverte (GKM) (M&R). *Hampshire County;* Romney (GKM). *Kanawha County;* Alum Creek (NDR), Charleston (GKM), Dunbar (GKM), Institute (GKM). *Lincoln County;* Myra (M&R), Sweetland (M&R). *Logan County;* Sharples (M&R), Stone Branch (NDR). *McDowell County;* Iaeger (M&R), Panther (M&R). *Mason County;* Leon (NDR). *Mercer County;* Princeton (M&R), Speedway (M&R). *Mingo County;* Williamson (M&R). *Monroe County;* Salt Sulphur Springs (M&R), Sweetsprings (M&R). *Morgan County;* Berkeley Springs (NDR). *Nicholas County;* Summersville (GKM). *Pendleton County;* Franklin (NDR) (GKM), Upper Tract (GKM). *Pocahontas County;* Marlinton (GKM). *Summers County;* Talcott (GKM). *Upshur County;* French Creek (MRS. GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Baileysville (M&R), Oceana (M&R).

Family Succineidæ

Shell ovate or oblong, whitish to greenish horn-colored, very thin and fragile, imperforate, smooth or minutely wrinkled or striate; whorls 2½ to 4, the last usually very large and much expanded, more or less oblique; spire short, acute, or elevated; suture moderately to deeply impressed; aperture oblique, elongate-oval to roundly-oval or broadly rounded; peristome simple, acute; columella deep, folded, or arcuate.

Genus Succinea Draparnaud

The characters of the genus are the same as those of the family.

The habits of the animal do not vary much from those of *Helix*. They have been described as being amphibious, but are not in any sense this way, as they live upon land exclusively and are air-breathers. Some of them occupy situations very distant from any body of water, and others

inhabit wet localities at the borders of swamps and ponds, attaching themselves to the leaves of plants growing out of the water.

The animals retire into their shells on the approach of winter and during seasons of drought; every part of the body is retracted within in the plane of the aperture, and over it is extended a membranous epiphragm. They cannot, however, retract the body much beyond the plane of the mouth, and the foot is never wholly drawn into the aperture of the mantle and concealed by it.

Succinea ovalis Say

(Plate 3, fig. 5)

Shell ovate, pale green, yellowish-green, or amber colored to cinereous, very thin and fragile, pellucid, sometimes roseate at apex; periostraca shining, minutely wrinkled or striate; whorls rather more than 3, the last very large and much expanded and more or less oblique; spire very small, not prominent nor pointed; suture distinct, impressed; aperture oval, large, and expanded, more or less oblique; columellar margin with a slight testaceous glazing; columella thin, sharp, narrowed; peristome thin, its edge blunted by the reflection of the periostraca. Greatest length 25 mm.; ordinary length 18 mm.

Type Locality: Not designated (Say, 1817).

Range: Newfoundland; Canada; United States, Maine to Montana, south to Oklahoma, east to Florida, and north to New Jersey.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R). *Braxton County;* Shady Side (GKM). *Cabell County;* Lesage (M&R). *Clay County;* Clay (GEW) (GKM). *Doddridge County;* West Union (FRW). *Fayette County;* Clifftop (GKM). *Jefferson County;* Charles Town (MSB), Leetown (MSB), Meyerstown (MSB). *Kanawha County;* Nitro (GKM). *Lewis County;* Jackson's Mill (GKM). *Logan County;* Blair (NDR) (M&R), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Panther (NDR). *Mason County;* Leon (NDR). *Monongalia County;* Smithtown (NDR). *Morgan County;* (P&I). *Nicholas County;* Richwood (NDR) (CJG). *Pendleton County;* Franklin (NDR). *Pocahontas County;* Mill Point (NDR) (GKM). *Preston County;* Cranesville (MGN). *Randolph County;* Cheat Bridge (NDR), Huttonsville (NDR) (GKM). *Tucker County;* Parsons (MRS. GKM). *Webster County;* Bolair (M&R). *Wyoming County;* Baileysville (M&R).

Remarks: This species lives under leaves and other forest debris that

affords concealment during the day. In wet weather it may often be seen on tree trunks at considerable heights above the ground, and sometimes in dry weather it may be found clinging to these high places, awaiting more favorable conditions.

Succinea avara Say

(Plate 3, fig. 6)

Shell rather small, very thin and fragile, straw-colored, rosy, amber-colored, or greenish; periostraca shining or presenting minute hairy processes in the young; whorls 3, very convex, separated by a deep suture; last whorl rather large, not much expanded; spire very prominent, acute; aperture ovate, rounded at both extremities, about half as long as the shell. Extreme length about 6 mm.

Type Locality: Northwest Territory (Say, 1822).

Range: Newfoundland; Canada; and the United States.

West Virginia Records

Boone County; Seth (M&R). *Cabell County;* Barboursville (GKM) (M&R). *Greenbrier County;* Organ Cave (NDR), Renick Valley (NDR), Ronceverte (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Leetown (MSB), Meyerstown (MSB). *Kanawha County;* Alum Creek (NDR), Dunbar (GKM), Nitro (GKM), Tornado (GKM). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Myra (M&R), Sweetland (M&R). *Logan County;* Sharples (M&R). *McDowell County;* Panther (M&R). *Marion County;* Curtisville (NDR), High Point (NDR), Mt. Harmony (NDR), Rivesville (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R), Spanishburg (M&R). *Mingo County;* Taylorsville (M&R). *Monongalia County;* Coopers Rock (CBW), Morgantown (HHS). *Monroe County;* Salt Sulphur Springs (NDR) (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Pendleton County;* Circleville (NDR), Franklin (NDR), Judy Gap (GKM), Ruddle (GKM), Upper Tract (NDR). *Raleigh County;* Daniels (M&R). *Randolph County;* Huttonsville (GKM). *Summers County;* Riffle (GKM). *Tucker County;* Parsons (GKM). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (GKM) (M&R). *Wyoming County;* Oceana (M&R), Pineville (M&R).

Remarks: In the young shells the periostraca is covered with numerous fine, hairy processes, which accumulate particles of dirt, and in this way the shell is coated over its entire surface.

It is found under stones and fragments of wood in moist places, and often on hillsides and other positions far removed from water.

Family POLYGYRIDÆ Pilsbry

Shell discoidal or lens-shaped to globose-conic, wrinkled to striate, usually with 5½ whorls, which are rounded or keeled; aperture broadly open to narrowly transverse; lip reflected and expanded, toothless to tridentate; umbilicus perforate or imperforate.

The members of this family are snails of humid country; most eastern *Polygyridæ* being woodland snails living under dead wood or leaves or under stones, chiefly in limestone areas, but also in sandstone and shaly areas, and feeding mainly upon the mycelix of fungi. At night or after a rain they may be found wandering about, but this habit is taken up more freely with the young than the adults, often being found on plants where the adults are under cover.

Genus MESODON Rafinesque

Shell umbilicated or with the umbilicus closed, subglobose or orbicularly depressed, thin, delicately striate, with sometimes a decussated sculpture; whorls 5-6, regular; aperture rotundly lunar, sometimes narrowed by a small denticle on the parietal wall and a lamellar-like denticle or tooth on the inner edge of the peristome; peristome thickened, white, expansively reflexed.

Mesodon albolabris albolabris (Say)

(Plate 4, fig. 1)

Shell thin, fragile; convex, imperforate; with six volutions, whorls obtusely wrinkled across, and spirally striated with very fine impressed lines, a little waved by passing over the wrinkles, both becoming extinct towards the apex, which is perfectly smooth; aperture lunate, not angulated at the base of the column, but obtusely curved, lip contracting the mouth abruptly, widely reflected, flat and white. Breadth one inch (25 mm.).

Type Locality: Harrigate, Country estate of Jacob Gilliams, outside of Philadelphia (Say, 1816).

Range: Quebec and Ontario; Minnesota, Kansas and Louisiana eastward to Atlantic Ocean.

West Virginia Records

Barbour County: Nestorville (GKM), Philippi (GEW) (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;*

Frametown (GKM), Gassaway (GKM), Shadyside (GKM). *Cabell County;* Barboursville (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GEW) (GKM). *Doddridge County;* West Union (FRW). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Petersburg (PR), Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), White Sulphur Springs (P&L). *Hampshire County;* Lehew (J. A. G. REHN), Romney (GKM). *Hancock County;* Pughtown (LL). *Hardy County;* Moorefield (LL), Wardensville (GHC). *Harrison County;* Bristol (NDR). *Jefferson County;* Aldridge (MSB), Bardane (MSB), Bolivar (MSB), Charles Town (JPEM), Engle (MSB), Halltown (MSB), Harper's Ferry (EJC) (MSB) (JPEM) (GWT), Jamestown (MSB), Kearneysville (MSB), Millville (MSB), Mt. Mission (JPEM), Mt. Pleasant (MSB), Morgan Grove (MSB), Reedson (MSB), Shenandoah Junction (MSB), Summit Point (MSB), Uvilla (MSB) *Kanawha County;* Alum Creek (NDR), Charleston (GKM), Dunbar (GKM), Hudnall (CBW), Institute (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Slagle (CG). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), Mt. Harmony (NDR), Rivesville (NDR). *Mason County;* Point Pleasant (NDR) (CBW). *Mercer County;* Athens (MGN), Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Speedway (M&R). *Mineral County;* Keyser (IHM), New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (MGN) (NDR) (CBW), Sturgisson (NDR). *Monroe County;* Sweetsprings (M&R). *Morgan County;* Berkeley Springs (NDR). *Nicholas County;* Belva (NDR), Craigsville (GKM), Richwood (CJG) (NDR), Swiss (MCZ). *Ohio County;* Wheeling (MGN). *Pendleton County;* Franklin (MGN) (NDR) (GKM), Judy Gap (GKM), Upper Tract (MGN) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Hillsboro (MGN), Marlinton (MGN) (GKM), Mill Point (MGN) (NDR). *Preston County;* Cascade (NDR), Corinth (MGN), Terra Alta (RLF) (MGN). *Putnam County;* Poca (GKM). *Raleigh County;* Eccles (M&R), Flat Top Mt. (P&L), Shady Spring (M&R). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Summers County;* Hinton (USFC), Talcott (GKM). *Tucker County;* Parsons (GKM). *Tyler County;* Sistersville (GHC). *Upshur County;* French Creek (MRS. GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR). *Wetzel County;* Silver Hill (NDR). *Wirt County;* (WJF). *Wood County;* Boaz (CBW). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Mesodon albolabris dentatus Tryon

(Plate 4, fig. 2)

Mesodon albolabris with a tooth on the parietal wall of the aperture, closely resembling *M. zaletus*, but distinguished by its larger size, less convex body whorl, broader lip, more transverse aperture, and generally lighter color.

Type Locality: Not designated (Tryon, 1867).

Range: Much the same as *M. albolabris*.

West Virginia Records

Barbour County; Philippi (GKM). *Greenbrier County;* Alderson (GKM). *Logan County;* Slagle (CG). *Nicholas County;* Richwood (NDR). *Pocahontas County;* (GHC). *Upshur County;* French Creek (GKM).

Mesodon profundus (Say)

(Plate 4, fig. 3)

Shell pale horn-color; spire convex, very little elevated; whorls 5, regularly rounded and wrinkled transversely, body whorl with a single revolving line, which is almost concealed upon the spire by the suture, but which passes for a short distance above the aperture; aperture dilated; labrum reflected, white, and excepting near the superior angle flat, a slightly projecting callus near the base on the inner edge; umbilicus large, profound, exhibiting all the volutions to the apex. Transverse diameter 19/20 of an inch (23 ¾ mm.).

Type Locality: Not designated (Say, 1821).

Range: New York to Minnesota, south to Louisiana, east to Alabama, and north to Maryland.

West Virginia Records

Barbour County; Nestorville (GKM). *Boone County;* Racine (M&R). *Braxton County;* Frametown (GKM). *Brooke County;* Bethany (MGN). *Cabell County;* Kelleys (USFC). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Grant County;* Bayard (NDR). *Greenbrier County;* Renick Valley (NDR). *Jefferson County;* Harper's Ferry (B. Chambers) (GWT). *Kanawha County;* Hudnall (CBW). *Logan County;* Blair (NDR) (M&R), Davin (NDR). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* Fairmont (NDR), Smithville (CBW). *Marshall County;* Bannon (NDR), Cameron (GB), Powhattan Point (FRW). *Mercer County;* Speedway (M&R). *Mineral County;* Keyser (IHM). *Monongalia County;*

Cheat Mt. (HHS). *Monroe County;* Sweetsprings (M&R). *Nicholas County;* Swiss (MCZ). *Ohio County;* Wheeling (MGN) (CB) (NDR) (CBW). *Pocahontas County;* Durbin (MGN). *Wirt County;* (WJF). *Wyoming County;* Oceana (M&R), Pineville (M&R).

Mesodon mitchellianus (Lea)

(Plate 4, fig. 4)

Shell imperforate, depressed, conoid-globose, thin, without crowded striæ and very crowded, decussating, microscopic lines, pellucid, horn-color, polished, spire briefly conoid; whorls 5, moderately convex, gradually increasing, the last ventricose, subconstricted and briefly deflected anteriorly; aperture diagonal, lunate, subperlaceous within; peristome white, thickened, its terminations slightly converging, subequally reflected, that of the columella narrow, adherent, or subdilated and spreading. Greater diameter 16½, lesser 14½ mm., height 10 mm.

Type Locality: Ohio (Lea, 1839).

Range: New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Kentucky, West Virginia, and Virginia.

West Virginia Records

Brooke County; Bethany (CBW). *Mercer County;* Spanishburg (MCZ). *Ohio County;* Wheeling (MGN) (NDR) (CBW).

Remarks: This species resembles *M. clausus* closely in size, texture, and color, but may be known by the somewhat different shape and the closed umbilicus, the columellar terminations of the lip being appressed over it, while in *M. clausus* a cleft always remains open.

Mesodon thyroidus (Say)

(Plate 4, fig. 6)

Shell thin, fragile, convex, umbilicate; whorls wrinkled or rather with equidistant, gradually elevated, obtuse lines, and spirally striate with numerous, impressed lines; lip widely reflected, white and flat before, partially concealing the umbilicus; pillar lip furnished with a very oblique tooth. Breadth four-fifths to nine-tenths of an inch. (19-22 mm.).

Type Locality: Not designated (Say, 1817).

Range: Quebec and Ontario; Maine to Minnesota, south to Texas, east to Alabama, and north to New Jersey.

West Virginia Records

Barbour County; Philippi (MRS. GKM) (GKM). *Berkeley County;* (MGN). *Boone County;* Peytona (NDR) (M&R), Seth (M&R). *Braxton County;* Frame-

town (GKM), Gassaway (GKM), Shadyside (GKM). *Brooke County;* Bethany (CBW). *Cabell County;* Barboursville (GKM) (M&R), Lesage (M&R), Milton (AEO) (CBW). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GEW) (MRS. GKM) (GKM). *Doddridge County;* Smithburg (NDR), West Union (FRW). *Grant County;* Greenland Gap (NDR), Maysville (LL), Mount Storm (NDR), Petersburg (PR). *Greenbrier County;* Alderson (NDR) (GKM), Organ Cave (NDR), Renick Valley (NDR), Ronceverte (GKM) (M&R). *Hampshire County;* Romney (GKM). *Hardy County;* Moorefield (LL). *Jefferson County;* Aldridge (MSB), Bardane (MSB), Bloomery (MSB), Bolivar (MSB), Charles Town (MSB), Duffield (MSB), Engle (MSB), Gibsontown (MSB), Halltown (MSB), Harper's Ferry (EJC) (MSB) (GWT), Kabletown (MSB), Kearneysville (MSB), Keystone (MSB), Leetown (MSB), Loudoun Heights (JPEM), Middleway (MSB), Millville (MSB), Morgan Grove (MSB), Ranson (MSB), Shenandoah City (MSB), Shenandoah Junction (MSB), Shepherdstown (MSB) (JPEM), Skeetersville (MSB), Uvilla (MSB). *Kanawha County;* Alum Creek (NDR), Dunbar (GKM), Hudnall (CBW), Nitro (GKM), South Charleston (NDR), Tornado (GKM). *Lewis County;* Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Davin (NDR), Stone Branch (NDR). *McDowell County;* Panther (NDR). *Marion County;* Fairmont (NDR), High Point (NDR), Rivesville (NDR), Smithville (CBW). *Marshall County;* Cameron (GB), Kent (NDR). *Mason County;* Leon (NDR), Maysville (CBW). *Mercer County;* Princeton (M&R), Spanishburg (M&R), Speedway (M&R). *Mineral County;* Burlington (GKM), Ridgeley (AEO). *Mingo County;* Williamson (M&R). *Monongalia County;* Cheat Mt. (AEO), Morgantown (HHS). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (M&R), Sweetsprings (M&R), Willow Bend (M&R). *Nicholas County;* Belva (NDR), Richwood (CJG). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Ruddle (GKM), Upper Tract (MGN) (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Marlinton (GKM). *Preston County;* Cascade (NDR). *Putnam County;* Poca (GKM), Red House (CBW). *Randolph County;* Elkins (GHC), Huttonsville (GKM). *Ritchie County;* Pennsboro (FRW). *Summers County;* Riffle (GKM), Talcott (GKM). *Tucker County;* Parsons (GKM). *Tyler County;* Friendly (CBW). *Wayne County;* Echo (M&R), Fort Gay (M&R), Sandy River (Sanderson Smith). *Webster County;* Bolair (NDR) (GKM). *Wetzel County;* New Martinsville (CBW). *Wirt County;* (WJF). *Wood County;* Boaz (CBW), Williamstown (FRW). *Wyoming County;* Baileysville (M&R).

Remarks: Many specimens of *M. thyroidus* possess a small tooth on the

parietal wall of the aperture, which, apparently, was not present on the specimen upon which Say based his description of this species. Dr. Pilsbry believes that *thyroidus* was described from a small form of this species in and around Philadelphia and has selected one from near the mouth of Wissahickon Creek as the neotype.

Mesodon pennsylvanicus (Green)

(Plate 4, fig. 7)

Shell subglobose; spire elevated; whorls six or seven, with numerous oblique wrinkles or striæ, suture deeply impressed; epidermis smooth and of an olive brown color; umbilicus closed or masked; aperture slightly contracted at base, a small callosity on the inner margin of the lip, near its lower angle; shell rather more than half an inch in diameter (17 mm.).

Type Locality: Near Chartiers Creek, Washington County, Pennsylvania (Green, 1827).

Range: Pennsylvania, Ohio, Indiana, Michigan, Illinois, Missouri, Kentucky, and West Virginia.

West Virginia Records

Doddridge County; West Union (FRW). *Marion County;* Fairmont (NDR), Smithville (CBW). *Marshall County;* Cameron (GB). *Monongalia County;* Morgantown (HHS). *Monroe County;* Sweetsprings (M&R). *Ohio County;* Wheeling (CB) (MGN) (NDR) (CBW).

Remarks: M. pennsylvanicus is somewhat like *M. clausus* in size and color, but it is perforate, the whorls are more closely coiled, the aperture of more irregular shape and the basal lip is straight or obscurely toothed. The spire is usually high, much as in *M. elevatus*, but this varies.

The type locality in Washington County, Pennsylvania, is near Canonsburg, as *M. pennsylvanicus* was collected, along with *Ambystoma jeffersoniana*, in the moist ground near Chartiers Creek in the vicinity of Jefferson College, which is now a part of Washington and Jefferson College at Washington, Pa.

Mesodon zaletus (A. Binney)

(Plate 4, fig. 9)

Shell imperforate, convex, somewhat ventricose; epidermis of a uniform yellow horn- or russet color; whorls between 5 and 6, with fine parallel striæ crossing them obliquely; body whorl large and ventricose; suture

well marked and distinct; aperture rounded, contracted by peristome, the plane of the aperture making a considerable angle with the plane of the base; peristome thickened, white, reflected, the basal portion subdentate, parietal wall with a prominent, white, oblique tooth; umbilicus covered. Greater diameter 28, lesser 23 mm.; height 17 mm.

Type Locality: Cincinnati, Ohio (A. Binney, 1837).

Range: Lake Erie Islands, Ontario; New York to Wisconsin, south to Arkansas, east to Alabama, and north to Maryland.

West Virginia Records

Barbour County; Nestorville (GKM). *Boone County;* Racine (M&R). *Braxton County;* Shadyside (GKM). *Calhoun County;* Grantsville (NDR). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Renick Valley (NDR). *Hampshire County;* Romney (GKM). *Kanawha County;* Dunbar (GKM), Hudnall (CBW). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* Fairmont (NDR), Hammond (NDR), Kingmont (GRH), Mt. Harmony (NDR). *Marshall County;* Bannon (NDR), Cameron (GB). *Mercer County;* Speedway (PCB) (M&R). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (CBW), Smithtown (NDR), Sturgisson (NDR). *Nicholas County;* Richwood (NDR). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pendleton County;* Onega (MGN). *Pocahontas County;* Cass (MGN), Durbin (MGN), Marlinton (GKM), Mill Point (MGN) (NDR) (GKM). *Preston County;* Cold Spring Park (GRH). *Randolph County;* Huttonsville (MGN) (GKM). *Summers County;* Talcott (GKM). *Taylor County;* Valley Falls (NDR). *Tucker County;* Parsons (GKM). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (NDR) (M&R), Webster Springs (J. A. Moore), *Wyoming County;* Pineville (M&R).

Remarks: Though resembling *M. albolabris* in many respects, *M. zaletus* differs in being smaller, more convex, and the body whorl is more ventricose. The peristome is less flat and broad and is sometimes a little grooved. The aperture is more round, and the plane of the mouth, instead of being flattened in the direction of the plane of the base, is much more upright, making a considerable angle with the base of the shell. However, many forms of *albolabris* have the plane of the aperture at a considerable angle with the base of the shell, nearly as much as in *zaletus;* the only difference being the absence of a tooth in *albolabris* and the presence of it in *zaletus.*

Mesodon sayanus (Pilsbry)

(Plate 4, fig. 10)

Shell somewhat depressed; spire convex, very little elevated; whorls 5, rounded, regularly but not prominently wrinkled, and grooved transversely; aperture moderate; labrum reflected, with a slightly projecting dentiform callus near the base on the inner edge; labrum with an oblique tooth on the middle; umbilicus rather large, profound, exhibiting all the volutions. Breadth rather more than seven-tenths of an inch (27 mm.).

Type Locality: New York (Say, 1824).

Range: Quebec and Ontario; Maine to Michigan, south to Tennessee and North Carolina, and north to Maryland.

West Virginia Records

Barbour County; Nestorville (GKM). *Boone County;* Peytona (M&R), Racine (M&R). *Cabell County;* Barboursville (NDR), Ona (M&R). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Greenbrier County;* Alderson (GKM). *Kanawha County;* Hudnall (CBW). *Lincoln County;* Myra (M&R). *Logan County;* Blair (NDR) (M&R), Davin (NDR), Sharples (M&R), Slagle (CG). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* High Point (NDR). *Marshall County;* Cameron (GB). *Mercer County;* Athens (MGN). *Mingo County;* Taylorsville (M&R). *Monongalia County;* Cheat Mt. (HHS). Coopers Rock (NDR) (CBW), Maiden Spring Run (GRH), Sturgisson (NDR). *Nicholas County;* Lockwood (GKM), Richwood (NDR) (CJG), Snake Den Mt. (NDR), Swiss (MCZ). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (MGN). *Pocahontas County;* Arbovale (MGN), Dunmore Spring (GKM), Durbin (MGN), Marlinton (MGN) (GKM), Mill Point (NDR) (GKM), Minnehaha Springs (MGN), Travellers Repose (GHC). *Preston County;* Cranesville (MGN). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Webster County;* Bolair (NDR) (M&R). *Wyoming County;* Oceana (M&R), Pineville (M&R).

Remarks: The large umbilicus, light color, thin shell, and small but constant tooth at the base of the columella, are characteristics of this species. *M. sayanus* was first described by Thomas Say (1824) as *Helix diodonta,* but, as this name had been used previously, H. A. Pilsbry (1906) changed the terminology to its present status, *sayanus.*

Mesodon dentiferus (A. Binney)

(Plate 5, fig. 1)

Shell imperforate, flattened, convex on the upper surface, convex below; epidermis yellowish horn-color, immaculate; spire depressed; whorls 5,

with delicate, parallel, oblique striæ; sutures distinct, not deeply impressed; aperture contracted by the peristome, flattened towards the plane of the base; peristome thickened, white, broadly and abruptly reflected; parietal wall with a prominent, white, toothlike process, nearly parallel with the lower margin of the aperture, not projecting towards the umbilicus, base convex. Greater diameter 23, lesser 18 mm.; height 10 mm.

Type Locality: Eastern slopes of Green Mountains of Vermont. (A. Binney, 1840).

Range: Quebec and Ontario; New England States; New York and Pennsylvania, south to Tennessee and North Carolina.

West Virginia Records

Barbour County; Philippi (GKM). *Braxton County;* Shadyside (GKM). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Marion County;* Fairmont (NDR), High Point (NDR), Mt. Harmony (NDR). *Monongalia County;* Cheat Mt. (HHS), Sturgisson (NDR). *Monroe County;* Alderson (GKM). *Nicholas County;* Richwood (NDR) (CJG), Snake Den Mt. (NDR), Summersville (GKM). *Pendleton County;* Onega (MGN). *Pocahontas County;* Cass (MGN), Durbin (MGN), Hillsboro (MGN) (GKM), Mill Point (MGN) (NDR) (GKM), Seebert (CJG). *Preston County;* Cranesville (MGN), Terra Alta (MGN). *Randolph County;* Cheat Bridge (GKM), Helvetia (VS), Huttonsville (MGN) (GKM). *Summers County;* Talcott (GKM). *Tucker County;* Parsons (GKM). *Webster County;* Bolair (GKM) (M&R). *Wirt County;* (WJF).

Remarks: M. dentiferus can be distinguished from *M. albolabris dentatus* by the more depressed and thinner shell, narrower aperture, broader lip, and more conspicuous parietal tooth.

Mesodon clausus (Say)

(Plate 4, fig. 5)

Shell subimperforate, conoidly semi-globose, rather solid, with crowded, rib-like striæ, yellow horn-color; spire sub-regularly conoid; whorls 5½, rather convex, gradually increasing, penultimate subangular, the last rounded, anteriorly subconstricted, and briefly deflected; umbilicus narrow, almost covered by the reflected peristome; aperture diagonal, subregularly lunate; peristome with a heavy white thickening, uniformly subangularly reflected, its columellar portion subdilated. Greater diameter 18½, lesser 16 mm.; height 11½ mm.

Type Locality: Illinois (Say, 1821).

Range: Pennsylvania to Minnesota, south to Oklahoma, east to Georgia, and north to Maryland.

West Virginia Records

Berkeley County; Martinsburg (GHC). *Fayette County;* Oak Hill (UM).

Remarks: This species might be confused with the small form of *M. thyroidus* known as *M. thyroidus bucculentus*, but *M. clausus* has no parietal tooth in contrast with *M. thyroidus*. Dr. Pilsbry believes that in some forms of *thyroidus* the umbilicus may become closed. In *clausus* the crevis always remains open.

Mesodon appressus appressus (Say)

(Plate 4, fig. 8)

Shell depressed, brownish horn-color; whorls five, depressed, forming an angle on the external one, more acute near the superior angle of the labrum, with numerous transverse, elevated, equidistant lines, with interstitial grooves; umbilicus covered over with calcareous matter, but concave within; aperture moderate; labrum dilated, reflected, white, margined with brownish; near the base, appressed to the body-whorl, and covering umbilicus; a slight projecting dentiform angle on the inner middle; labrum with a strong, prominent, oblique, compressed, white tooth, which gradually slopes and becomes obsolete towards the umbilicus. Breadth three-fifths of an inch. (18 mm.).

Type Locality: Not designated. (Say, 1821).

Range: Pennsylvania to Indiana, south to Alabama, and north to West Virginia.

West Virginia Records

Braxton County; Frametown (GKM). *Cabell County:* Barboursville (GKM) (M&R), Lesage (M&R), Milton (CBW). *Kanawha County;* Hudnall (CBW), Nitro (GKM), South Charleston (NDR), Tornado (GKM). *Lincoln County;* Branchland (M&R), Sheridan (NDR). *Logan County;* Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (NDR) (M&R). *Mason County;* Leon (NDR). *Mercer County;* Bluefield (M&R). Spanishburg (M&R), Speedway (MGN) (PCB) (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Morgantown (H. Kahl). *Summers County;* Hinton (USFC), Talcott (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R).

Remarks: Thomas Say, in his description of *M. appressus*, did not notice the minute sculpture of the shell consisting of papillæ. The microscopic papillæ are found between the rib striations and are strung into spiral lines on the last whorl; on the base they are closely scattered.

Dr. Pilsbry has selected specimens from Ohio as the neotypes, designating Gallipolis as the type locality. Say stated in his description, "Inhabits banks of the Ohio and Missouri. This species is very common on the banks of the Ohio below Gallipolis; I also found it near Council Bluff." His description was drawn evidently from the Ohio forms in which there is no upper tooth.

Mesodon appressus perigraptus (Pilsbry)

(Plate 4, fig. 11)

The shell is depressed, glossy, chamois-colored. Striations very fine and close, weaker on the base in front, the later whorls cut by engraved spiral lines throughout. The broadly reflected lip has no tooth in the outer arc, basal margin with a blade-like thickening within, truncate at its outer end. Parietal tooth short and high, widely separated from the axial callus, but generally a very low callus ridge runs nearly to the latter (but this is often weak or wanting). Height 8.5-12.6 mm., diameter 15.8-23.4 mm.; whorls 5¾.

Type Locality: Woodville, Jackson County, Alabama. (Pilsbry, 1894).

Range: West Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, and Arkansas.

West Virginia Records

Boone County; Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Cabell County;* Barboursville (NDR), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GEW) (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Stony River Dam (MGN). *Greenbrier County;* Alderson (GKM). *Kanawha County;* St. Albans (UM), South Charleston (NDR), Tornado (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R). *Logan County;* Blair (NDR) (M&R), Davin (NDR), Sharples (M&R), Slagle (CG). *McDowell County;* Iaeger (M&R), Panther (M&R.) *Mingo County;* Taylorsville (M&R). *Nicholas County;* Belva (NDR), Lockwood (GKM), Richwood (NDR), Summersville (GKM). *Raleigh County;* Daniels (M&R), Shady Spring (M&R). *Wayne County;* Fort Gay (M&R). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Remarks: The smooth engraved lines, usually developed strongly down to the umbilical callus, distinguishes this subspecies from *M. appressus*. Also, there is no trace of a superior tooth on the outer arc of the lip.

Genus Triodopsis Rafinesque

Shell moderate to large, umbilicate or imperforate, depressed and carinate to subglobose-conic. Whorls 5-7, the last wider, more or less deflexed in front. Surface may be striate, with or without spiral lines or hirsute. Aperture lunate, typically obstructed by three teeth, two on the lip and one on the parietal wall but any or all are often absent; peristome reflected and thickened within.

Most of the species live around decaying logs and under and upon decaying leaves in forests. Some prefer shady, leaf-carpeted and rocky bark of other trees. Most species come from their hiding places in the warm days of early spring, and during rainy weather in summer. They may be found crawling upon the dead leaves, or ascending nettles, the leaves of which they eat. They may also be found adhering to the lower surfaces of nettle leaves in the summer after a rain, but never have been known to ascend trees.

Triodopsis platysayoides (Brooks)

(Plate 4, figs. 13, 14)

The five whorls are flattened and only very slightly convex; base flattened and slightly inflated at the aperture. The shell is thin and translucent but not fragile. The color is light-horn with a yellowish area on the exterior surface of the peristome which exhibits a punctate appearance. This area of punctation extends back past the constriction of the peristome and over the first four or five oblique striæ. The whorls striated obliquely, terminating in the wide, inverted cone-shaped umbilicus which exhibits all of the volutions to the apex. The first whorl is smooth. The umbilicus seems slightly excentric due to the deflection of the body whorl at the aperture. The aperture is oblong-lunate. The lip is reflected, flat, white, and quite heavy; the basal edge forming quite a straight line, thickened with a deposit of callus. The basal angles thickened and extending into the body whorl, visible in the umbilicus as a whitish band for the full length of the body whorl. On the parietal wall is a thick, obtusely pointed, tongue-shaped tooth, its apex directed tangentially out and away from the aperture; it is quite similar to the parietal tooth in *M. dentiferus*. Greater diameter 22 mm., lesser 18 mm.; height 8 mm.

Type Locality: Coopers Rock, Monongalia County, West Virginia (Brooks, 1932).

Range: West Virginia Record; *Monongalia County;* Coopers Rock (MGN) (NDR).

Remarks: It is a *Triodopsis* in which the lip teeth have become degenerate as in some forms of *T. tridentata.*

Triodopsis fraudulenta fraudulenta (Pilsbry)

(Plate 5, fig. 6)

"The shell is similar to *T. tridentata* but slightly less depressed, cinnamon-buff. The whorls are rather closely coiled, the last descending steeply in front, strongly contracted behind the spreading lip, with a distinct external impression at the position of the outer lip-tooth. The embryonic whorl has short radial lines below the suture (when not worn). Last whorl is regularly striate, with traces of spiral lines below the suture (or none), and densely, minutely papillose at umbilicus and below suture; aperture is distinctly dished, nearly closed by the large teeth. The lip is rather widely reflected in its outer and basal arcs, the basal margin straightened. Within the outer lip is a wide, receding tooth; a narrow tooth in the basal margin, and a high, nearly straight parietal tooth. Height 7.7-9 mm., diameter 14.7-16.7 mm., 6 whorls."

Type Locality: Morgan County, West Virginia (Pilsbry, 1894).

Range: Pennsylvania, West Virginia, and Virginia.

West Virginia Records

Braxton County; Gassaway (GKM), Shadyside (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Organ Cave (NDR), Renick Valley (NDR), Ronceverte (GKM) (M&R). *Hampshire County;* Capon Bridge (JPEM). *Hancock County;* Pughtown (LL). *Jefferson County;* Mt. Pleasant (MSB). *Lewis County;* Weston (GKM). *Mercer County;* Princeton (M&R). *Mineral County;* Keyser (IHM), New Creek (NDR), Ridgeley (AEO). *Monroe County;* Alderson (GKM), Gap Mills (NDR), Salt Sulphur Springs (NDR) (M&R), Waitesville (M&R). *Morgan County;* Berkeley Springs (NDR), Largent (NDR). *Nicholas County;* Belva (NDR), Summersville (C&A) (MCZ). *Ohio County;* Wheeling (MGN). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (MGN). *Pocahontas County;* Cass (MGN), Hillsboro (MGN) (GKM), Marlinton (MGN) (GKM), Mill Point (NDR) (GKM), Minnehaha Springs (MGN). *Randolph County;* Huttonsville (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Tucker County;* Canaan Valley (MGN). *Webster County;* Bolair (NDR).

Remarks: T. fraudulenta was based upon a mountain form characterized by the development of a heavy, nearly straight ledge within the basal lip, upon which the basal tooth stands. In an oblique view this tooth appears to pass down the inner side of the straight callus ledge. The basal lip structure is sometimes similar to *T. fallax*, but the decidedly wider umbilicus and the straight parietal tooth of *fraudulenta*, as well as the greater size,

differentiates them at once. The outer lip tooth is very broad and deeply receding, while the parietal tooth is long and straight.

Triodopsis fraudulenta vulgata Pilsbry

(Plate 4, fig. 12)

"The shell is cream buff to sea-foam yellow. It differs from *T. tridentata* and *T. tridentata juxtidens* by having the upper lip-tooth wider than its fellows, and distinctly bent inward, and the peristome is more or less dished. Compared with *T. fraudulenta fraudulenta* the teeth of *T. f. vulgata* are not so large and the aperture is more open. The parietal tooth is straight or nearly so, and not so long as in *fraudulenta*, leaving much more space between it and the two lip teeth. The basal lip, while well thickened within, does not have the prominent straight callus of *fraudulenta*. The bay between the lip teeth is more symmetrical. The umbilicus is somewhat well-like beyond the enlargement at the last whorl, and wider than in *T. t. juxtidens*, showing the first whorl plainly at the bottom. Height 7.3-10.4 mm.; diameter 13.5-19.5 mm."

Type Locality: Columbus, Ohio (Pilsbry, 1940).

Range: Ontario; New York to Michigan and Illinois, south to Missouri and Alabama.

West Virginia Records

Barbour County; Nestorville (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (NDR), Renick Valley (NDR), White Sulphur Springs (P&L). *Jefferson County;* Middleway (MSB). *Kanawha County;* Hudnall (CBW). *Marshall County;* Kent (NDR). *Mineral County;* Burlington (GKM). *Monroe County;* Alderson (GKM). *Nicholas County;* Craigsville (GKM), Richwood (NDR). *Ohio County;* Wheeling (CBW). *Pendleton County;* Franklin (NDR), Judy Gap (GKM), Onega (MGN), Upper Tract (NDR). *Pocahontas County;* Durbin (MGN), Mill Point (GKM). *Randolph County;* Cheat Bridge (NDR) (GKM), Mill Creek (GRH). *Summers County;* Talcott (GKM). *Tucker County;* Canaan Valley (MGN). *Webster County;* Bolair (GKM). *Wood County;* Boaz (CBW).

Remarks: The aperture of this variety is more dished than in *T. t. juxtidens*, and there is an arcuate impression behind the peristome in the region back of the outer lip-tooth, which is lacking in *juxtidens*.

Triodopsis rugeli (Shuttleworth)

(Plate 5, fig. 2)

Shell imperforate, orbicularly convex, with granulate striations and few hairs, waxen horn-color; spire short, obtuse; whorls 5½, rather convex,

the last suddenly falling in front and strongly contracted at the aperture; aperture depressed, narrowed by a tongue-shaped, flexuose, strong parietal denticle; peristome reflected, within thickened, its right termination with a large, obtuse, very deeply seated tooth (whose position is marked on the exterior of the shell by a groove or pit), the basal terminus furnished with a smaller, transverse, submarginal denticle. Greater diameter 13, lesser 11½ mm.; height 6¼ mm.

Type Locality: Tennessee (Shuttleworth, 1852).

Range: West Virginia; Virginia; Kentucky; Tennessee; North Carolina; South Carolina; Georgia, and Alabama.

West Virginia Records

McDowell County; Avondale (M&R), Panther (NDR) (M&R). *Mercer County;* Bluefield (M&R), Spanishburg (MCZ).

Remarks: T. rugeli is distinct from *T. inflecta* by the decidedly more deeply immersed and larger tooth on the outer lip and more strongly curved parietal tooth.

Triodopsis denotata (Ferussac)

(Plate 5, fig. 3)

Shell depressed, with elevated lines, forming grooves between them; epidermis fuscous rugose with very numerous minute tuberculous acute prominences; volutions five, depressed above, beneath rounded, forming an obtuse angle exteriorly, which is more acute near the termination of the labrum, umbilicus covered with a white callous; aperture contracted by the labrum; labrum reflected widely, white, two profound, obtuse sinuses on the inner side above the middle, forming a prominent distinct tooth between them and a projecting angle near the middle of the lip; labium with a large, prominent, white tooth, placed perpendicularly to the whorl, and obliquely to the axis of the shell, and nearly attaining the umbilical callus. Greatest breadth four-fifths of an inch (20 mm.).

Type Locality: Illinois (Say, 1821).

Range: Ontario; Maine to Wisconsin, south to Arkansas and Mississippi, east to Alabama, and north to New Jersey.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Braxton County;* Frametown (GKM), Gassaway (GKM), Shadyside (GKM). *Brooke County;* Williamsburg (CBW). *Cabell County;* Barboursville (M&R). *Calhoun County;* Grantsville (NDR). *Doddridge County;* West Union (GRH). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Hampshire County;* Romney (GKM). *Kanawha County;* South Charleston (NDR). *Logan County;* Blair

(M&R), Davin (NDR), Sharples (M&R). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (GRH), High Point (NDR). *Marshall County;* Bannon (NDR), Kent (NDR). *Mercer County;* Speedway (M&R). *Mineral County;* Keyser (IHM), New Creek (NDR). *Mingo County;* Williamson (M&R). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (CBW), Sturgisson (NDR). *Nicholas County;* Richwood (NDR) (CJG). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pendleton County;* Circleville (NDR). *Pocahontas County;* Marlinton (GKM). *Preston County;* Cascade (NDR). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Tucker County;* Parsons (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM). *Webster County;* Bolair (NDR). *Wood County;* Boaz (CBW). *Wyoming County;* Pineville (M&R).

Remarks: T. denotata is very distinct from all others except *T. obstricta,* which is much more keeled at the periphery. The surface is roughened by stiff periostracal hairs, more strongly developed than in any other *Helix* of the region.

This species was first described by Thomas Say in 1821 as *Helix palliata.* However, J. D. W. Hartmann had given this same specific name to a *Helix* in 1807. By this means, *H. palliata* of Say became a synonym of *H. denotata* of Ferussac, mentioned by him in 1821. Since that name was not validated by a description or figure, *H. notata* was substituted, as this appeared to be the first published name to be defined, and that by Deshayes in 1830. It is possible that *notata* was an error for *denotata,* or an emendation of it, as Deshayes attributed it to Ferussac, and referred to his "Tableau Systematique."

Triodopsis tridentata tridentata (Say)

(Plate 5, fig. 4)

Shell depressed, spire very little raised, brownish or horn-color; whorls 5, crossed by numerous raised, equidistant, acute lines, separated by regular grooves; aperture lunate, three toothed; teeth placed triangularly, one on the pillar lip situated diagonally; outer lip abruptly contracting the aperture, widely reflected and white, furnished with two of the teeth resembling projecting angles; umbilicus moderate. Half an inch wide (14-16 mm.).

Type Locality: Middle States (Say, 1816).

Range: Quebec and Ontario; Maine to Minnesota, south to Arkansas, east to Georgia, and north to New Jersey.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GEW) (MRS. GKM) (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM). *Brooke County;* Bethany (CBW), Williamsburg (CBW). *Cabell County;* Barboursville (NDR) (GKM) (M&R), Lesage (M&R), Milton (AEO) (CBW), Ona (M&R). *Calhoun County;* Arnoldsburg (GRH), Grantsville (NDR). *Clay County;* Clay (GEW) (MRS. GKM) (GKM). *Doddridge County;* Sherwood (NDR), Smithburg (NDR), West Union (FRW). *Fayette County;* Clifftop (GKM), Oak Hill (AFA) (MCZ). *Grant County;* Greenland Gap (NDR), Maysville (LL), Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Organ Cave (NDR), Renick Valley (NDR), White Sulphur Springs (P&L). *Hampshire County;* Capon Bridge (JPEM). *Hardy County;* Moorefield (LL). *Harrison County;* Bristol (NDR). *Jackson County;* Odaville (CBW). *Jefferson County;* Aldridge (MSB), Bakerton (MSB), Bloomery (MSB), Charles Town (JPEM), Halltown (MSB), Harper's Ferry (NDR) (GWT) (JPEM), Jamestown (MSB), Kabletown (MSB), Loudoun Heights (MSB), Mechanicstown (MSB), Middleway (MSB), Morgan Grove (MSB), Mt. Mission (JPEM), Shepherdstown (MSB), Uvilla (MSB). *Kanawha County;* Alum Creek (NDR), Charleston (GKM), Dunbar (GKM), Hudnall (CBW), Institute (GKM), South Charleston (NDR), Tornado (GKM). *Lewis County;* Jackson's Mill (MRS. GKM) (GKM), Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (NDR) (M&R), Davin (NDR), Sharples (M&R) Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (NDR) (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR) (GRH), Glady Creek (NDR), Hammond (NDR), High Point (NDR), Kingmont (GRH), Smithville (CBW). *Marshall County;* Bannon (NDR), Cameron (GB), Kent (NDR), Moundsville (CBW), Powhattan Point (FRW). *Mason County;* Leon (NDR), Point Pleasant (NDR) (CBW). *Mercer County;* Bluefield (MGN) (M&R), Oakvale (M&R), Princeton (M&R), Spanishburg (M&R) (AFA) (C&A) (MCZ), Speedway (PCB) (M&R). *Mineral County;* Keyser (IHM), New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (MGN) (NDR) (CBW), Morgantown (HHS), Smithtown (NDR), Sturgisson (NDR). *Monroe County;* Alderson (GKM), Gap Mills (M&R), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (GRH) (M&R), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR), Largent (NDR). *Nicholas County;* Lockwood (GKM), Powell Mt. (MRS. GA), Richwood (CJG), Summersville

(GKM). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM), Onega (MGN). *Pocahontas County;* Cass (MGN), Greenbank (GKM), Hillsboro (GKM), Marlinton (GKM), Mill Point (NDR), Travellers Repose (GHC). *Preston County;* Cascade (NDR), Cheat Mt. (GRH), Cranesville (MGN), Terra Alta (MGN). *Putnam County;* Poca (GKM). *Raleigh County;* Daniels (GKM) (M&R), Eccles (M&R). *Randolph County;* Cheat Bridge (NDR) (GKM), Helvetia (VS), Huttonsville (GKM), Nettie (NDR), Richwood (NDR). *Ritchie County;* Pennsboro (FRW). *Summers County;* Riffle (GKM), Talcott (GKM). *Taylor County;* Valley Falls (NDR). *Tucker County;* Canaan Valley (NDR), Parsons (MRS. GKM) (GKM). *Tyler County;* Friendly (CBW). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R). *Webster County;* Bolair (NDR) (GKM) (M&R), Hodon Creek (GRH). *Wetzel County;* Silver Hill (NDR). *Wirt County;* (WJF). *Wood County;* Boaz (CBW), Parkersburg (FRW). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: Dr. Pilsbry believes that Thomas Say described the small form of this species common on the gneiss around Philadelphia and has selected a specimen from Montgomery County, near the northern edge of Philadelphia, as the neotype. On calcareous soils it is often larger than the typical specimens, attaining diameters up to 18.5 mm.

T. tridentata is more abundant on limestone soils, but it lives everywhere wherever there is some shade, with moderate moisture, herbage, dead leaves or woodshelter. Though hilly country is preferred, it is not found in the higher Appalachians.

Triodopsis tridentata juxtidens (Pilsbry)

(Plate 5, fig. 5)

This form is distinguished from typical *tridentata* by the lower position of the upper lip-tooth, the latter part of the parietal lamella being directed towards this tooth or to a point above it, whilst in the type the lip-teeth are more separated and the latter portion of the parietal lamella is directed towards a point on the peristome between them. The variety is more coarsely striated also. The number of whorls (5) is the same in the variety and type. Altitude 6-7, diameter 11-14 mm.

Type Locality: Cave Town, Maryland (Pilsbry, 1894).

Range: New Jersey to Ohio, south to Tennessee and North Carolina.

West Virginia Records

Boone County; Peytona (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM), Shadyside (GKM). *Brooke County;* Bethany (MGN). *Cabell County;* Barboursville (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Petersburg (PR). *Greenbrier County;* Alderson (NDR), Organ Cave (NDR). *Hampshire County;* Romney (GKM). *Jefferson County;* Aldridge (MSB), Bolivar (MSB), Duffield (MSB), Gibsontown (MSB), Halltown (MSB), Harper's Ferry (EJC), Kabletown (MSB), Keystone (MSB), Mechanicstown (MSB), Millville (MSB), Morgan Grove (MSB), Shenandoah Junction (HAP) (MSB), Shepherdstown (MSB), Skeetersville (MSB), Uvilla (MSB). *Kanawha County;* Dunbar (GKM), Institute (GKM). *Lewis County;* Jackson's Mill (GKM), Weston (GKM)). *Lincoln County;* Branchland (M&R). *Logan County;* Davin (NDR), Slagle (CG). *Marshall County;* Cameron (GB). *Mercer County;* Princeton (M&R). *Mineral County;* Burlington (GKM). *Monongalia County;* Cheat Mt. (HHS). *Monroe County;* Sweetsprings (GRH). *Morgan County;* Berkeley Springs (NDR), Largent (NDR). *Nicholas County;* Craigsville (GKM), Richwood (NDR), Summersville (GKM). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Macksville (MGN), Upper Tract (MGN) (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM), Marlinton (GKM), Mill Point (GKM), Travellers Repose (GHC). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Summers County;* Talcott (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R).

Triodopsis rugosa Brooks and MacMillan

(Plate **5**, fig. 8)

Shell somewhat depressed, costate, reddish horn-color, with a narrow umbilicus. Whorls 5¼, flattened above and rounded below, body-whorl rounded. Suture impressed. Rib-striations prominent and continue undiminished into the umbilicus; interstitial striæ few and faint; spiral striæ weak, hardly discernible; a few granulations are visible on the upper whorls, becoming more numerous on the basal part of the shell. Striations on embryonic whorl and a quarter very weak, on next whorl and a half they become broken into short bars, and on remaining whorls they become gradually larger until they are rib-like on the last two whorls. Aperture lunate, tridentate; peristome white, broad, thickened within; outer margin bearing a small, narrow, squarish tubercle which is bent slightly inward; basal lip bearing a marginal tubercle; parietal denticle

tongue-shaped, entering slightly into the aperture, and separated from the umbilical margin of the peristome by a narrow channel. Umbilicus narrow, deep, the inner whorls hardly perceptible. Greater diameter 10.9, lesser diameter 9.2, height 5.6 mm.

Type Locality: Damp Ravine, Blair Mountain, one mile southwest of Blair, Logan County, West Virginia (Brooks and MacMillan, 1940).

Range: West Virginia records; *Logan County;* Blair (M&R), Slagle (CG). *Nicholas County;* Richwood (NDR), Summersville (GKM). *Putnam County;* Buffalo (CBW).

Remarks: The essential features of this species are the thickening of the outer lip, which produces a sloping buttress below the outer lip and the rough sculpture of the shell produced by the prominent and well-separated rib-striations. The parietal tooth is strongly developed as in *T. fallax* and *T. vannostrandi.*

Triodopsis fallax (Say)

"The shell is narrowly umbilicate, the umbilicus about 9 times in the diameter, depressed, with dome shaped or conoidal spire; deep olive-buff (or dilute snuff-brown). Whorls closely coiled, the last most convex above the middle, deeply constricted behind the peristome. First whorl smooth with a band of short radial striæ below the suture. Later whorls with little gloss, closely thread-striate, with minute papillæ around the umbilicus. The aperture is irregularly trilobed. The reflected peristome is white, thickened within, with a blunt, rather wide inwardly bent tooth in the outer margin, and a callous ledge surmounted by a transverse tubercle in the middle of the basal margin. Parietal tooth rather long and strongly arcuate or angularly curved. On the columellar axis there is a white ridge (sometimes rising to form a tubercle) formed by a continuation inward of the ledge upon the basal lip. Height 7.5-8.2 mm.; diameter 11.8-12.4 mm.; 5½ whorls." (Pilsbry).

Type Locality: Vicinity of Philadelphia, Pennsylvania (Say, 1825).

Range: New Jersey and Pennsylvania, south to Tennessee and Georgia.

West Virginia Records

Hampshire County; Junction (NDR). *Jefferson County;* Jamestown (MSB), Summit Point (MSB). *Mineral County;* Burlington (GKM).

Remarks: T. fallax differs from *T. fraudulenta* by having the upper tooth smaller and not as deeply seated in the aperture, possessing a narrower umbilicus, and the presence of a callus tubercle within the axis of the lip. There is also a callous ridge from the basal tooth to the base of the columella within. The parietal tooth is somewhat tongue-shaped.

Genus STENOTREMA Rafinesque

Shell small, compact, imperforate or umbilicate; subglobose, globose-depressed, or lens-shaped, the periphery varying from rounded to acutely keeled; surface dull, smooth, generally hairy. Whorls 5-6, closely revolving, the last suddenly deflected in front. Aperture basal, narrow, obstructed by an oblique blade-like parietal tooth parallel to the reflexed basal lip, the latter often notched in the middle. Last whorl generally having in its last fourth a short transverse partition on its axis. Embryonic whorls generally with a dense pattern of radially lengthened granules, or sometimes radially striate.

Stenotrema stenotrema (Ferussac)

(Plate 5, fig. 7)

The imperforate shell is depressed-globose, with low conoid spire, strongly convex base and rounded periphery; from buckthorn brown to cinnamon brown in color. Embryonic whorls with the usual sculpture, the later whorls unevenly striate, set with papillæ bearing rather short hairs in forwardly descending trends; these continue over the base, where they are fine near the axis. The narrow aperture has buff to brown borders. Parietal tooth high, but not rising to the level of the basal lip, leaning towards the latter, gently curved, its outer end turning into the interdenticular sinus (and often further curved into a very short hook at the end), a low and inconspicuous buttress between parietal tooth and terminations of the outer lip. The basal lip has a thin, wholly adnate outer margin; inner margin nearly straight in basal view, with a small but well-marked median notch, with slightly raised, callous border. The interdenticular sinus is moderate, deep and narrow. The outer lip bears a low tooth or none. The fulcrum is well developed with convex edge. Height 5.3-8.6 mm., diameter 7.8-12.8 mm.; 5-5¾ whorls.

Type Locality: Indiana (Ferussac, 1842).

Range: Virginia to Missouri, south to Louisiana and Georgia.

West Virginia Records

Boone County; Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM). *Cabell County;* Barboursville (NDR) (M&R), Milton (AEO) (CBW), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Fayette County;* Clifftop (GKM), Gauley Bridge (GRH). *Jefferson County;* Harper's Ferry (JPEM). *Kanawha County;* Charleston (GKM), Hudnall (CBW), St. Albans (UM), South Charleston (NDR). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R).

Logan County; Blair (NDR) (M&R), Davin (NDR), Sharples (M&R), Slagle (CG). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (NDR) (M&R). *Mercer County;* Princeton (M&R), Spanishburg (MCZ) (C&A) (M&R), Speedway (PCB) (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monroe County;* Gap Mills (M&R), Salt Sulphur Springs (M&R). *Nicholas County;* Richwood (NDR), Summersville (MRS. GA). *Putnam County;* Poca (GKM). *Raleigh County;* Eccles (M&R). *Summers County;* Talcott (GKM). *Wayne County;* Fort Gay (M&R). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Remarks: S. stenotrema is larger than *S. hirsutum*, with a decidedly narrower aperture, a higher parietal tooth, a wider basal lip, and the interdenticular sinus is narrower and deeper.

Stenotrema hirsutum (Say)

(Plate 5, fig. 12)

The shell is depressed globose with rather low, convexly conoid spire, rounded periphery and strongly convex base, cinnamon-buff to clay color. After the initial smooth stage the embryonic shell has close, radially lengthened granules. The later whorls have short, moderately stiff hairs with rounded bases, arranged in oblique series, over the usual microscopic lineolation. The parietal tooth is slightly bowed, rather high but lower than the level of the basal lip, slightly sinuous in the outer third, the end not turning towards the interdenticular sinus. The basal lip is rather broad, its outer edge closely appressed, the calloused inner edge having a large and deep, slightly oblique notch with slightly raised edges. The interdenticular sinus is rather broadly rounded. Tooth in the outer lip is rather well developed, bluntly conic. Height 4.3-5.7 mm., diameter 6.2-9.6 mm.; 5 whorls.

Type Locality: Not designated (Say, 1817).

Range: Ontario; Maine to Minnesota, south to Louisiana and Georgia.

West Virginia Records.

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (GB) (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Barboursville (GKM) (M&R), Lesage (M&R), Milton (CBW), Ona (M&R), *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (MRS. GKM) (GKM). *Doddridge County;* West Union (FRW). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Renick Valley (NDR). *Hampshire County;* Junction (NDR), Romney (GKM). *Harrison County;* Bristol (NDR). *Jefferson County;* Harper's Ferry (GWT)

(MSB), Mt. Mission (JPEM). *Kanawha County;* Dunbar (GKM), Hudnall (CBW), Institute (GKM), South Charleston (NDR), Tornado (GKM). *Lewis County:* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Stone Branch (NDR). *McDowell County;* Iaeger (M&R), Panther (M&R). *Marion County;* Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Kingmont (GRH). *Mineral County;* Burlington (GKM), New Creek (NDR), Ridgeley (AEO). *Mingo County;* Williamson (M&R). *Monongalia County;* Coopers Rock (CBW). *Monroe County;* Gap Mills (M&R), Salt Sulphur Springs (M&R), Sweetsprings (M&R). *Morgan County;* (AFA). *Ohio County;* Wheeling (NDR) (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR) (GKM). *Pocahontas County;* Cass (MGN), Marlinton (GKM), Mill Point (NDR) (GKM). *Putnam County;* Buffalo (CBW), Red House (CBW). *Raleigh County;* Flat Top Mt. (P&L). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Ritchie County;* Pennsboro (FRW). *Summers County;* Talcott (GKM). *Taylor County;* Grafton (FRW). *Tucker County;* Parsons (MRS. GKM) (GKM). *Tyler County;* Friendly (CBW). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM) (M&R). *Wetzel County;* Proctor (VS). *Wirt County;* (AFA) (WJF). *Wyoming County;* Baileysville (M&R), Oceana (M&R).

Remarks: This species is smaller than *S. stenotrema;* the parietal tooth is not so high and its outer end not at all turned into the interdenticular sinus. The notch is generally wider.

Stenotrema edvardsi (Bland)

(Plate **5**, figs. 10, 11)

Shell imperforate, lenticular, carinate, the carina obsolete near the aperture, rather thin, beneath the epidermis pale brown, the epidermis dark-chestnut color, with numerous minute curved hair-like processes lying flat upon, and attached to the epidermal surface of the upper whorls in the direction of the incremental striæ, the epidermis at the base covered with acute, raised, transverse tubercles, most numerous, and having erect bristles near the aperture; spire convex-conoid; whorls five, flattened, gradually increasing, the last gibbous above, suddenly but slightly deflected; apex minutely granulate; base convex, little indented in the umbilical region, and with impressed spiral lines beneath the epidermis; suture deeply impressed; aperture oblique, transverse, auriform, narrowed by a slender slightly arcuate lamelliform parietal tooth extending across from the umbilical axis, and terminating with a short angular deflection within

the aperture; upper margin of the peristome acute, scarcely reflected, lower margin slightly arcuate, depressed, slightly reflected, and partially appressed to the body whorl, with a tooth-like callus within, having an almost obsolete notch in the center. Diameter major 9, minor 8, altitude 5, mm.

Type Locality: Mountains, Fayette or Greenbrier Counties, West Virginia (Bland, 1858).

Range: West Virginia, Virginia, Kentucky, and Tennessee.

West Virginia Records

Boone County; Peytona (M&R), Racine (M&R). *Fayette County;* (T. Bland), Clifftop (MRS. GKM) (GKM). *Greenbrier County;* (T. Bland). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW), Kanawha City (AFA) (T. Bland). *Lincoln County;* Myra (M&R), Sheridan (NDR). *Logan County;* Blair (M&R), Davin (NDR). *McDowell County;* Panther (M&R). *Mercer County;* Spanishburg (AFA) (M&R), Speedway (PCB) (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Nicholas County;* Lockwood (GKM), Richwood (NDR). *Raleigh County;* Eccles (M&R). *Wayne County;* Fort Gay (M&R). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: The peripheral carination, the rather low parietal tooth, not projecting as far as the level of the basal lip, the very small basal notch, shallow interdenticular sinus and absence of a buttress between parietal tooth and upper end of lip, are its main characters. It is very near *S. barbigerum*, but higher and with less developed fringe.

Stenotrema leai (Ward)

(Plate 6, fig. 1)

The umbilicate shell is depressed with low, convexly conoid spire of narrow, very closely coiled whorls; very bluntly subangular or rounded at the periphery, which is above the middle, the base convex. Dilute isabella color, slightly translucent and somewhat glossy. Embryonic whorls with the usual fine sculpture of radially lengthened granules, often running into striæ, and generally almost or quite effaced in adult shells. Later whorls with faint lines of growth, the last having very short, delicate hairs rising from little acute bases, which alone remain in most adult shells. The oval-lunate, oblique aperture has a brownish or white peristome thickened within, well reflected in its outer and basal margins. Parietal tooth short, white, straight, standing obliquely on the thin parietal callus, and typically not prolonged towards and aperture. The fulcrum is quite short with convex edge. Height 3.9-5.7 mm., diameter 6.7-9.4 mm.; 5¾-6⅛ whorls.

Type Locality: Above Thunder Bay, Lake Huron, Michigan (Rackett, 1822).

Range: New Brunswick, Ontario; Maine to North Dakota, south to Texas and Alabama.

West Virginia Records

Barbour County; Philippi (GEW) (GKM). *Clay County;* Clay (GKM). *Doddridge County;* West Union (FRW). *Greenbrier County;* Ronceverte (M&R). *Kanawha County;* Hudnall (CBW). *Lewis County;* Weston (GKM). *Marion County;* High Point (NDR). *Mineral County;* New Creek (NDR). *Monroe County;* Salt Sulphur Springs (M&R), Willow Bend (M&R.) *Nicholas County;* Richwood (NDR), Summersville (GKM). *Ohio County;* Wheeling (MGN) (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Marlinton (GKM), Mill Point (GKM). *Randolph County;* Huttonsville (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM).

Remarks: S. leai differs from *S. fraternum* by the closer coils of the spire, usually having one more turn in specimens of about equal size; the umbilicus is typically larger; the surface is smoother, more or less glossy, hairs or their scars being delicate and generally almost or quite absent in adults; and the parietal tooth is short and does not extend to and into the umbilicus.

Stenotrema fraternum fraternum (Say)

(Plate 6, fig. 2)

The shell is imperforate or nearly covered perforate, with convexly conoid spire of closely coiled whorls, which are noticeably wider than in *S. leai* the rather strongly convex base is impressed around the axis; the rounded periphery is above the middle. Color of cartridge buff to tawny olive. Embryonic whorl closely covered with radially lengthened granules, often somewhat indistinct. Later whorls densely covered with short hairs or their bases. Aperture much as in *S. leai:* parietal tooth short, rather long, nearly straight but with the ends often a trifle turned towards the basal lip. Basal lip well thickened within. The fulcrum is rather short. Height 5.2-6.9 mm., diameter 7.8-10.5 mm.; 5½-5 2/3 whorls.

Type Locality: Pennsylvania (Say, 1824).

Range: Ontario; Maine to Minnesota, south to Missouri and Alabama.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GEW) (MRS. GKM) (GKM). *Boone County;* Peytona (M&R), Racine (M&R). *Braxton County;* Gassaway (GKM), Shadyside (GKM). *Cabell County;* Lesage (M&R). *Calhoun County;* Grantsville (NDR). *Doddridge County;* Smithburg (NDR). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Organ Cave (NDR), Renick Valley (NDR), Ronceverte (M&R). *Hampshire County;* Junction (NDR). *Jefferson County;* Harper's Ferry (JPEM). *Kanawha County;* Dunbar (GKM), Hudnall (CBW). *Lewis County;* Weston (GKM). *Lincoln County;* Sweetland (M&R). *Logan County;* Blair (M&R). *Marion County;* High Point (NDR). *Mason County;* Leon (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R). *Mineral County;* New Creek (NDR). *Monongalia County;* Coopers Rock (NDR) (CBW), Morgantown (HHS). *Monroe County;* Alderson (GKM), Gap Mills (M&R), Salt Sulphur Springs (NDR) (M&R), Willow Bend (M&R). *Morgan County;* Largent (NDR). *Nicholas County;* Craigsville (GKM), Summersville (GKM). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Hillsboro (GKM), Marlinton (GKM), Mill Point (NDR). *Raleigh County;* Shady Spring (M&R). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Summers County;* Talcott (GKM). *Taylor County;* Valley Falls (NDR). *Tucker County;* Parsons (GKM). *Tyler County;* Friendly (CBW). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Genoa (M&R). *Webster County;* Bolair (NDR) (M&R). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Baileysville (M&R).

Remarks: Differs chiefly from *S. leai* by the noticeably wider whorls in an apical view and the short, but long parietal tooth that extends to and into the umbilicus.

Stenotrema fraternum cavum (Pilsbry and Vanatta)

(Plate 6, fig. 3)

Shell larger than *S. fraternum;* more openly umbilicate, deeply impressed or excavated around the umbilicus. Parietal tooth short, its ends about equally remote from the termination of the lip. Fulcrum well developed, notched above and below. Whorls 5½. Pilosity fine and short, about as in *S. fraternum.* Altitude 6, diameter 10.5 mm.

Type Locality: Cazenovia, Madison County, New York (Pilsbry and Vanatta, 1911).

Range: Ontario, Quebec, and New Brunswick; Maine to Minnesota, south to Iowa and Maryland.

West Virginia record: Jefferson County; Harper's Ferry (GWT).

Family ENDODONTIDÆ Pilsbry

Shell globose to depressed, rugose to costulately striate, or radially striate, and widely umbilicated. Whorls 3½ to 6½, gradually increasing, rounded to carinate, or bicarinate. White, straw-colored to dark reddish-horn, or greenish; with or without brownish revolving bands, interrupted and obliquely arranged reddish patches and spots, or yellowish lines. Aperture semilunate or rhomboidal, or stirrup-shaped, oblique, furnished within with or without a single, basal tooth, or 1 to 3 pairs of minute, conical, white teeth on external wall; peristome simple, acute, extremities joined by a thin to heavy callus. Umbilicus perspective to funnel-shaped, showing all inner volutions.

Genus PUNCTUM Morse

Shell minute, thin, subdiscoidal but with convex spire, openly umbilicate; unicolored; whorls about 4, convex, the apical 1½ smooth, rather distinctly demarked from the following whorls, which have oblique striæ or irregular riblets and excessively fine spiral striæ; the last whorl cylindrical, not descending in front. Aperture lunate, rounded; lip simple, thin.

Punctum minutissimum (I. Lea)

(Plate 6, fig. 4)

Shell subglobose, above obtusely conical, below convex; Brown horn-colour, very minutely striate, umbilicate; spire short; sutures impressed; whorls four, round; lip acute. Diameter 0.06., length 0.04 of an inch. (1.5 x 1 mm.).

Type Locality: Cincinnati, Ohio (I. Lea, 1841).

Range: Newfoundland; Canada; United States.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM). *Cabell County;* Barboursville (M&R), Lesage (M&R), Ona (M&R). *Fayette County;* Clifftop (GKM). *Grant County;* Green-

land Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (NDR) (GKM), Renick (GRH), Renick Valley (NDR). *Hampshire County;* Romney (GKM). *Jefferson County;* Bloomery (JPEM), Shepherdstown (MSB). *Kanawha County;* Tornado (GKM). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Sharples (M&R). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Glady Creek (NDR), High Point (NDR). *Mason County;* Leon (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Speedway (M&R). *Mineral County;* Burlington (GKM), New Creek (NDR). *Mingo County;* Williamson (M&R). *Monroe County;* Alderson (GKM), Sweetsprings (GRH) (M&R), Willow Bend (M&R). *Nicholas County;* Lockwood (GKM), Summersville (GKM). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM), Marlinton (GKM), Mill Point (GKM). *Putnam County;* Poca (GKM). *Randolph County;* Cheat Bridge (GKM), Helvetia (VS). *Summers County;* Riffle (GKM), Talcott (GKM). *Tucker County;* Parsons (GKM). *Upshur County;* French Creek (MRS. GKM). *Wayne County;* Eccho (M&R), Fort Gay (M&R). *Webster County;* Bolair (NDR) (M&R). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Pineville (M&R).

Remarks: Due to the small size of this species it can easily be overlooked by collectors. However, it may be found beneath the bark of fallen trees, on small limbs and twigs of fallen timber, and in forest debris.

Punctum vitreum H. B. Baker

(Plate 6, figs. 5, 6)

Shell: minute, depressed turbinate; light corneous to vitreus and almost transparent. Whorls: 4½ (maximum), later ones rounded but depressed (*i.e.*, elliptical in outline); last whorl slightly descending; suture strongly impressed (although more broadly so than in *P. minutissimum*). Embryonic whorls: 1¾, quite high; first whorl irregularly wrinkled but almost smooth; last ¾ whorl with fine spiral striæ becoming more and more distinct. Later whorls: major growth riblets high and thin, weakly arcuate just above periphery; interspaces with 5-10, very low but sharp, minor growth ridges, which are crossed by fine, spiral lines so that minute squares are formed. Umbilicus: open, about 3.3 times in major diameter of shell. Aperture: depressed; altitude 0.44, diameter 0.52 mm., slightly oblique (about 25° to axis of shell). Peristome: simple and sharp; weakly arcuate above the periphery. Pallial complex as in *P. conspectum jaliscoense.*

Type Locality: Pleasure Gardens, New Braunfels, Comal County, Texas (H. B. Baker, 1930).

Range: New Jersey to Iowa, south to Texas and Alabama.

West Virginia Records

Boone County; Peytona (M&R). *Braxton County;* Gassaway (GKM). *Hampshire County;* Romney (GKM). *Jefferson County;* Harper's Ferry (JPEM). *Kanawha County;* Tornado (GKM). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* High Point (NDR). *Mason County;* Leon (NDR). *Monroe County;* Sweetsprings (M&R). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM). *Webster County;* Bolair (M&R).

Remarks: This species is about the size of *minutissimum* but has more depressed whorls and the sculpture of the *Toltecia* group (*i.e.*, the contrast between the major and minor growth riblets is much greater and the former are more widely spaced). *P. vitreum* also has thinner and more lightly colored epidermis, and its sculpture is more delicately and sharply cut. Under the binocular microscope, *P. minutissimum* looks as if it were moulded out of bronze, but *P. vitreum* appears as if it were cut from yellowish crystal.

Genus HELICODISCUS Morse

Shell small, disk or coin-shaped, with flat spire and broad, shallow umbilicus. Whorls numerous (3-5), convex and closely coiled, smooth, slightly wrinkled, or spirally striated or lirate, the last lacking or possessing one or several pairs of tubercular teeth within, situated upon the basal or outer wall. Aperture lunate, lip thin, simple.

The species of this genus are found under bark or in the interstices of wet and decaying wood, and under layers of wet leaves and stones in damp places in forests.

Helicodiscus parallelus (Say)

(Plate 7, fig. 1)

Shell widely umbilicated, discoidal; epidermis greenish; whorls 4, visible on the base of the shell as well as above, with numerous equidistant, parallel, raised lines revolving upon them; suture much impressed; aperture remote from axis, semi-lunate, narrow, not expanding; peristome acute, thin; umbilicus wide, forming a concave depression of the base, each volution visible to the apex; within the aperture, on the external circumference, are placed from 1 to 3 pairs of minute, conical, white teeth, the

first pair in sight when looking into the aperture, the others more remote. Greater diameter 3½ mm., lesser 3 mm.; height 1½ mm.

Type Locality: Near Philadelphia, Pennsylvania (Say, 1817).

Range: Newfoundland; Quebec to Manitoba; United States east of Rocky Mountains.

West Virginia Records

Barbour County: Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM). *Cabell County;* Barboursville (GKM) (M&R), Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (NDR) (GKM), McClungs Cave (A. M. Reese), Organ Cave (NDR), Renick (GRH), Renick Valley (NDR), Ronceverte (GKM) (M&R). *Hampshire County;* Junction (NDR), Romney (GKM). *Jefferson County;* Aldridge (MSB), Bakerton (MSB), Bardane (MSB), Bloomery (MSB) (JPEM), Bolivar (MSB), Charles Town (JPEM), Duffield (MSB), Engle (MSB), Halltown (MSB), Harper's Ferry (JPEM) (NDR) (MSB) (GWT) (CC), Jamestown (MSB), Kabletown (MSB), Kearneysville (MSB), Keys Gap (JPEM), Leetown (MSB), Loudoun Heights (JPEM), Mechanicstown (MSB), Middleway (MSB), Morgan Grove (MSB), Mt. Mission (JPEM), Reedson (MSB), Rippon (MSB), Shenandoah City (MSB), Shenandoah Junction (MSB), Skeetersville (MSB), Uvilla (MSB). *Kanawha County;* Alum Creek (NDR), Dunbar (GKM), Hudnall (CBW), Nitro (GKM), Tornado (GKM). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (MRS. GKM) (M&R), Stone Branch (NDR). *McDowell County;* Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR). *Marshall County;* Bannon (NDR). *Mason County;* Leon (NDR), Point Pleasant (NDR). *Mercer County;* Bluefield (M&R), Princeton (M&R), Spanishburg (M&R), Speedway (M&R). *Mineral County;* Burlington (GKM), New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Coopers Rock (NDR), Smithtown (NDR), Uffington (NDR). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (GRH) (M&R), Union (GKM), Waitesville (M&R). *Morgan County;* Berkeley Springs (NDR), Largent (M&R). *Nicholas County;* Craigsville (GKM), Lockwood (GKM), Richwood (NDR), Summersville (GKM). *Ohio County;* Wheeling (NDR). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR) (GKM).

Pocahontas County; Black Mt. (P&L), Dunmore Spring (GKM), Greenbank (GKM), Hillsboro (GKM), Marlinton (GKM), Mill Point (GKM). *Putnam County;* Poca (GKM). *Raleigh County;* Eccles (M&R), Flat Top Mt. (P&L). *Randolph County;* Cheat Bridge (NDR) (GKM), Cheat Mt. (P&L), Huttonsville (GKM). *Summers County;* Talcott (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Tyler County;* Friendly (CBW). *Upshur County;* French Creek (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM) (M&R), Point Mt. (GRH). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Oceana (M&R), Pineville (M&R).

Remarks: The most salient characters of this species are the parallel, spiral ridges encircling the shell and the large, excavated umbilicus.

Genus Discus Fitzinger

Shell widely umbilicated, depressed, discoid, turbinate, or globosely-depressed, rugose or costulately striate; whorls 3½-6½, equal or gradually increasing, rounded to carinate, or bicarinate. White to reddish-horn color, with or without yellowish lines. Aperture lunately rounded, rhomboidal, or stirrup-shaped, oblique, furnished within with or without a single basal tooth. Peristome simple, acute, extremities joined by a thin callus. Umbilicus wide, showing all inner volutions.

Discus patulus patulus (Deshayes)

(Plate 6, fig. 7)

Shell broadly and perspectively umbilicated, orbicular, scarcely convex above, excavated below, thin, reddish horn-color, regularly ribbed; whorls 6½, gradually increasing; aperture small, lunately subcircular, within furnished with a single, subprominent tooth on the base of the shell; peristome simple, acute, its extremities separated widely. Greater diameter 8, lesser 7½ mm.; height 3 mm.

Type Locality: Environs of New York. (Deshayes, 1830).

Range: Ontario; United States east of the Rocky Mountains.

West Virginia Records

Boone County; Peytona (M&R), Racine (M&R), Seth (M&R). *Brooke County;* Bethany (CBW), Williamsburg (CBW). *Cabell County;* Ona (M&R). *Calhoun County;* Grantsville (NDR). *Doddridge County;* West Union (GRH). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Renick Valley

(NDR). *Jackson County;* (W. M. Gabb). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW), South Charleston (NDR), Tornado (GKM). *Lewis County;* Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), East Fairmont (NDR), Fairmont (NDR) (GRH), Glady Creek (NDR), High Point (NDR), Kingmont (GRH), Mill Creek (GRH), Smithville (CBW). *Marshall County;* Bannon (NDR), Cameron (GB). *Mason County;* Point Pleasant (NDR) (CBW). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Speedway (M&R). *Mineral County;* New Creek (NDR). *Mingo County;* Williamson (M&R). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (CBW). *Monroe County;* Alderson (GKM), Gap Mills (M&R), Salt Sulphur Springs (M&R), Sweetsprings (M&R), Willow Bend (M&R). *Nicholas County;* Lockwood (GKM), Snake Den Mt. (NDR), Summersville (GKM). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pocahontas County;* Hillsboro (GKM), Marlinton (GKM). *Preston County;* Cascade (NDR). *Putnam County;* Poca (GKM). *Raleigh County;* Daniels (GKM), Eccles (M&R). *Randolph County;* Huttonsville (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (M&R). *Wetzel County;* Burton (GRH). *Wood County;* Boaz (CBW). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: In 1817 Thomas Say described a new American snail as *Helix perspectiva.* This same specific name had been given to a *Helix* described by Megerle von Muhlfeld in 1816. As Megerle's species had been described first, it had the priority over Say's species. Consequently Say's name became a synonym of *Helix patula* of Deshayes.

This snail selects drier stations than those of related species, and is commonly found under dead trees, under bark close to the ground, or between the bark and wood; it is occasionally found under flat stones. It is particularly abundant under the bark of decaying trees, sometimes found there in vast numbers.

Discus patulus carinatus, MacMillan

(Plate 6, fig. 8)

Shell slightly elevated, reddish-horn color, dull; spire elevated; whorls 5½, angulated; embryonic whorl smooth; surface heavily ribbed above, the rib-striations forming a carina as they pass over the periphery; rib-striations smooth on top; intermediate striæ faint; rib-striations below

continue into umbilicus; umbilicus moderately wide, deep, showing all inner whorls; aperture somewhat rounded; internal columellar tubercle medium in size. Diameter 8 mm.; height 3.5 mm.

Type Locality: Paint Rock, Madison County, North Carolina (Kutchka, 1938).

Range: Michigan and Illinois to western Pennsylvania; western Maryland; West Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, and Alabama.

West Virginia Records

Barbour County; Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM). *Cabell County;* Barboursville (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Fayette County;* Clifftop (MRS. GKM) (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Renick Valley (NDR). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW), South Charleston (NDR). *Lewis County;* Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR). *Mason County;* Point Pleasant (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Spanishburg (M&R), Speedway (M&R). *Mineral County;* New Creek (NDR). *Mingo County;* Williamson (M&R). *Monroe County;* Gap Mills (M&R), Salt Sulphur Springs (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Nicholas County;* Lockwood (GKM). *Ohio County:* Wheeling (NDR). *Pocahontas County;* Marlinton (GKM). *Raleigh County;* Eccles (M&R). *Randolph County;* Huttonsville (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Taylor County;* Valley Falls (NDR). *Tucker County;* Parsons (MRS. GKM). *Upshur County;* French Creek (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM) (M&R). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Remarks: This subspecies was first described as *Discus patulus angulatus* by G. M. Kutchka (the present author) in 1938. Ten years earlier F. C. Baker described *Gonyodiscus macclintocki angulatus*. Since the International Zoological Congress has passed the ruling that "specific and subspecific names . . . . are coördinate," *angulatus* of *Discus patulus* has been superceded by *angulatus* of *Discus macclintocki*, and therefore be-

came untenable. Subsequently the author (*Nautilus*, 1940, vol. 53, p. 143) re-named this form as *Discus patulus carinatus*.

Discus patulus carinatus can readily be distinguished from the typical *Discus patulus* by the angulation of the periphery; the rib-striations, in passing over the periphery, form a carina, which is more or less prominent.

Discus cronkhitei (Newcomb)

(Plate 7, fig 2)

Shell remarkably thin, somewhat depressed; of a very delicate horn-color, transparent; whorls 4, very finely striated transversely; spire scarcely elevated; suture moderate; aperture nearly rounded; labrum not reflected nor thickened. Umbilicus not remarkably large, in diameter not equal to the body whorl; transverse diameter one-fifth of an inch. (Greater diameter 6 mm., lesser 5½ mm.; height 5 mm.).

Type Locality: Near Strawberry Mansion, Fairmont Park, Philadelphia, Pennsylvania (Pilsbry, 1906).

Range: Newfoundland; Canada; United States.

West Virginia Records

Jefferson County; Bakerton (MSB), Charles Town (MSB), Harper's Ferry (JPEM), Shenandoah Junction (MSB). *Monongalia County;* Morgantown (HHS). *Pendleton County;* Franklin (NDR). *Tucker County;* Parsons (GKM). *Wayne County;* Ceredo (CBW).

Remarks: Dr. H. A. Pilsbry changed the terminology of this species from *Helix striatella* to *Pyramidula cronkhitei*, as *striatella* (Anthony, 1840) had been used by Rang in 1831 for a species of *Helix*.

D. cronkhitei differs from *patulus* as being altogether a more delicate shell in structure and markings, the number of whorls is two and one-half less, the color is lighter, and the shell smaller; the sharp external edge is also more conspicuous, and looking into the throat, there is no tooth-like thickening which exists within the lower margins of *patulus*.

Genus Anguispira Morse

Shell rather large and solid, globose to depressed, with convex spire and open umbilicus; whorls 5-6½, rounded or carinated at the periphery. Surface wrinkled, striate, or rib-striate, obliquely flamed, or spirally banded. Aperture oval to rhomboidal; peristome thin, simple, acute, its

extremities joined by a thin to heavy callus. Umbilicus open, deep, showing all inner volutions.

Anguispira alternata alternata (Say)

(Plate 7, fig. 3)

Shell broadly umbilicated, orbicularly depressed; thin, smoky horn-color varied with red, interrupted, obliquely arranged patches and spots, roughened by crowded, elevated, rib-like striæ, smoother below; whorls 5½, flattened, ... "rounder," pervious; aperture very oblique, lunately rounded, banded within; peristome simple, acute, its terminations joined by a very thin, transparent callus, that of columella subreflected. Greater diameter 21, lesser 19 mm.; height 10 mm.

Type Locality: Middle States (Say, 1816).

Range: Canada; Maritime Provinces, Quebec, and Ontario; United States; east of the Rocky Mountains.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Braxton County;* Gassaway (GKM). *Brooke County;* Bethany (CBW), Williamsburg (CBW). *Cabell County;* Lesage (M&R). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Ronceverte (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Bakerton (MSB), Bloomery (MSB), Bolivar (MSB), Halltown (MSB), Harper's Ferry (HAP) (MSB), Leetown (MSB), Loudoun Heights (JPEM), Middleway (MSB), Shenandoah City (MSB). *Kanawha County;* Charleston (UM), Hudnall (CBW). *Logan County;* Davin (NDR). *McDowell County;* Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), High Point (NDR), Mt. Harmony (NDR), Rivesville (NDR), Smithville (CBW). *Marshall County;* Powhattan Point (FRW). *Mercer County;* Bluefield (MGN) (M&R), Oakvale (M&R), Princeton (M&R). *Mineral County;* Burlington (GKM), Ridgeley (AEO). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (CBW), Sturgisson (NDR), Uffington (NDR). *Monroe County;* Alderson (GKM), Gap Mills (M&R), Salt Sulphur Springs (M&R). *Morgan County;* Cherry Run (NDR). *Nicholas County;* Summersville (GKM). *Ohio County;* Wheeling (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Onega (MGN), Upper Tract (MGN) (NDR) (GKM). *Pocahontas County;* Mill Point (GKM), Travellers Repose (GHC). *Preston County;* Cheat River (HHS), Cranesville (MGN). *Raleigh County;* Flat Top Mt. (P&L). *Randolph County;* Helvetia (VS). *Summers County;* Talcott

(GKM). *Upshur County;* French Creek (GKM). *Wood County;* Boaz (CBW). *Wyoming County;* Pineville (M&R).

Remarks: The best collecting places for this species are on hillsides covered with timber, sticks, and forest debris. Among the hardwoods and aspens it is found under leaf mould, the underside of rotten logs, fallen bark, rotten stumps, ferns, and poison ivy. In pine groves it lives under rotten wood that is frequently covered with lichens. In bog woods it is often collected at the base of *Arbor vitæ* and spruce. It is not uncommon in open country in moist situations, where shelter is found under logs and stumps. After rains it has been observed to crawl over reindeer moss in considerable numbers. In late autumn it often congregates in great numbers under flat rocks, hibernating in such situations, and sometimes burrowing in the loose soil for a distance of one or more inches.

Anguispira alternata angulata Pilsbry

(Plate 7, fig. 4)

Shell broadly umbilicated, orbicularly depressed, thin, smoky horn-colored with red, interrupted, obliquely arranged patches and spots, roughened by crowded, elevated, rib-like striæ; smooth below. Whorls 5½, flattened, the last strongly carinated at its periphery. Aperture very oblique, lunately rounded except where the periphery is carinated, whitish within. Peristome simple, acute, its terminations joined by a very thin, transparent callus. Umbilicus large, pervious. Greater diameter 21, lesser 19 mm.; height 10 mm.

Type Locality: Emory River, Harriman, Tennessee (Pilsbry and Rhoads, 1896).

Range: New York to Indiana, south to Alabama, and north to Maryland.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (MRS. GKM) (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R). *Braxton County;* Gassaway (GKM). *Brooke County;* Bethany (MGN). *Cabell County;* Barboursville (NDR) (M&R), Lesage (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Doddridge County;* Smithburg (NDR). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (NDR) (GKM), Organ Cave (NDR), Renick Valley (NDR), Ronceverte (GKM) (M&R), White Sulphur Springs (P&L). *Jefferson County;* Bolivar (MSB), Halltown (MSB), Middleway (MSB), Millville (JPEM), Shenandoah City (MSB), Silver

Grove (MSB). *Kanawha County;* Dunbar (GKM), South Charleston (NDR). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Myra (M&R). *Logan County;* Davin (NDR), Sharples (MRS. GKM) (M&R), Slagle (CG). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Mt. Harmony (NDR), Rivesville (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R), Spanishburg (M&R). *Mineral County;* Burlington (GKM), Keyser (IHM). *Mingo County;* Williamson (M&R). *Monongalia County;* Morgantown (HHS), Sturgisson (NDR), Uffington (NDR). *Monroe County;* Alderson (GKM), Gap Mills (M&R), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (M&R), Waitesville (M&R). *Nicholas County;* Richwood (NDR), Summersville (GKM). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (MGN) (NDR) (GKM). *Pocahontas County;* Mill Point (NDR) (GKM). *Preston County;* Cascade (NDR). *Randolph County;* Helvetia (VS). *Summers County;* Talcott (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (NDR). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Pineville (M&R).

Remarks: In this form the periphery has a distinct, bluntly angulated, but not acute, carina; the earlier whorls are quite strongly ribbed, but the ribs diminish in strength on the penultimate whorl and the last whorl becomes finely and closely striate. The striæ pass over the carina and continue into the umbilicus, but become much weaker below the carina, and in fully mature specimens they become sub-obsolete towards the aperture. The younger shells are quite strongly carinated and somewhat excavated below the carina. Between the ribs there is developed a fine vertical striation.

Anguispira alternata mordax (Shuttleworth)

(Plate 7, figs. 5, 6)

Shell widely and perspectively umbilicated, depressed, sublenticular, carinate, thin, yellow-horn color, ornamented with interrupted red streaks in bands, beautifully sculptured with strong, flexuous ribs above and below; whorls 5½, flat; aperture very oblique, angularly crescentric, oval; peristome simple, acute. Great diameter 18, lesser 16, height 6 mm.

Type Locality: Mountains of North Carolina (Shuttleworth, 1852).

Range: West Virginia; Virginia; Kentucky; Tennessee; North Carolina; South Carolina; Georgia; and Alabama.

West Virginia Records

McDowell County; Avondale (M&R), Iaeger (M&R), Panther (M&R). *Mercer County;* Speedway (M&R).

Remarks: This subspecies is very similar to *alternata,* but is distinguished from it by the stronger ribs, which are 1 mm. apart at the periphery and which extend on the under side into the umbilicus. The carina is well developed, though rather more rounded than in *angulata,* but the under side, just below the carina, is distinctly concave, as in *Discus bryanti.* This disappears in full-grown specimens towards the aperture, but is always evident on the first two-thirds of the last whorl, and is particularly marked in young shells. The micro-sculpture is well developed, consisting of very fine irregular lines of growth between the ribs, which are cut transversely by numerous fine revolving lines. It differs from *A. cumberlandiana* in having the shell strongly striate and costate.

Anguispira alternata mordax has been reported occuring in Greenbrier and Jefferson Counties, but I am dubious regarding these localities and the correct identification of the shells found in those two counties. It is my contention that they are specimens of *A. alternata angulata* and I have added them to the localities of that species. The true *mordax* has been collected only in McDowell and Mercer Counties, the two southernmost counties of West Virginia.

Anguispira kochi (Pfeiffer)

(Plate 7, fig. 7)

Shell broadly umbilicated, globosely depressed, coarse, solid, diaphanous, obliquely and crowded wrinkled, from white to dark-reddish horn-color, with from two to three brownish revolving bands; whorls 6, convex; suture deep; aperture roundly lunate, pearly white and banded within; peristome simple, acute, the ends joined by a thin transparent callus, that of the columella dilated, subreflected. Greater diameter 25, lesser 22 mm.; height 15 mm.

Type Locality: Unknown (Pfeiffer, 1845).

Range: Western Pennsylvania and western West Virginia, central Mississippi River Valley west to Pacific Ocean; British Columbia; Islands in western Lake Erie, Ontario.

West Virginia Records

Brooke County; Bethany (CBW). *Marshall County;* Cameron (GB), Kent (NDR). *Ohio County;* Wheeling (MGN) (NDR) (CBW).

Remarks: The specific name of *kochi* is now used in place of *solitaria* Say (1821), as *Helix solitaria* was pre-empted by Poiret in 1805. The type locality of *kochi* is unknown, the shell coming from the collection of H. Cuming, Esq.; that of Say's *solitaria* is Lower Missouri.

The animal buries itself from five to six inches or more in the soft soil of moist hillsides to begin its period of hibernation. It issues forth when the first warm rays of the vernal sun penetrates its hiding place. During the summer it is usually found in great numbers under leaves and partially buried, an inch or two, in the soft soil.

Family ZONITIDÆ

Shell small to large, conic to depressed, thin, shining. Whorls 2-8, regularly to rapidly increasing, rounded to keeled; smooth, polished, covered with strongly marked, curved wrinkles or equidistant, elevated, oblique ribs, or indented with delicate striæ of growth or deep, equidistant, radiating parallel lines; also sculptured with microscopic revolving lines; furnished with or without rows of upright denticles on floor of whorls. Color, whitish to greenish-horn or chestnut. Sutures slightly to deeply impressed. Aperture large to narrow, oblique, nearly circular to transversely rounded, with or without rows of very minute, white teeth or lamelliform, elongated, nearly parallel teeth. Peristome simple, thin, acute, slightly or not thickened within, terminations joined by a slight to heavy callus deposit. Umbilicus large to narrow, slightly covered by reflected peristome or entirely covered, impressed.

Subfamily KALIELLINÆ

Genus GUPPYA Moerch

Shell perforate, depressed-conic, rather solid or thin, glossy, pale rusty-brown or yellowish, with or without numerous faint lines of growth; spire slightly elevated or depressed, having 4 or 5 closely revolving, well-rounded whorls, separated by a very deep suture; periphery rounded; base flattened or convexly rounded and excavated around a small, deep, open or closed umbilicus; aperture wide, nearly circular or semi-lunate; peristome simple, slightly expanded, and at the columellar region decidedly reflexed.

Guppya sterkii (Dall)

(Plate 7, figs. 9, 10, 11)

Shell minute, thin, yellowish translucent, brilliant, lines of growth hardly noticeable, spire depressed, four-whorled; whorls rounded, base flattened, somewhat excavated about the center, which is imperforate; aperture wide, hardly oblique, not very high, semi-lunate, sharp edged, the upper part of the columella slightly reflected; upper surface of the whorls roundish, though the spire as a whole is depressed. Maximum diameter. 044 inch.; altitude 0.026 inch. (1 x .6 mm.).

Type Locality: New Philadelphia, Ohio (Dall, 1888).

Range: New Jersey to Ohio, south to Louisiana and Florida.

West Virginia Records

Barbour County; Nestorville (GKM). *Boone County;* Peytona (M&R), Racine (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Ona (M&R). *Greenbrier County;* Alderson (NDR) (GKM), Renick (GRH), Renick Valley (NDR), White Sulphur Springs (P&L). *Hampshire County;* Romney (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Sharples (M&R). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* High Point (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R). *Mineral County;* Burlington (GKM). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Sturgisson (NDR). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (GRH), Waitesville (M&R). *Nicholas County;* Craigsville (GKM), Lockwood (GKM), Summersville (GKM). *Pendleton County;* Franklin (GKM), Judy Gap (GKM). *Pocahontas County;* Black Mt. (P&L), Greenbank (GKM), Marlinton (GKM), Mill Point (GKM). *Preston County;* Cheat Mt. (GRH). *Putnam County;* Poca (GKM). *Raleigh County;* Flat Top Mt. (P&L). *Summers County;* Riffle (GKM). *Webster County;* Bolair (NDR). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: This snail, due to its small size, is easily overlooked by most collectors. It is most readily found in the sifted samples of forest loam collected under fallen logs or slabs of sandstone and limestone.

Genus Euconulus Reinhardt

Shell imperforate or very narrowly perforate, turbinate, arctispiral; whorls 4½ to 7, rounded or bluntly angular, minutely striated or in-

distinctly wrinkled; suture moderate to distinct; yellowish-white to brownish-amber in color; aperture narrow, nearly transverse or depressed-lunar; periphery simple, acute; base with or without 1 to 3 low, radial teeth.

Euconulus fulvus (Mueller)

(Plate 8, figs. 1, 2)

Shell imperforate, subconical, thin, pellucid; epidermis smooth, shining, minutely striated, amber colored; whorls 5 or 6, bluntly angular, very narrow, suture distinct and deep; aperture transverse, narrow; peristome simple, acute; base convex; umbilical region indented, umbilicus closed. Greater diameter 4, lesser 3½ mm.; height 3 mm.

Type Locality: Fridrichsdal, Denmark (Mueller, 1774).

Range: Greenland; Newfoundland; Canada; Alaska; United States.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM), *Boone County;* Peytona (GB), Racine (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Barboursville (M&R), Ona (M&R). *Fayette County;* Clifftop (GKM). *Grant County;* Bismark (NDR), Mount Storm (NDR). *Greenbrier County;* Renick (GRH), Renick Valley (NDR), Ronceverte (GKM). *Hampshire County;* Romney (GKM). *Jefferson County;* Harper's Ferry (GWT). *Kanawha County;* Hudnall (CBW). *Lewis County;* Jackson's Mill (GKM), Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Sharples (M&R). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* Glady Creek (NDR), High Point (NDR). *Monroe County;* Alderson (GKM), Sweetsprings (M&R), Waitesville (M&R). *Nicholas County;* Summersville (GKM). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM). *Pocahontas County;* Dunmore Spring (GKM), Marlinton (GKM). *Summers County;* Riffle (GKM). *Tucker County;* Parsons (GKM). *Upshur County;* French Creek (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Pineville (M&R).

Remarks: The shell is much less elevated than in *chersinus,* with the 5 whorls not so closely coiled, and the last one distinctly but bluntly angular at the periphery. It is also distinguished from *chersinus* and its varieties by the fewer, wider whorls, and generally less elevated countour.

Euconulus chersinus chersinus (Say)

(Plate 8, figs. 4, 5)

Shell subglose-conic, pale yellowish-white, pellucid; convex beneath; volutions about six, wrinkles not distinct; spire convex-elevated; suture moderate; body whorl rounded; mouth nearly transverse, unarmed, the two extremities nearly equal; labrum simple; umbilicus none. Breadth 1/10 of an inch (2½ mm.).

Type Locality: Sea Islands of Georgia (Say, 1821).

Range: Maine to Wisconsin, south to Mississippi and Florida.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R). *Braxton County;* Frametown (GKM). *Cabell County;* Ona (M&R). *Clay County;* Clay (GKM). *Greenbrier County;* Renick Valley (NDR), Ronceverte (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Bolivar (MSB), Harper's Ferry (GWT), Reedson (MSB). *Kanawha County;* Alum Creek (NDR). *Lincoln County;* Sweetland (M&R). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R) *Mason County;* Leon (NDR), Point Pleasant (NDR). *Mineral County;* New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Morgantown (HHS). *Monroe County;* Alderson (GKM). Salt Sulphur Springs (M&R), Sweetsprings (GRH) (M&R), Waitesville (M&R), Willow Bend (M&R). *Nicholas County;* Lockwood (GKM), Summersville (GKM). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM). *Pocahontas County;* Hillsboro (GKM). *Putnam County;* Poca (GKM). *Upshur County;* French Creek (MRS. GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R). *Webster County;* Bolair (NDR) (GKM). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Remarks: Euconulus chersinus is a smoother shell then *Euconulus fulvus*, and the whorls are round in comparison to the bluntly angulated whorls of *fulvus*.

Euconulus chersinus dentatus (Sterki)

(Plate 8, figs. 8, 9)

Rather small, with narrow whorls of the species, the last whorl containing 1 to 3 low, radial teeth, forming transverse barriers on the basal wall, and appearing when the shell is viewed from the base as white radial stripes. The radiating "teeth" are exactly the same type found in *Ventridens lamellidens.*

Type Locality: Jackson County, Alabama (Sterki, 1893).

Range: Indiana; Ohio; Maryland; Virginia; West Virginia; North Carolina; South Carolina; Alabama; Mississippi; Louisiana; and Arkansas.

West Virginia Records

Boone County; Seth (M&R). *Cabell County;* Ona (M&R). *Hampshire County;* Romney (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Mingo County;* Williamson (M&R). *Monongalia County;* Morgantown (HHS). *Nicholas County;* Summersville (GKM). *Pendleton County;* Franklin (NDR) (GKM). *Wayne County;* Fort Gay (M&R).

Remarks: The "teeth" found on the base of the shell of this variety are placed at somewhat irregular intervals, are rounded or elongate in a radial direction. They are not high, but tooth-like and quite distinct and in the form of radial bars. When two or three are present, they are always of the same character, either round or transverse.

Euconulus chersinus polygyratus (Pilsbry)

(Plate 7, fig. 8)

Similar to *Euconulus chersinus trochulus*, but less elevated, with narrow aperture; whorls over 6, very narrow, the last one rounded; upper surface with a luster of silk; base glossy, with a silky band around the outer margin. Color generally deep, brownish amber. Altitude 2.2, diameter 3 mm.

Type Locality: Hamilton, Ontario, Canada (Pilsbry, 1899).

Range: Ontario to British Columbia; Maine to Minnesota, south to Arkansas and Alabama.

West Virginia Records

Boone County; Peytona (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Grant County;* Greenland Gap (NDR). *Jefferson County;* Bolivar (MSB). *Lincoln County;* Branchland (M&R). *Logan County;* Blair (M&R). *McDowell County;* Iaeger (M&R). *Marion County;* High Point (NDR). *Mason County;* Leon (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R). *Mineral County;* New Creek (NDR). *Monroe County;* Alderson (GKM), Sweetsprings (M&R). *Morgan County;* Berkeley Springs (NDR). *Nicholas County;* Summersville (GKM). *Pendleton County;* Franklin (GKM). *Pocahontas County;* Marlinton (GKM). *Raleigh County;* Eccles (M&R).

Remarks: Euconulus chersinus polygyratus is a smaller shell, with narrower and more numerous whorls than *Euconulus chersinus*.

Subfamily Zonitinæ

Genus Omphalina Rafinesque

Shell globose to depressed-globose, thin, shining, wrinkled to striated, reddish to reddish-chestnut in color, and umbilicated. Whorls 4-5½, rounded or flattened, regularly and rapidly increasing, the last very large and ventricose. Sutures slightly to moderately impressed. Sculpture consisting of fine and close striæ or wrinkles to coarse and regularly spaced rib-striations above; spiral sculpture consisting of microscopic granules, prominent above and obsolete below. Spire short, smooth, conic or depressed. Aperture large, circular and oblique; parietal wall covered with or without a thin callus deposit. Peristome simple, thin, acute, and slightly reflected over the umbilicus. Umbilicus deep and narrow, and sometimes slightly expanded.

Omphalina cuprea Rafinesque

(Plate 8, fig. 6)

Shell thin, depressed on upper surface, epidermis dark, approaching to chestnut-color, sometimes almost black, shining and wrinkled; whorls 4½, rapidly increasing, with irregular, oblique wrinkles, the last whorl very voluminous and expanding transversely towards the aperture; suture very little impressed; aperture very oblique, ample, lunate-oval, within pearly or iridescent; peristome simple, thin, brittle, with a light, testaceous deposit within, the two terminations approaching each other very nearly, that of the columella somewhat reflected; umbilicus deep, not much expanded. Greater diameter 26, lesser 22 mm.; height 13 mm.

Type Locality: Kentucky (Rafinesque, 1831).

Range: Ontario; Maine to Minnesota, south to Louisiana and Florida.

West Virginia Records

Barbour County; Nestorville (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM), Shadyside (GKM). *Cabell County;* Barboursville (NDR) (M&R), Lesage (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Charmco

(NDR). *Hampshire County;* Romney (GKM). *Kanawha County;* Alum Creek (NDR), Charleston (GKM), Hudnall (CBW), Institute (GKM). *Lewis County;* Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Slagle (CG), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Jayenne (GRH), Midway Park (GRH). *Marshall County;* Cameron (GB), Kent (NDR), Powhattan Point (FRW). *Mercer County;* Bluefield (M&R), Princeton (M&R), Spanishburg (MCZ) (C&A) (M&R), Speedway (MGN) (M&R). *Mineral County;* Burlington (GKM), Keyser (IHM), New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Coopers Rock (NDR) (CBW), Smithtown (NDR), Sturgisson (NDR). *Monroe County;* Gap Mills (M&R), Waitesville (M&R). *Morgan County;* Largent (NDR). *Nicholas County;* Belva (NDR), Lockwood (GKM), Richwood (NDR) (CJG), Snake Den Mt. (NDR), Summersville (GKM). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Onega (MGN), Upper Tract (MGN) (NDR). *Pocahontas County;* Marlinton (GKM), Mill Point (GKM). *Preston County;* Cascade (NDR), Laurel Mt. (GRH), Manheim (JHA), Terra Alta (MGN). *Putnam County;* Poca (GKM). *Raleigh County;* Daniels (GKM), Eccles (M&R), Flat Top Mt. (P&L). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Roane County;* Walton (NDR). *Tucker County;* Parsons (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR). *Wetzel County;* Burton (GRH). *Wirt County;* (WJF). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: This species was known as *Helix fuliginosus* for a long time, but it is now called *Omphalina cuprea.* The name *fuliginosus* had been applied to a species of *Helix* by Griffith in a letter to A. Binney, which was published in the *Journal of the Boston Society of Natural History,* 1841, vol. 3, p. 417, pl. 24. Rafinesque applied the name *cuprea* to a species of *Omphalina* in 1831. As this species was similar to *Helix fuliginosus,* it had priority over Griffith's species.

Genus Oxychilus Fitzinger

Shell very depressed and almost discoid, more convex beneath, thin and brittle, very glossy, smooth, and semitransparent, of an amber or yellowish-horn color above, and whitish, with often a greenish or bluish tinge around the umbilicus, which is comparatively narrow, but deep and

slightly overspread by the apertural margin; lines of growth shallow and indistinct, slightly puckered at the sutures and microscopically striate in the spiral direction; suture with a channeled aspect and showing often as a darker line; epidermis comparatively thick, whorls 5-6, regularly but slowly increasing; spire slightly raised; aperture broadly lunate, and slightly oblique, with simple and direct margins, the basal margin slightly reflected over and encroaching on the umbilicus, the upper margin projecting beyond the lower.

Oxychilus drapernaldi (Beck)

(Plate 8, fig. 11)

Umbilicated, thin, irregularly impressed striate, pellucid, shining, smooth, yellowish corneous or greenish, base becoming whitish; whorls 5½, sutures impressed, the last whorl much wider, subdepressed. Diameter 14 mm.

Type Locality: France (Draparnaud, 1801).

Range: California; Pennsylvania; West Virginia; and Virginia.

West Virginia Records

Jefferson County; Bolivar (MSB), Charles Town (MSB), Jamestown (MSB), Ranson (MSB).

Oxychilus cellarius (Mueller)

(Plate 8, fig. 12)

Shell very much depressed, thin, fragile, pellucid; epidermis light-greenish horn-color; smooth, lightly polished; whorls 5, slightly rounded, with minute and almost imperceptible oblique striæ; aperture not dilated, the transverse diameter the greatest; umbilicus moderate, regularly rounded, deep; base rounded, thickened within by a testaceous deposit; bluish-white; peristome simple, acute. Greater diameter 13, lesser 11½ mm., height 5 mm.

Type Locality: Havnia (Norway?) (Mueller, 1774).

Range: Ontario and Quebec; Maine; New York; Pennsylvania; West Virginia; South Carolina; and California.

West Virginia Records

Jefferson County; (MSB). *Monroe County;* Alderson (GKM). *Summers County;* Riffle (GKM).

Genus MESOMPHIX Beck

Shell depressed-globose to flattened. Epidermis yellowish-horn, greenish-horn, or chestnut colored, shining, thin. Whorls 4½ to 6, rather flattened, rounded, regularly increasing, last whorl moderately to widely expanding. Suture moderately impressed. Sculpture consisting of minute, delicate wrinkles, or regular, oblique striæ; sometimes minute microscopical granulations are present on the upper surface, but absent below; spiral sculpture of minute and microscopical lines. Aperture oblique to slightly oblique, transverse to lunar in shape, with or without a white testaceous deposit within. Peristome simple, thin, acute, its extremities slightly approaching, lower extremities inserted into center of the base and slightly reflected. Umbilicus small, round, deep.

Mesomphix inornatus (Say)

(Plate 8, fig. 3)

Shell depressed; epidermis yellowish horn-color, smooth, shining, with very minute lines, not breaking the smoothness of the surface; whorls 5; suture not much impressed; aperture transverse, scarcely oblique, oblique lunar, with a thick, white testaceous deposit around its whole inner surface, a little distant from the margin; peristome thin, acute, fragile, its ends somewhat converging, the columellar margin reaching to the center of the base, subdilated above; umbilicus small; base rather flattened, indented in the center. Greater diameter 16, lesser, 12½ mm.; height 6 mm.

Type Locality: Pennsylvania (Say, 1822).

Range: Quebec, Ontario; United States, east of the Mississippi River.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (MRS. GKM) (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM), Shadyside (GKM). *Cabell County;* Barboursville (NDR) (M&R), Lesage (M&R), Milton (AEO) (CBW), Ona (M&R). *Calhoun County;* Arnoldsburg (GRH), Grantsville (NDR). *Clay County;* Clay (GEW) (GKM). *Doddridge County;* Sherwood (NDR), Smithburg (NDR), West Union (GRH) (FRW). *Fayette County;* Clifftop (MRS. GKM) (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Organ Cave (NDR), Renick Valley (NDR), White Sulphur Springs (P&L). *Hampshire County;* Romney (GKM). *Harrison County;* Bristol (NDR), Salem (GRH), West Milford (GRH). *Jackson County;*

(W. M. Gabb). *Kanawha County;* Alum Creek (NDR), Charleston (GKM), Hudnall (CBW), St. Albans (UM), South Charleston (NDR). *Lewis County;* Jackson's Mill (MRS. GKM) (GKM), Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (NDR) (M&R), Davin (M&R), Sharple (MRS. GKM) (M&R), Slagle (CG). *McDowell County;* Avondale (M&R), Iaeger (M&R) , Panther (M&R . *Marion County;* Chesapeake (NDR), Curtisville (NDR), Fairmont (NDR) (GRH), Glady Creek (NDR), Hammond (NDR), High Point (NDR), Kingmont (GRH), Mt. Harmony (NDR), Norway (GRH), Smithville (CBW). *Marshall County;* Cameron (GB), Powhattan Point (FRW). *Mason County;* Point Pleasant (NDR) (CBW). *Mercer County;* Bluefield (MGN) (M&R), Oakvale (M&R), Princeton (M&R), Spanishburg (M&R), Speedway (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (NDR) (MGN) (CBW), Morgantown (Dr. H. Kahl), Smithtown (NDR), Sturgisson (NDR). *Monroe County;* Alderson (GKM), Gap Mills (M&R), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Nicholas County;* Craigsville (GKM), Lockwood (GKM), Nettie (NDR), Richwood (CJG) (NDR), Snake Den Mt. (NDR), Summersville (GKM). *Ohio County;* Wheeling (MGN) (NDR) (CBW). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM). *Pocahontas County;* Cass (MGN), Hillsboro (MGN) (GKM), Marlinton (GKM), Mill Point (MGN) (NDR) (GKM). *Preston County;* Caddell (GRH), Cascade (NDR), Cheat Mt. (GRH), Manheim (JHA), Terra Alta (MGN). *Raleigh County;* Daniels (GKM) (M&R), Flat Top Mt. (P&L), Shady Spring (M&R). *Randolph County;* Cheat Bridge (GKM), Helvetia (VS), Huttonsville (MGN) (NDR) (GKM). *Roane County;* Walton (NDR). *Summers County;* Riffle (GKM), Talcott (GKM). *Taylor County;* Grafton (FRW). *Tucker County;* Canaan Valley (MGN), Parsons (MRS. GKM) (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM) (M&R). *Wetzel County;* Burton (GRH), Silver Hill (NDR). *Wirt County;* (WJF). *Wood County;* Boaz (CBW). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Mesomphix perlaevis vulgatus H. B. Baker

(Plate 8, fig. 10)

Shell somewhat convex, often depressed, epidermis greenish horn-color, shining, thin; whorls 5, rather flattened, rapidly enlarging, with beautiful and regular oblique striæ and revolving microscopic lines, the last whorl

expanding towards the aperture, not descending; aperture transverse, broadly lunar, ample, with a testaceous deposit within; peristome thin, acute, straight, extremities approaching, its lower extremity inserted into center of base and somewhat reflected; base smooth perforate. Greater diameter 18, lesser 15, height 9 mm.

Type Locality: Kentucky (Rafinesque, 1821).

Range: New York to Ohio, Kentucky to Arkansas, south to Florida, and north to Maryland.

West Virginia Records

Barbour County; Nestorville (GKM). *Doddridge County;* West Union (GRH). *Grant County;* Greenland Gap (NDR). *Harrison County;* Bristol (NDR). *Kanawha County;* Hudnall (CBW). *McDowell County;* Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Jayenne (GRH), Mt. Harmony (NDR). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (NDR) (CBW), Smithtown (NDR), Sturgisson (NDR). *Ohio County;* Wheeling (MGN) (NDR) (CBW) (GRH). *Preston County;* Cascade (NDR). *Summers County;* Talcott (GKM). *Tucker County;* Parsons (GKM). *Wetzel County;* Burton (GRH).

Remarks: M. p. vulgatus is a more globose shell than *M. inornatus;* it also differs from *inornatus* by its coarser sculpture.

This subspecies was described in 1821 by Rafinesque as *Helix lævigata.* However, Linné used the same specific name for a *Helix* in 1766, thereby making Rafinesque's name a nude name. For this reason it is now known as *Mesomphix perlævis vulgatus,* a name given to it by H. B. Baker in 1933.

Mesomphix rugeli oxycoccus (Vanatta)

(Plate 8, fig 7)

Shell depressed-globose, perforate, thin, delicately wrinkled, greenish horn-color. Spire elevated, somewhat rounded. Whorls 6, rounded, the last globose. Sculpture consists of first 3½ whorls slightly striate; the striæ gradually becoming weaker to form wrinkles, comparatively smooth below; the spiral sculpture consists of densely microscopical granules above but much weaker below. Aperture large, rounded, somewhat oblique; peristome simple, thin, acute, its ends approaching slightly. Umbilicus narrow, and slightly covered by reflected peristome. Greater diameter 17, lesser 16¾ mm.; height 13 mm.

Type Locality: Cranberry, Avery County, North Carolina (Vanatta, 1903).

Range: North Carolina and West Virginia.

West Virginia Records

Logan County; Davin (NDR). *Mercer County;* Bluefield (M&R). *Mingo County;* Taylorsville (M&R). *Wyoming County;* Pineville (M&R).

Remarks: The shell is microscopically granulate above and nearly smooth on the base, which distinguishes it from *M. rugeli.*

Genus Paravitrea Pilsbry

Shell polished, corneous to hyaline; usually with major and minor series of growth-striæ, which are less prominent on umbilical side; whorls overlapping (sutural spiral usually much contracted); peristome simple and sharp; internal armature commonly reduced in adults.

Paravitrea multidentata (A. Binney)

(Plate 8, figs. 13, 14, 15)

Shell depressed, sub-planulate above, very thin, pellucid; epidermis smooth, shining; whorls 6, narrow, slightly convex, increasing but slowly in diameter, lines of growth hardly visible; suture impressed; aperture semi-lunate, narrow; lip acute; umbilicus very small, round, not exhibiting any of the volutions; base convex, indented around umbilicus. Two or more rows of very minute, white teeth, radiating from the umbilicus, are seen through the shell, within the base of the last whorl. Greatest transverse diameter one-eighth of an inch (13¼ mm.).

Type Locality: Not designated (A Binney, 1840).

Range: Quebec and Ontario; Maine to Wisconsin; south to Arkansas and Georgia.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Lesage (M&R). *Clay County;* Clay (GKM). *Doddridge County;* West Union (FRW). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (GRH) (GKM), Organ Cave (NDR), Renick (GRH), Renick Valley (NDR), Ronceverte (M&R), White Sulphur Springs (P&L). *Jefferson County;* Harper's Ferry (JPEM). *Lewis County;* Jackson's Mill (GKM), Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R). *Marion County;* Curtisville

(NDR), Fairmont (NDR), High Point (NDR). *Marshall County;* Bannon (NDR). *Mason County;* Leon (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R), Spanishburg (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Morgantown (HHS). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (NDR) (M&R), Waitesville (M&R), Willow Bend (M&R). *Nicholas County;* Lockwood (GKM), Richwood (NDR), Snake Den Mt. (NDR), Summersville (GKM). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM). *Pocahontas County;* Black Mt. (P&L), Dunmore Spring (GKM), Marlinton (GKM), Mill Point (GKM). *Putnam County;* Poca (GKM). *Raleigh County;* Eccles (M&R). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Ritchie County;* Pennsboro (FRW). *Summers County;* Riffle (GKM), Talcott (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (NDR) (GKM). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Remarks: The numerous narrow whorls on the upper surface, together with the minute, rounded umbilicus, and narrow aperture, are sufficient to distinguish this species. There are from two to four rows of very minute, delicate teeth on the lower side of the interior of the last whorl, radiating from the center. One row is usually so near the aperture that it can be seen with the aid of a microscope; the other rows are more or less remote; each row contains from five to six distinct teeth, which are visible through the shell.

Paravitrea lamellidens (Pilsbry)

(Plate 8, figs. 16, 17; Plate 9, fig. 1)

Shell small, thin, depressed, glossy, cinnamon-buff to darker reddish brown in color, umbilicate; spire low-conoid; suture moderately impressed; whorls 6½, closely coiled, rounded; sculpture: first whorl smooth, remaining closely, regularly, and strongly striate, the striations much weaker on peripheral and basal surfaces; periphery rounded; aperture narrowly lunate, cavity obstructed by one to three white, curved, obliquely protractive radial barriers within the outer and adjacent basal walls; peristome thin, acute, simple, terminations widely separated, joined by a very thin callus deposit, dilated close to columellar insertion; base flattened, indented; umbilicus narrow, deep, funnel shaped, not exhibiting all inner volutions to apex. Diameter 3.5-3.7 mm.; height 1.6-1.9 mm.

Type Locality: Thunderhead, Great Smoky Mountains, Blount County, Tennessee (Pilsbry, 1898).

Range: Tennessee; North Carolina; and West Virginia.

West Virginia Records

Braxton County; Gassaway (GKM). *Doddridge County;* West Union (FRW).

Paravitrea capsella (Gould)

(Plate 9, figs. 2, 3)

Shell quite small, planorboid, pellucid, glistening, amber, colored. Spire nearly plane, composed of about six and one-half, closely revolving, flattened whorls. Surface with distant, impressed, radiating striæ. Suture margined. Aperture narrow, semilunar; lip simple, not thickened by a callus within. Base perforated by a deep, rather small, funnel-shaped umbilicus. Diameter one-fifth of an inch; axis one-tenth of an inch (5 x 2.5 mm.).

Type Locality: Tennessee (Gould, 1848).

Range: Alabama; Tennessee; Kentucky; West Virginia.

West Virginia Records

Boone County; Peytona (M&R), Racine (M&R), Seth (M&R). *Clay County;* Clay (GKM). *Grant County;* Mount Storm (NDR). *Kanawha County;* Alum Creek (NDR), Dunbar (GKM), Tornado (GKM). *Logan County;* Blair (M&R), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Panther (M&R). *Mercer County;* Bluefield (M&R), Spanishburg (M&R), Speedway (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Nicholas County;* Lockwood (GKM), Richwood (NDR). *Pendleton County;* Franklin (GKM), Judy Gap (GKM). *Preston County;* Cheat Mt. (GRH), Cold Spring Park (GRH). *Summers County;* Riffle (GKM), Talcott (GKM). *Taylor County;* Grafton (FRW). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: This species has the size and color of *Retinella indentata*, and is similarly striated above. The whorls are numerous and closely convoluted, as in *Ventridens suppressus*, which it most nearly resembles; but it has a larger umbilicus, like *Ventridens lasmodon*, and has no thickening, or plate, within the aperture.

Paravitrea placentula placentula (Shuttleworth)

(Plate 9, figs. 4, 5)

Shell widely umbilicated, very much depressed, arctispiral, very shining, marked by irregular, distant, impressed striæ, horn-color, diaphanous,

below of uniform color; whorls 7, most gradually increasing, scarcely convex, the last convex below, subexcavated around the umbilicus; aperture oblique, lunate; peristome simple, acute. Greater diameter 7½, lesser 6¼ mm.; height 3 mm.

Type Locality: Tennessee (Shuttleworth, 1852).

Range: Arkansas; Tennessee; North Carolina; Virginia; Kentucky; and West Virginia.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R). *Kanawha County;* Hudnall (CBW). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Mercer County;* Bluefield (M&R), Spanishburg (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monroe County;* Sweetsprings (M&R). *Pendleton County;* Franklin (GKM). *Summers County;* Talcott (GKM). *Tucker County;* Parsons (MRS. GKM). *Webster County;* Bolair (M&R). *Wyoming County;* Pineville (M&R).

Paravitrea placentula lacteodens (Pilsbry)

(Plate 9, figs. 6, 7)

The shell is similar to *P. capsella,* except that most specimens have one to three pairs of tubercular teeth within the last whorl. The sutures are a trifle less impressed, and the striations perceptibly closer. It differs from *P. significans* in the usual persistence of the teeth in the adult stage, and the median position of the periphery. In fully adult *significance* the periphery is sub-basal, and there are no teeth. Altitude 2.6, diameter 5 mm.; whorls 6½.

Type Locality; "Ramp Cove," Tuskeegee Mts., North Carolina (Pilsbry, 1903).

Range: Florida; North Carolina; and West Virginia.

West Virginia Records

Boone County; Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Clay County;* Clay (GKM). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW). *Lincoln County;* Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Glady Creek (NDR), High Point (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Spanishburg (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R).

Monroe County; Alderson (GKM), Sweetsprings (GRH) (M&R), Willow Bend (M&R). *Nicholas County;* Lockwood (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Wayne County;* Fort Gay (M&R). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: This variety was first considered a subspecies of *Paravitrea capsella,* but many conchologists have now made it a subspecies of *P. placentula.* It is distinguished from the former by the persistence of the pairs of teeth in the adult shells.

Paravitrea petrophila (Bland)

(Plate 9, fig. 8)

Shell broadly umbilicate, depressed; subglobose, thin, shining, translucent, whitish, irregularly striated; suture moderately impressed; whorls 5½-6, rather convex, the last more convex, not descending; umbilicus widely excavated externally; pervious; aperture roundly lunate; peristome simple, somewhat thickened, often rose-colored, the columellar margin slightly reflected. Diameter major 6, minimum 5-5¼; altitude 3 mill.

Type Locality: The Cliffs, Knoxville, Tennessee (Bland, 1883).

Range: Arkansas; Georgia; South Carolina; North Carolina; Tennessee; West Virginia.

West Virginia Records

Marion County; Fairmont (NDR). *Mason County;* Leon (NDR). *Monongalia County;* Sturgisson (NDR). *Pendleton County;* Franklin (NDR) (GKM). *Summers County;* Talcott (GKM). *Webster County;* Bolair (M&R).

Remarks: This species, in general form, is closely allied to *Zonitoides arboreus,* but the color is different, the sutures are more developed, and the umbilicus is much wider.

Paravitrea reesei J. P. E. Morrison

(Plate 9, figs. 9, 10, 11)

Shell small, subdiscoidal, polished, the last 5¾ whorls (of type) closely wound. Spire low, with shallow sutures. Periphery well rounded above and below, is an almost even curve from suture to umbilicus. Sculpture consisting of irregular spaced growth wrinkles or radial grooves; spiral sculpture indistinct above and below. Umbilicus deep, well-like, exhibiting all the whorls to the apex, contained about 5 times in major diameter of the shell. Aperture transverse-lunate; lip thin, simple. Internal armature consisting in the smallest shell seen (of 2 to 2½ whorls and 1 to 1.3 mm. major diameter) of two conical teeth in a radial row, dividing the

periphery into three almost equal sectors. In a specimen of 3 whorls and 1.4 mm. major diameter, two other teeth appear, a third prominent conical tooth basal to the earlier pair, and a fourth which is an indistinct callous or tubercle just beneath the suture. All teeth are retained in the largest (adult) specimens; the uppermost prominent tooth is at the periphery, the two others in each row are evenly spaced on the base of the whorl. Height 1.6 mm.; major diameter 3.1 mm.; minor diameter 3 mm.; aperture height 1.2 mm.; aperture width 1.45 mm.; umbilicus diameter 0.6 mm.

Type Locality: West Virginia Record; *Monroe County;* Peters Mt. (Morrison, 1937) (GRH).

Remarks: This new form may be easily distinguished by its small size; three prominent teeth in a radial row retained in large shells; and by an umbilicus narrower than that of *P. pilsbryana.*

Genus RETINELLA Fischer

Shell small, subglobose to depressed, thin, pellucid; epidermis pale or shining, almost colorless to brownish horn-color; finely wrinkled or striated, or with regular equidistant impressed transverse lines, with or without microscopic spiral wrinkles or impressed lines; whorls 3½ to 7, rounded, convex or planulate, regularly increasing, the last globose; suture moderately impressed; aperture large, transverse, depressed, lunate to suborbicular in shape; peristome simple, acute; umbilicus covered by reflected peristome or broadly umbilicated and showing all inner whorls.

Retinella electrina (Gould)

(Plate 9, fig. 12; Plate 10, fig. 1)

Shell umbilicated, small, depressed, thin, fragile; epidermis pale, or brownish horn-color, wrinkled, shining; whorls 4, the last rapidly enlarging towards the aperture; aperture transversely rounded; peristome simple, its edge rather thickened, not acute; umbilicus small, but well marked and constant. Greater diameter 5, lesser 4⅔ mm.; height 2 mm.

Type Locality: Borders of Fresh Pond, Cambridge, Massachusetts (Gould, 1841).

Range: Newfoundland; Canada; Alaska; United States.

West Virginia Records

Barbour County; Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R). *Cabell County;* Lesage (M&R). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM). *Jefferson County;* Bolivar (MSB),

Meyerstown (MSB), Shenandoah Junction (MSB). *Lincoln County;* Branchland (M&R). *Marion County;* Glady Creek (NDR). *Mingo County;* Williamson (M&R). *Monongalia County;* Morgantown (HHS). *Monroe County;* Waitesville (M&R). *Nicholas County;* Craigsville (GKM), Summersville (GKM). *Ohio County;* Wheeling (NDR). *Pendleton County;* Franklin (NDR) (GKM). *Wayne County;* Echo (M&R). *Webster County;* Bolair (NDR). *Wyoming County;* Pineville (M&R).

Remarks: In size, depressed-conical shape of the upper surface, the number of whorls, and the rapid enlargement of the last whorl, this species corresponds with *R. indentata.* It differs in the darker, smoky horn-color, its constant umbilicus, its rather thick and shining lip, and its whitish wrinkles, which, instead of being remote, are crowded as in other species. From *Zonitoides arboreus* it differs in having one whorl less, the last one dilating; its apex not being depressed, its thinner, more shining structure, and its somewhat smaller umbilicus. In *Z. arboreus* the outer lip has a flexuous curve, but is nearly a direct section of the whorl in this.

Retinella electrina, described as *Helix electrina* (Gould, Invert. Mass., 1841), has been known also as *Helix radiatula* (Ald., Trans. Nat. Hist. Soc. Northumb., 1830), *Helix viridula* (Menke, Sym., ed. 2, 1830), and *Helix hammonis* (Strom., Trondl., 1765). It seems that *electrina* has been selected for the American species to distinguish it from the European and other exotic species.

Retinella binneyana (Morse)

(Plate 10, figs. 2, 3)

Shell umbilicated, subglobose, transparent, almost colorless, shining, smooth, with microscopic wrinkles of growth and still more delicate oblique wrinkles; spire not much elevated; whorls about 4, rounded, gradually enlarging, the last globose, broadly umbilicated below; aperture oblique, subcircular, large; peristome simple, acute, extremities not approaching, that of columella subreflected. Greatest diameter 4 mm.; height 2 mm.

Type Locality: Maine (Morse, 1864).

Range: Quebec to British Columbia; Alaska; northern United States from Maine and West Virginia to California.

West Virginia Records

Boone County; Racine (M&R). *Clay County;* Clay (GKM). *Hampshire County;* Romney (GKM). *Kanawha County;* Dunbar (GKM). *McDowell*

County; Panther (M&R). *Mercer County;* Princeton (M&R). *Mingo County;* Taylorsville (M&R). *Monroe County;* Salt Sulphur Springs (NDR), Waitesville (M&R). *Pendleton County;* Judy Gap (GKM). *Pocahontas County;* Hillsboro (GKM). *Randolph County;* Cheat Bridge (GKM), Huttonsville (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Webster County;* Bolair (M&R).

Remarks: This species is nearest allied to *R. electrina;* it differs from that species in the following particulars: it is nearly one-third smaller, and its color is quite different, being white with a greenish tinge.

Retinella burringtoni (Pilsbry)

(Plate 10, figs. 4, 5)

The shell is depressed, umbilicate, glossy, somewhat translucent, of a warm buff tint. It resembles *R. rhoadsi* but differs by having the retractive radial grooves less widely spaced, minor grooves and wrinkles between them more strongly developed; on the latter part of the last whorl the grooves become closely though somewhat irregularly spaced. Under the compound microscope the surface is seen to be covered with fine, distinct, weakly beaded spiral striæ, not seen in *R. rhoadsi.* The umbilicus is contained about 4.4 times in the diameter. The spire is slightly convex; four rapidly widening whorls. The aperture is lunate, shaped much as in *R. rhoadsi.* Height 2, diameter 4 mm.

Type Locality: Near and at Natural Bridge, Virginia (Pilsbry, 1928).

Range: Connecticut and New York, south to West Virginia and Virginia.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM). *Cabell County;* Lesage (M&R). *Fayette County;* Clifftop (GKM). *Greenbrier County;* North Cadwell (GRH), Renich Valley (NDR), Ronceverte (GKM) (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Charles Town (MSB), Harper's Ferry (JPEM), Mt. Mission (JPEM), Reedson (MSB). *Kanawha County;* Dunbar (GKM), Institute (GKM). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R). *McDowell County;* Avondale (M&R). Iaeger (M&R), Panther (M&R). *Mason County;* Point Pleasant (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R), Speedway (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Sturgisson (NDR). *Monroe County;* Salt Sulphur Springs (M&R), Sweetsprings (M&R),

Waitesville (M&R). *Morgan County;* Berkeley Springs (NDR). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Seneca Rocks (NDR), Upper Tract (GKM). *Pocahontas County;* Dunmore Spring (GKM), Marlinton (GKM). *Putnam County;* Poca (GKM). *Summers County;* Riffle (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM).

Remarks: Fresh shells of *R. burringtoni* show distinct spiral striæ and and widely spaced, radial lines. The shell also has a dull sheen, produced by the more sharply cut sculpture, while that of *R. electrina* looks like it has been varnished. In addition *burringtoni* has more depressed whorls and usually develops a lower spire.

Retinella circumstriata (J. W. Taylor)

(Plate 10, figs. 6, 7)

Shell small, depressed, perforate, with impressed lines. Whorls 4¾, rounded, regularly and gradually increasing, the last one large. Sculpture consisting of regularly spaced, crowded impressed lines above, fainter below, and fine and crowded spiral impressed lines above and below. Amber colored. Aperture large, oblique, subcircular; peristome simple, acute. Umbilicus narrow, deep, exhibiting all inner volutions. Greater diameter 3¼, lesser 2 9/10 mm.; height 1⅓ mm.

Type Locality: Wetumpka, Alabama (Taylor, 1908).

Range: Arkansas; Alabama; and West Virginia.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Barboursville (M&R), Lesage (M&R), Ona (M&R). *Fayette County;* Clifftop (GKM). *Greenbrier County;* Alderson (GKM), Renick (GRH). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R). *Marion County;* High Point (NDR). *Marshall County;* Bannon (NDR). *Mercer County;* Bluefield (M&R), Princeton (M&R), Speedway (M&R). *Mingo County;* Williamson (M&R). *Monroe County;* Gap Mills (M&R). *Nicholas County;* Craigsville (GKM), Summersville (GKM). *Pendleton County;* Judy Gap (GKM). *Pocahontas County;* Dunmore Spring (GKM), Marlinton (GKM), Mill Point (GKM). *Putnam County;* Poca (GKM). *Raleigh County;* Eccles (M&R). *Randolph County;* Huttonsville (GKM). *Summers County;* Talcott (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Upshur County;* French

Creek (MRS. GKM) (GKM). *Wayne County;* Echo (M&R), Genoa (M&R). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Pineville (M&R).

Remarks: J. W. Taylor's original description (*Vitrea radiatula electrina circumstriata*) is as follows: "It is, therefore, proposed to regard as strictly typical of the race (*electrina*), only those specimens possessing an amber-coloured shell and upon which the microscopic striation is apparently absent or but faintly visible. . . . and to apply the term *circumstriata* to the shells clearly exhibiting the deep and distinct revolving striæ. . . ." According to H. B. Baker, *Proc. Acad. Nat. Sci. Phila.*, vol. 82, 1930, pp. 203, 204, this species should be based on Dr. Bryant Walker's paper, *Terrestrial Shell-bearing Mollusca of Alabama*, 1928, p. 78, which seems to be the first use of a trinomial that is accompanied by a recognizable description, since a quadrinomial has no status in nomenclature. I believe, however, that this species should be dated on J. W. Taylor's paper, even if it was there described under a quadrinomial, as Bryant Walker copied Taylor's original description in his paper.

Retinella wheatleyi (Bland)

(Plate 10, figs. 8, 9)

Shell umbilicated, depressed, thin, shining, pelucid, brownish horn-colored, finely striated; spire subplanulate, suture slightly impressed; whorls little convex, the last more convex at the base, rapidly increasing at the aperture, scarcely descending; umbilicus pervious; aperture depressed, obliquely lunate; peristome simple, acute, the margins approximating, joined by a thin callus. Diameter major 5, minimum 3½; altitude 2 millimeter.

Type Locality: The Cliffs, Knoxville, Tennessee (Bland, 1883).

Range: Pennsylvania; Illinois; south to Tennessee, North Carolina, and Albama. West Virginia Record: *Mingo County;* Williamson (M&R).

Remarks: R. wheatleyi is more nearly allied to *R. electrina* than any other North American form, but differs from that species especially in the form of the aperture, in the descending last whorl, and in having a wider umbilicus.

This species was collected on ledges of rocks among dead leaves at the type locality where the cliffs are very steep and rocky, and face north, and are almost always shady, damp, and covered with mosses and ferns. It also lives in grass and under stones in fields and other types of open country, and is quite often found buried in plant trash in shrubby thickets.

Retinella virginica J. P. E. Morrison

(Plate 10, figs. 10, 11, 12)

Shell markedly depressed, somewhat flattened above and below, umbilicate, vitreous, pinkish-horn colored. The radial grooves (major growth wrinkles) are rather closely but irregularly spaced; minor growth wrinkles less prominent; with minute spiral striæ above and below, less distinct than in *R. burringtoni*. The spire is lower than that of any of the related species, in some examples approaching a plane; whorls 5 to 6 in adult shells. The earlier whorls seen from above slowly increasing and closely wound; the last whorl not rapidly expanding as in *R. wheatleyi*. Umbilicus funicular, rapidly widening by the centrifugal growth of the body whorl, in immature shells contained about 5 times in major diameter of shell; in adult shells about 3¾ times in major diameter of shell. Aperture transverse, wider than high; upper end of peristome meeting the penultimate whorl horizontally well above its periphery. Height 2.1 mm.; major diameter 5.3 mm.; minimum diameter 4.6 mm.; aperture height 1.7 mm.; aperture diameter 2.1 mm.; umbilicus diameter 1.4 mm.

Type Locality: West slope of Blue Ridge, Clarke County, Virginia (Morrison, 1937).

Range: Virginia and West Virginia. West Virginia Record: *Jefferson County;* Loudoun (JPEM).

Remarks: This species may be distinguished by its larger size; by the proportionately wider umbilicus of adults; by the greater number of more slowly increasing whorls, with a lower spire and proportionately smaller aperture.

Retinella lewisiana (Clapp)

(Plate 11, figs. 1, 2, 3)

Shell small, depressed widely, perspectively umbilicate, all whorls showing to the apex, umbilicus contained about five times in the diameter of the shell; yellowish-white, translucent, the inner whorls showing through the body of the shell, highly polished; the delicate growth lines are very regularly spaced and close together; smooth below. Spire much flattened; suture well impressed; margined; whorls 3½, slightly convex, the last wide. Aperture oblong-lunate, depressed above, lower margin parallel with the base, lip simple. Greater diameter 3½, lesser 2.8, altitude 1½ mm.

Type Locality: Monte Sano, near Huntsville, Alabama (Clapp, 1908).

Range: Alabama; Tennessee; and West Virginia.

West Virginia Records

Cabell County; Barboursville (M&R). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R). *Logan County;* Blair (M&R).

McDowell County; Avondale (M&R), Iaeger (M&R). *Pendleton County;* Judy Gap (GKM). *Putnam County;* Poca (GKM).

Remarks: The color, and particularly the *very regular close* lines of growth, at once distinguishes this shell from all other species. It is perhaps nearest to *R. dalliana*, but differs in color, shape, and sculpture. In *dalliana* there is a very minute spiral sculpture, only visible under a magnification of about 60 times.

Retinella raderi (Dall)

(Plate 11, figs. 4, 5, 6)

Shell depressed, four-whorled, smooth except for faint, rather regularly spaced, incremental lines above, of a pale waxen whitish color; spire raised above the last whorl, which is much the largest; periphery evenly rounded, suture appressed, base moderately rounded, the umbilical slope of the last whorl somewhat flattish; umbilicus very wide, exhibiting all the volutions; aperture wider than high, the upper margin slightly in advance of the lower lip, the two connected by a thin wash of callus over the body. Altitude 1.5, maximum diameter 4, minimum diameter 3 mm.

Type Locality: Cumberland, Maryland (Dall, 1898).

Range: Maryland and West Virginia.

West Virginia Records

Cabell County; Barboursville (M&R). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (NDR). *Logan County;* Sharples (M&R). *Marion County;* High Point (NDR). *Mercer County;* Speedway (M&R). *Mingo County;* Williamson (M&R). *Monroe County;* Salt Sulphur Springs (M&R), Waitesville (M&R). *Pendleton County;* Franklin (NDR) (GKM), Upper Tract (NDR). *Pocahontas County;* Marlinton (GKM).

Remarks: The nearest relative of this species is *R. wheatleyi*, which is a larger shell with higher spire, more rounded whorls, and a much smaller and more steep-sided umbilicus.

Retinella rhoadsi rhoadsi (Pilsbry)

(Plate 11, figs. 7, 8)

Similar to *R. indentata*, but differing from that species in the distinct umbilicus, about one-half millimeter wide, showing the penultimate whorl within; radial grooves more numerous, and therefore closer. The same character, and the smaller size, separate *rhoadsi* from *R. carolinensis.* Altitude 2.5, diameter 4.8 mm., or somewhat smaller.

Type Locality: White Pond, Warren County, New Jersey (Pilsbry, 1899).

Range: Ontario; Michigan; Maine to Pennsylvania, south to Tennessee and North Carolina.

West Virginia Records

Barbour County; Philippi (MRS. GKM) (GKM). *Boone County;* Peytona (M&R), Racine (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Lesage (M&R), Ona (M&R). *Clay County;* Clay (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM), Ronceverte (GKM). *Hampshire County;* Capon Bridge (JPEM), Romney (GKM). *Jefferson County;* Bloomery (MSB) (Bartsch & Morrison), Charles Town (JPEM), Harper's Ferry (JPEM). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW). *Lewis County;* Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Sharples (M&R). *McDowell County;* Panther (M&R). *Marion County;* East Fairmont (NDR), Fairmont (NDR), High Point (NDR). *Mineral County;* Burlington (GKM), New Creek (NDR). *Mingo County;* Williamson (M&R). *Monongalia County;* Coopers Rock (NDR). *Monroe County;* Salt Sulphur Springs (NDR) (M&R), Sweetsprings (GRH) (M&R), Waitesville (M&R). *Nicholas County;* Summersville (GKM). *Ohio County;* Wheeling (NDR). *Pendleton County;* Franklin (GKM), Judy Gap (GKM). *Pocahontas County;* Marlinton (GKM). *Raleigh County;* Shady Spring (M&R). *Randolph County;* Huttonsville (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Tucker County;* Parsons (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (M&R). *Wirt County;* (WJF). *Wyoming County;* Pineville (M&R).

Retinella rhoadsi austrina H. B. Baker

(Plate 11, figs. 9, 10)

Shell quite small, hyaline, thin and transparent; spire more depressed than in *rhoadsi;* umbilicus smaller (8 to 9 times in major diameter); spiral sculpture quite weak; radiating lines rather closely spaced (41 on last whorl).

Type Locality: Sink Hole, about three miles northwest of Johnson City, Washington County, Tennessee (Baker, 1930).

Range: Tennessee; North Carolina; Virginia; and West Virginia.

West Virginia Records

Calhoun County; Grantsville (NDR). *Grant County;* Mount Storm (NDR). *Mason County;* Point Pleasant (NDR). *Morgan County;* Berkeley Spring (NDR). *Pendleton County;* Franklin (NDR).

Retinella indentata indentata (Say)

(Plate 11, figs. 11, 12)

Shell depressed, pellucid, highly polished; whorls four, with regular, distant, subequidistant, impressed lines across, of which there are about twenty-eight to the body whorl, all extending to the base; suture not deeply indented; aperture rather large; labrum simple, terminating at its inferior extremity at the center of the base of the shell; umbilicus none, but the umbilical region is deeply indented. Greater breadth one-fifth of an inch (5 mm.).

Type Locality: Harrigate, near Philadelphia, Pennsylvania (Say, 1822).

Range: Canada and the United States.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM). *Cabell County;* Barboursville (GKM) (M&R), Lesage (M&R), Ona (M&R). *Clay County;* Clay (GKM). *Doddridge County;* West Union (FRW). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (NDR), Renick Valley (NDR), Ronceverte (GKM) (M&R). *Hampshire County;* Capon Bridge (JPEM), Romney (GKM). *Harrison County;* Bristol (NDR). *Jefferson County;* Aldridge (MSB), Bakerton (MSB), Bardane (MSB), Bloomery (JPEM), Bolivar (MSB), Charles Town (MSB), Harper's Ferry (MSB) (NDR) (JPEM) (EJC) (GWT), Jamestown (MSB), Kabletown (MSB), Keys Gap (JPEM), Keystone (MSB), Meyerstown (MSB), Middleway (MSB), Millville (MSB), Morgan Grove (MSB), Mt. Mission (JPEM), Reedson (MSB), Rippon (MSB), Shenandoah City (MSB), Shenandoah Junction (MSB), Uvilla (MSB). *Kanawha County;* Alum Creek (NDR), Dunbar (GKM), Hudnall (CBW), Institute (GKM), Nitro (GKM), St. Albans (UM), South Charleston (NDR), Tornado (GKM). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Iaeger (M&R), Panther (NDR) (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Jayenne

(GRH). *Marshall County;* Cameron (GB), Moundsville (VS). *Mason County;* Leon (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R), Speedway (M&R). *Mineral County;* New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Morgantown (HHS). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (M&R), Union (GKM), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Largent (NDR). *Nicholas County;* Richwood (NDR). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Seneca Rocks (NDR), Upper Tract (NDR). *Pocahontas County;* Dunmore Spring (GKM), Marlinton (GKM), Mill Point (NDR). *Putnam County;* Poca (GKM). *Raleigh County;* Daniels (M&R). *Randolph County;* Huttonsville (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Upshur County;* French Creek (MRS. GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (M&R). *Wetzel County;* Proctor (VS), Silver Hill (NDR). *Wirt County;* (WJF). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: This species may be mistaken for *Zonitoides arboreus*, but it is destitute of the umbilicus, in place of which there is an indented center to the base in which the labrum terminates. The spire is very much depressed, and the surface radiated by distant impressed lines, the interstices being perfectly smooth.

Retinella indentata paucilirata (Morelet)

(Plate 12, fig. 1)

Shell convexly depressed, horn-colored, shining, smooth, indented. Whorls 4½, flat, rounded, the last subdilated in front, not deflected. Sculpture consists of radiating indentations remotely and equidistantly placed above and below. Aperture oblique, lunately oval; peristome simple, acute. Umbilicus closed, but the region around it indented. Greatest diameter 6 mm.; altitude 2 mm.

Type Locality: Near Salama, Guatemala (Morelet, 1851).

Range: New Jersey to California, south to Arizona and Florida.

West Virginia Records

Barbour County; Nestorville (GKM). *Boone County;* Racine (M&R). *Cabell County;* Barboursville (NDR) (M&R), Ona (M&R). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Mount Storm (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (GKM). *Hampshire*

County; Romney (GKM). *Jefferson County;* Rippon (MSB). *Kanawha County;* Alum Creek (NDR), Dunbar (GKM). *Lincoln County;* Myra (M&R). *Logan County;* Davin (NDR), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), High Point (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monroe County;* Salt Sulphur Springs (NDR) (M&R), Waitesville (M&R). *Pendleton County;* Circleville (NDR), Franklin (NDR), Judy Gap (GKM), Upper Tract (NDR). *Pocahontas County;* Marlinton (GKM). *Putnam County;* Poca (GKM). *Summers County;* Talcott (GKM). *Taylor County;* Valley Falls (NDR). *Tucker County;* Parsons (MRS. GKM) (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: This variety is distinguished from the typical species by the radiating lines, which are further apart in *indentata paucilirata* than in *indentata.*

Retinella carolinensis (Cockerell)

(Plate 11, figs. 13, 14, 15)

Maximum diameter 10, altitude 5 mm., whorls 5. Pale-horn, shiny, semi-transparent, umbilical region somewhat whitened. Surface of shell with strong transverse growth lines and distinct transverse grooved lines. The grooved lines number about 26 on body whorl. Umbilicus small, narrow. Aperture large-lunate, the upper angle much smaller than lower. Peristome not sinuate.

Type Locality: Not designated (Cockerell, 1890).

Range: Alabama and Georgia, north to West Virginia and Maryland.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Berkeley County;* Hodgesville (NDR). *Boone County;* Peytona (GB) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM). *Cabell County;* Barboursville (NDR) (GKM) (M&R), Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM), Organ Cave (NDR), Ronceverte (GKM) (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Bolivar (MSB), Charles Town (MSB), Jamestown (MSB), Meyerstown (MSB). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW). *Lincoln County;* Branchland (M&R), Myra (M&R), Sheridan (NDR), Sweetland (NDR). *Logan County;* Blair (M&R), Davin

(NDR), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (NDR) (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Rivesville (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Spanishburg (M&R), Speedway (M&R). *Mineral County;* New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Smithtown (NDR). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR). *Nicholas County;* Lockwood (GKM), Summersville (GKM). *Ohio County;* Wheeling (NDR). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM), Marlinton (GKM), Mill Point (GKM). *Raleigh County;* Daniels (GKM), Eccles (M&R). *Randolph County;* Huttonsville (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (GKM). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Retinella cryptomphala cryptomphala (Clapp)

(Plate 12, figs. 2, 3)

Shell thin, polished, very light horn-color to white, generally white, translucent; whorls 5 to 5½, those of the spire regularly increasing, the last widening very rapidly and doubling the diameter of the shell. Aperture broadly lunate, sutures well impressed, all whorls showing through the shell. Surface sculptured with rather evenly spaced, radiating grooves continued to the base as in *R. indentata* and *carolinensis*, there being from 23 to 34 on the body whorl. Microsculpture of even, close, clear-cut, spiral, engraved lines like those of *carolinensis*, best seen with a magnification of 25 diameters or over. Spire much depressed, almost flat, the termination of the last whorl slightly raised at the lip which is straight on the lower edge and well curved forward above, projecting about 1 mm. beyond the lower lip; at the columellar end the lip is thickened and joined to a *tongue-like callus which completely covers the umbilicus at all stages of growth.* There is a thin, microscopically granular parietal callus as in *R. indentata.* Base of shell well rounded and less impressed in the umbilical region than *indentata* or *carolinensis.* 5.1-5.9 x 4.2-5 x 2.1-2.8 mm.

Type Locality: Knox County, Tennessee (Clapp, 1915).

Range: Alabama; Tennessee; North Carolina; and West Virginia.

West Virginia Records

Boone County; Peytona (M&R). *Braxton County;* Shadyside (GKM). *Cabell County;* Barboursville (M&R), Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM), Ronceverte (GKM). *Hampshire County;* Romney (GKM). *Kanawha County;* Hudnall (CBW). *Lewis County;* Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Stone Branch (NDR). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* High Point (NDR). *Mason County;* Point Pleasant (NDR). *Mercer County;* Speedway (M&R). *Mingo County;* Williamson (M&R). *Monroe County;* Salt Sulphur Springs (M&R). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM). *Pocahontas County;* Marlinton (GKM). *Putnam County;* Poca (GKM). *Raleigh County;* Eccles (M&R). *Summers County;* Talcott (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Upshur County;* French Creek (MRS. GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (M&R). *Wyoming County;* Pineville (M&R).

Remarks: The flatter spire, the umbilicus covered *at all stages of growth,* the less excavated umbilical region and the wider aperture separates this species from *R. carolinensis.*

Retinella cryptomphala solida H. B. Baker

(Plate 12, fig. 4)

Shell: color corneous though fulvous to almost chestnut; typically larger, heavier and with stronger sculpture than *cryptomphala.* Whorls 5¼. Height 4.05, greater diameter 7.5, lesser 6.48 mm.

Type Locality: Along calcareous ledges, south side of Prior Cove, near Jasper, Marion County, Tennessee (Baker, 1930).

Range: Arkansas; Alabama; and Florida, north to Virginia and West Virginia. West Virginia Record: *Pendleton County;* Upper Tract (GKM).

Retinella sculptilis (Bland)

(Plate 12, figs. 5, 6; Plate 13, fig. 1)

Shell scarcely perforate, suborbicular, depressed, subpellucid, pale horn-color above, of lighter shade beneath, shining, with regular, subequidistant, impressed transverse lines, those on the last whorl extending over the periphery, and converging in the umbilical excavation; spire very little elevated, scarcely convex; whorls 7, planulate, the last rapidly increasing,

equal at the aperture to one-third of the diameter of the shell, beneath flattened, and little excavated in the umbilical region; suture lightly impressed; aperture scarcely oblique, depressed, transverse, lunate; peristome simple, acute, sinuate, the columellar margin very rapidly and narrowly reflected over, and almost entirely covering the small perforation. Diameter major 12½ minor 11, altitude 5 mm.

Type Locality: Anantchely Mountains, North Carolina (Bland, 1858).

Range: Alabama and Georgia, north to West Virginia and Kentucky.

West Virginia Records

Pendleton County; Judy Gap (GKM). *Randolph County;* Cheat Bridge (GKM).

Remarks: In sculpture it is closely allied to *R. indentata,* but the impressed striæ are more numerous, and closer together.

Subfamily Vitreinæ

Genus Hawaiia Gude

Shell umbilicated, minute, depressed-convex to depressed; epidermis whitish to whitish-corneous; whorls 3½ to 4½, convex, increasing slowly, with microscopic wrinkles or fine but rather sharp growth striæ and crowded microscopic spiral striæ; suture very distinctly impressed; aperture round-lunate; peristome thin, acute, its columellar margin placed at one-fourth or two-thirds of the penultimate whorl; umbilicus large, deep, exhibiting the inner volutions.

Hawaiia minuscula minuscula (A. Binney)

(Plate 12, fig. 9)

Shell minute, depressed-convex; epidermis whitish; whorls 4, convex, not increasing rapidly in diameter; suture very distinctly impressed; aperture nearly circular; lip thin, acute; umbilicus large, not spread, deep, and exhibiting the volutions; base rounded, columella with a thin callus. Greatest transverse diameter less than one-eighth of an inch. Greater diameter 2½, lesser 2⅓ mm.; height 1 mm.

Type Locality: Not designated (A. Binney, 1840).

Range: Ontario, Manitoba; entire United States.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (CB) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Gassaway

(GKM). *Cabell County;* Barboursville (GKM) (M&R), Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (NDR) (GKM), Renick Valley (NDR), Ronceverte (GKM) (M&R), White Sulphur Springs (P&L). *Hampshire County;* Romney (GKM). *Jefferson County;* Bakerton (MSB), Bardane (MSB), Bloomery (MSB), Bolivar (MSB), Charles Town (MSB), Engle (MSB), Halltown (MSB), Harper's Ferry (NDR) (MSB), Jamestown (MSB), Kabletown (MSB), Kearneysville (MSB), Keystone (MSB), Leetown (MSB), Mechanicstown (MSB), Meyerstown (MSB), Middleway (MSB), Millville (MSB), Morgan Grove (MSB), Reedson (MSB), Rippon (MSB), Shenandoah City (MSB), Shepherdstown (MSB), Skeetersville (MSB), Summit Point (MSB), Uvilla (MSB). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW), Tornado (GKM). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R). *Logan County;* Blair (M&R), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR). *Marshall County;* Moundsville (VS). *Mason County;* Leon (NDR), Point Pleasant (NDR). *Mercer County;* Princeton (M&R), Spanishburg (M&R), Speedway (M&R). *Mineral County;* Burlington (GKM), New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Coopers Rock (CBW). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (GRH) (M&R), Waitesville (M&R), Willow Bend (M&R). *Nicholas County;* Lockwood (GKM). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR). *Pocahontas County;* Greenbank (GKM), Marlinton (GKM). *Putnam County;* Poca (GKM). *Randolph County;* Cheat Bridge (GKM). *Summers County;* Talcott (GKM). *Taylor County;* Valley Falls (NDR). *Tucker County;* Parsons (MRS. GKM) (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR). *Wetzel County;* Proctor (VS), Silver Hill (NDR). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Remarks: This species is slightly larger than *Vallonia pulchella*, which it resembles in its upper surface. It also bears some resemblance to *Zonitoides limatulus*. *H. minuscula* has four whorls, with a deep suture; and a circular aperture, and a large umbilicus, which exhibits about two volutions. The striæ are too minute to be visible to the unaided eye.

Hawaiia minuscula alachuana (Dall)

(Plate 12, figs. 7, 8)

Shell larger than *H. minuscula.* The junction of the inner lip of the body whorl takes place outside of the middle line or even at the outer third of the penultimate whorl. The aperture is a little dilated. A much larger portion of the base of the penultimate whorl is shown and the umbilicus is wider.

Type Locality: Alachuana County, Florida (Dall, 1885).

Range: Arizona; Texas; Arkansas; Kansas; New Jersey; West Virginia; and Florida.

West Virginia Records

Barbour County; Philippi (GKM). *Boone County;* Peytona (CB). *Cabell County;* Barboursville (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (NDR), Ronceverte (GKM). *Hampshire County;* Romney (GKM). *Kanawha County;* Nitro (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R). *Logan County;* Sharples (M&R). *Marion County;* High Point (NDR), Kingmont (GRH). *Mason County;* Leon (NDR). *Mercer County;* Princeton (M&R). *Monroe County;* Salt Sulphur Springs (NDR), Sweetsprings (GRH) (M&R), Waitesville (M&R). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR). *Pocahontas County;* Greenbank (GKM). *Tucker County;* Parsons (GKM). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (NDR). *Wyoming County;* Pineville (M&R).

Remarks: The larger shell, and the position of the inner lip of the body whorl with the penultimate whorl, distinguishes this variety from the typical species.

Subfamily Gastrodontinæ

Genus Gastrodonta Albers

Shell small, perforate or imperforate, orbicularly depressed, yellowish-red to greenish in color, polished. Whorls 5 to 8, regularly increasing, rounded, sculptured with a few faint, irregularly spaced growth lines, regular rows of oval beads, or regular, equidistant, elevated, obtuse rib-striations. Aperture transverse, subcrescentic; peristome simple, acute; within furnished with from one to four pairs of lamellæ.

Gastrodonta interna (Say)

(Plate 13, figs. 2, 3, 4)

Shell very narrowly perforated, depressed, slightly convex; epidermis reddish-brown, shining; whorls 8, with regular, equidistant, elevated, oblique, rounded ribs, separated by distinct grooves; suture deeply impressed; aperture flattened, transverse, narrow; peristome thin, acute, thickened internally; within the base of the aperture, somewhat distant from the margin are two prominent, sub-lamelliform, white teeth, not reaching the edge of the peristome; base smooth, polished, umbilical region indented. Greater diameter 5½ mm.; height 3½ mm.

Type Locality: Lower Missouri (Say, 1821).

Range: Pennsylvania to Missouri, south to Mississippi and Florida.

West Virginia Records

Braxton County; Frametown (GKM), Gassaway (GKM). *Calhoun County;* Arnoldsburg (GRH), Grantsville (NDR). *McDowell County;* Avondale (M&R). *Mercer County;* Speedway (M&R). *Wayne County;* Fort Gay (M&R). *Wirt County;* (WJF).

Remarks: The sculpture of this species, consisting of regular, equidistant, elevated, oblique, rounded ribs, distinguishes it from any other species of snail known from eastern North America. These ribs are separated by distinct grooves, and are obsolete on the base of the shell.

Gastrodonta fonticula Wurtz

"Shell distinctly umbilicate with the umbilicus contained about eight times in the greatest diameter of the shell. The umbilicus scarcely narrowing to the apex of the shell. Inner edge of last ¾ (usually) of the body whorl forming a ridge around the opening of the umbilicus. The base of the body whorl is strongly convex; the greatest convexity about midway between the umbilicus and the periphery. Between this and the umbilicus the surface is slightly concave and ribbed. The concave surface has the appearance of a broad, shallow groove surrounding the umbilicus. The inner edge forms a narrowly rounded ridge around the umbilicus. Shell of 7.9 whorls (type specimen). In the apical view the shell is not separable from *G. interna* (Say). The sculpturing is identical in the two species. The spire is dome-shaped, but not as high as in *G. interna.* Index of h/d-59% for the type specimen. Aperture as in *G. interna.* Two teeth appearing within the aperture as very short lamellæ about as long as high. The teeth are nearly the same size although the outer one shows a tendency towards a greater height and width. (In *G. interna* the outer tooth is appreciably bulkier than the inner tooth). Soft parts of the animal unknown. Height 3-3.7 mm., greatest diameter 5.7-6.9 mm.; 7.1-7.9 whorls."

Type Locality: On steeply sloping, wooded hillside on the east side of Paint Creek, Hudnall, Kanawha County, West Virginia (Wurtz, 1948).

Range: Has been reported only from West Virginia.

West Virginia Records

Boone County; Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Clay County;* Clay (GKM). *Kanawha County;* Hudnal (CBW). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R). *McDowell County;* Iaeger (M&R), Panther (M&R). *Upshur County;* French Creek (GKM). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: The most significant feature of this shell is the well-like umbilicus permitting an uninterrupted view to the apex. This character most readily allows its separation from *G. interna* (Say). *G. fonticula* is decidedly distinct in its distribution and environmental habits, since *G. interna* was not found at the same locality together with this species.

Genus Zonitoides Lehmann

Shell orbicular, depressed, slightly to moderately convex above and concave below, thin, shining, umbilicate. Whorls 4 to 5, convex, slowly and regularly increasing; last whorl larger, declining or not declining as it approaches the aperture. Suture deeply impressed. Sculpture consisting of delicate and oblique striæ to irregular and close rib-striations above, present or obsolete below. Whitish, greenish, or amber colored. Aperture oblique, lunate-circular to circular, flattened above; peristome simple, acute, thin, thickened or not within. Umbilicus narrow to large, deep; all inner volutions showing or not.

Zonitoides elliotti (Redfield)

(Plate 13, fig. 5)

Shell with a rather narrow umbilicus, depressed-orbiculate, with fine transverse striæ, greenish horn-colored, scarcely translucent, shining beneath; spire convex, but not much raised; whorls 5, rather convex, last one sometimes slightly depressed at the aperture; suture deeply impressed; aperture very oblique, lunate-circular; peristome a little sinuate, acute but thickened within. Diameter major 9, diameter minor 8, altitude 4 mm.

Type Locality: Not designated (Redfield, 1856).

Range: Appalachian Mountains from Alabama to West Virginia.

West Virginia Records

West Virginia; (Dr. W. D. Hartman Collection). *Mingo County;* Williamson (M&R). *Wayne County;* (W. G. Binney).

Remarks: This species is a larger, more coarsely striated, and more robust shell than *Z. arboreus*, while its umbilicus spreads less, and the aperture is more oblique. These same features distinguish it from *Z. nitidus* and *Z. limatulus*. Moreover, the inward thickening of the peristome, a marked feature of *elliotti*, is wanting in all other species of *Zonitoides*.

Zonitoides arboreus (Say)

(Plate 13, figs. 6, 7)

Shell umbilicated, depressed, very slightly convex, thin, pellucid; epidermis amber-colored, smooth, shining; whorls 4-5, with very minute, oblique striæ, apparent when viewed with the microscope; aperture transversely rounded; peristome thin, acute; umbilical region indented; umbilicus moderate, well developed, round, and deep. Greater diameter 5, lesser 4⅓; height 2¾ mm.

Type Locality: Not designated (Say, 1816).

Range: Newfoundland; Canada; Alaska; and United States.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (MRS. GKM) (GKM). *Berkeley County;* Hodgesville (NDR). *Boone County;* Peytona (CB) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM), Shadyside (GKM). *Brooke County;* Bethany (CBW). *Cabell County;* Barboursville (NDR) (GKM) (M&R), Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Organ Cave (NDR), Renick (GRH), Renick Valley (NDR), Ronceverte (GKM) (M&R), White Sulphur Springs (P&L). *Hampshire County;* Capon Bridge (JPEM), Junction (NDR), Romney (GKM). *Harrison County;* Bristol (NDR). *Jefferson County;* Bakerton (MSB), Bloomery (JPEM), Bolivar (MSB), Charles Town (JPEM), Harper's Ferry (MSB) (GWT) (EJC), Kearneysville (MSB), Keys Gap (JPEM), Keystone (MSB), Meyerstown (MSB), Morgan Grove (MSB), Reedson (MSB), Shenandoah Junction (MSB), Summit Point (MSB), Uvilla (MSB). *Kanawha County;* Charleston (GKM), Dunbar (GKM), Nitro (GKM), South Charleston (NDR), Tornado (GKM). *Lewis County;* Jackson's Mill (MRS. GKM) (GKM), Weston (GKM). *Lincoln*

County; Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (MRS. GKM) (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Chesapeake (NDR), Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Kingmont (NDR), Midway Park (GRH), Mt. Harmony (NDR), Poplar Island (NDR). *Marshall County;* Bannon (NDR), Moundsville (VS). *Mason County;* Point Pleasant (CBW). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Spanishburg (M&R). *Mineral County;* Burlinton (GKM), New Creek (NDR). *Mingo County;* Williamson (M&R). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (NDR), Morgantown (HHS). *Monroe County;* Alderson (GRH) (GKM), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (GRH) (M&R), Union (GKM), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR), Largent (NDR). *Nicholas County;* Craigsville (GKM), Summersville (AFA) (GKM). *Ohio County;* Wheeling (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM), Hillsboro (GKM), Marlinton (GKM), Mill Point (GKM). *Preston County;* Aurora (Heideman). *Putnam County;* Poca (GKM). *Raleigh County;* Daniels (GKM) (M&R), Eccles (M&R), Flat Top Mt. (P&L), Shady Spring (M&R). *Randolph County;* Cheat Bridge (NDR), Huttonsville (GKM). *Summers County;* Bellepoint (GKM), Riffle (GKM), Talcott (GKM). *Taylor County;* Valley Falls (NDR). *Tucker County;* Parsons (MRS. GKM) (GKM). *Tyler County;* Friendly (CBW). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Ceredo (CBW), Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM) (M&R). *Wetzel County;* Proctor (VS), Silver Hill (NDR). *Wirt County;* (WJF). *Wood County;* Boaz (CBW), Parkersburg (FRW). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Zonitoides nitidus (Mueller)

(Plate 13, figs. 8, 9)

Shell orbicularly depressed, moderately convex above and concave below, thin, shining, uniform brownish horn-color, with delicate striæ of growth; whorls 5 or more, convex, separated by a deeply impressed suture, the outer one disproportionately large, somewhat declining as it approaches the aperture, and obtusely angular at the periphery, beneath excavated around a broad, crateriform umbilicus, in which the whorls are displayed

to the apex; aperture oblique, lunate; peristome simple, its basal margin arcuate. Greater diameter 7½, lesser 6 mm.; height 3⅔ mm.

Type Locality: Friedricksberg, Germany (Mueller, 1774).

Range: Canada and United States.

West Virginia Records

Barbour County; Philippi (MRS. GKM) (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R), Seth (M&R). *Braxton County;* Gassaway (GKM), Shadyside (GKM). *Cabell County;* Barboursville (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Alderson (NDR), Organ Cave (NDR), Renick Valley (NDR), Ronceverte (GKM) (M&R). *Hampshire County;* Romney (GKM). *Kanawha County;* Charleston (GKM), Dunbar (GKM), Nitro (GKM), South Charleston (NDR). *Lincoln County;* Branchland (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (M&R), Sharples (M&R). *McDowell County;* Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Mt. Harmony (NDR). *Marshall County;* Bannon (NDR). *Mason County;* Leon (NDR). *Mercer County;* Princeton (M&R). *Mineral County;* Burlington (GKM). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Coopers Rock (NDR), Smithtown (NDR), Sturgisson (NDR), Uffington (NDR). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (M&R), Sweetsprings (M&R), Union (GKM), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR), Largent (NDR) (GRH). *Nicholas County;* Nettie (NDR), Richwood (CJG) (NDR), Summersville (GKM). *Pendleton County;* Circleville (NDR), Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM), Hillsboro (GKM), Marlinton (GKM), Mill Point (GKM). *Preston County;* Cascade (NDR). *Putnam County;* Poca (GKM). *Raleigh County;* Eccles (M&R), Shady Spring (M&R). *Randolph County;* Huttonsville (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Upshur County;* French Creek (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (GKM). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Genus STRIATURA Morse

Shell small, translucent, with a steel gray tinge or pale green to greenish horn-color, not shining; volutions 3 to 3½, the outer whorl rapidly en-

larging, aperture well rounded, very large, spire slightly elevated. Suture distinct, and deeply channeled near the apex. Umbilicus small or broadly open, abrupt, and exhibiting all the volutions. Periostraca minutely marked with fine revolving lines and lines of increase, which reticulate the whole surface.

Striatura exigua (Stimpson)

(Plate 13, fig. 10; Plate 14, fig. 1)

Shell broadly umbilicated, depressed, pellucid, greenish horn-color, marked with delicate revolving lines, and distant longitudinal ribs obliquely decussating the incremental striæ; spire scarcely elevated, apex free from striæ; whorls 3½, convex, the last rounded, widely umbilicated below; aperture oblique, transversely rounded, remote from the axis; peristome simple, acute, its columellar extremity not reflected. Greater diameter 2½ mm.; height ½ mm.

Type Locality: Vicinity of Boston, Massachusetts (Stimpson, 1850).

Range: Quebec and Ontario; New England States, Michigan; New York to Indiana, and West Virginia.

West Virginia Records

Pocahontas County; Greenbank (GKM). *Tucker County;* Parsons (GKM). *Webster County;* Bolair (M&R).

Striatura ferrea Morse

(Plate 13, figs. 11, 12 13)

Shell umbilicated, depressed-globose, transparent, of a very light steel-gray color, not shining, marked with very delicate incremental wrinkles and microscopic revolving lines; spire slightly elevated; whorls 3, rounded, the last rapidly enlarging, globose; aperture large, transversely subcircular; peristome simple, acute, its extremities not approaching, that of the columellar scarcely subreflected. Greater diameter 2½ mm.; height 1¼ mm.

Type Locality: Maine (Morse, 1864).

Range: Quebec and Ontario; Maine to Michigan and Illinois, south to Tennessee and North Carolina.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R). *Braxton County;* Gassaway (GKM). *Fayette County;* Cliff-top (GKM). *Hampshire County;* Romney (GKM). *Lewis County;* Weston

(GKM). *McDowell County;* Avondale (M&R). *Monongalia County;* Coopers Rock (NDR). *Nicholas County;* Lockwood (GKM), Summersville (GKM). *Pendleton County;* Franklin (GKM). *Pocahontas County;* Black Mt. (P&L), Greenbank (GKM), Hillsboro (GKM), Marlinton (GKM). *Raleigh County;* Flat Top Mt. (P&L), Shady Spring (M&R). *Randolph County;* Cheat Bridge (NDR), Cheat Mt. (P&L), Helvetia (VS), Huttonsville (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Upshur County;* French Creek (GKM). *Webster County;* Bolair (M&R).

Remarks: This species resembles very much the young of *Retinella indentata*, but the latter is perfectly smooth and exhibits only the faintest revolving lines; *Striatura ferrea* also lacks the impressed radiating lines so characteristic of *indentata*. The apex of *ferrea* is marked with distinct revolving lines, the open umbilicus is constant, and is not half as large as an adult *indentata;* finally, the dead color alone is sufficient to distinguish it from the latter shell.

Striatura milium (Morse)

(Plate 14, fig. 2)

Shell widely umbilicated, depressed, transparent, shining, white, with a greenish tinge, marked with distinct and regular striæ of growth and microscopic revolving lines, the latter more conspicuous below; spire but slightly elevated; whorls 3, rounded, rapidly increasing, the last planulate above, widely umbilicated below; aperture very oblique, subcircular, remote from the axis; peristome simple, acute, its terminations somewhat approached, that of the columellar not reflected. Greater diameter 1½ mm.; height ½ mm.

Type Locality: Mt. Independence, Westbrooke, Maine (Morse, 1859).

Range: Ontario to Manitoba; Maine to Minnesota, south to Mississippi and Florida.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM). *Cabell County;* Barboursville (M&R), Ona (M&R). *Fayette County;* Clifftop (GKM). *Grant County;* Mount Storm (NDR). *Greenbrier County;* Alderson (GKM), Organ Cave (NDR), Renick (GRH), Renick Valley (NDR), Ronceverte (GKM). *Hampshire County;* Romney (GKM). *Jefferson County;* Bolivar (MSB), Harper's Ferry (JPEM), Reedson (MSB). *Kanawha County;* Nitro (GKM), Tornado (GKM). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R). *Logan County;* Blair

(M&R), Davin (NDR), Sharples (M&R). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Glady Creek (NDR), High Point (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R). *Mineral County;* Burlington (GKM). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monroe County;* Sweetsprings (GRH), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR). *Nicholas County;* Craigsville (GKM), Summersville (GKM). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM), Upper Tract (NDR). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM). Marlinton (GKM), Mill Point (GKM). *Raleigh County;* Shady Spring (M&R). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Summers County;* Talcott (GKM). *Taylor County;* Valley Falls (NDR). *Tucker County;* Parsons (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (M&R). *Wyoming County;* Oceana (M&R), Pineville (M&R).

Remarks: The peculiarities of this species are its diminutive size, rapidly enlarging and well-rounded whorls, deep and regular striations, which become obscure at the apex, and the microscopic lines running parallel with the whorls.

Genus Ventridens Binney and Bland

Shell subperforate or umbilicated, orbicularly convex, diaphanous horn-color; glossy, more or less wrinkled; whorls 5-7; aperture lunar, almost always furnished at its base with fold-like denticles not reaching the margin; peristome simple, acute.

Ventridens suppressus suppressus (Say)

(Plate 14, fig. 3)

Shell globose, depressed, pale horn-color, polished, somewhat pellucid; body whorl opaque, whitish near the aperture; volutions six, wrinkled, spire convex; aperture sublunate, narrow beneath; within, a prominent tooth near the base, distant from the margin; labrum simple; umbilicus rather small, orbicular, profound; region of umbilicus indented. Greater breadth more than one-fifth of an inch (5 mm.).

Type Locality: Germantown, Philadelphia, Pennsylvania (Say, 1829).

Range: Ontario; Maine to Wisconsin, south to Mississippi and Florida.

West Virginia Records

Boone County; Racine (M&R). *Braxton County;* Shadyside (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM), Renick

(GRH), Renick Valley (NDR), Ronceverte (GKM) (M&R). *Hampshire County;* Capon Bridge (JPEM), Romney (GKM). *Jefferson County;* Bardane (MSB), Bloomery (JPEM) (MSB), Bolivar (MSB), Engle (MSB), Gibsontown (MSB), Harper's Ferry (JPEM) (HAP) (MSB) (EJC) (Dr. E. W. Hubbard) (CC), Jamestown (MSB), Mechanicstown (MSB), Meyerstown (MSB), Millville (MSB), Morgan Grove (MSB), Reedson (MSB), Shenandoah Junction (MSB), Shepherdstown (MSB). *Kanawha County;* Hudnall (CBW). *McDowell County;* Avondale (M&R), Panther (M&R). *Mercer County;* Bluefield (M&R). *Mineral County;* Burlington (GKM), New Creek (NDR). *Monroe County;* Sweetsprings (M&R), Waitesville (M&R). *Morgan County;* (P&I). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM), Seneca Rocks (NDR), Upper Tract (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM), Hillsboro (GKM), Marlinton (GKM). *Summers County;* Talcott (GKM). *Tucker County;* Parsons (GKM). *Wayne County;* Fort Gay (M&R).

Remarks: With the exception of size and armature of the aperture, it resembles somewhat *V. ligera;* but the capacity of the body whorl near the aperture is much more remarkable. These characters, combined with that of the teeth, will readily distinguish this species from others.

Ventridens suppressus virginicus (Vanatta)

(Plate 14, fig. 4)

The adult stage has a long nodule within the columellar lip and a rather short obtuse lamella within the outer lip, more remote from the columellar nodule than in the case with the outer tooth of *suppressus.* Other characters as in *V. suppressus.* Altitude 3.4 mm.; diameter 6 mm.; slightly over 6 whorls.

Type Locality: Endless Cavern Hills, near New Market, Shenandoah County, Virginia (Vanatta, 1936).

Range: New Jersey to Ohio, south to Alabama and Georgia.

West Virginia Records

Braxton County; Gassaway (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM), Organ Cave (NDR), Renick Valley (NDR), Ronceverte (GKM). *Hampshire County;* Junction (NDR), Romney (GKM). *Jefferson County;* Aldridge (MSB), Bloomery (JPEM), Blue Ridge (JPEM), Gibsontown (MSB), Harper's Ferry (NDR), Jamestown (MSB), Mt. Mission (JPEM), Rippon (MSB). *Lincoln County;* Branchland (M&R), Sheridan (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Pan-

ther (M&R). *Mineral County;* Burlington (GKM), New Creek (NDR). *Mingo County;* Williamson (M&R). *Monroe County;* Sweetsprings (M&R), Waitesville (M&R). *Morgan County;* Largent (NDR). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM), Seneca Rocks (NDR), Upper Tract (NDR) (GKM). *Pocahontas County;* Dunmore Spring (GKM), Greenbank (GKM), Hillsboro (GKM), Marlinton (GKM). *Summers County;* Talcott (GKM).

Remarks: In some individuals this two-toothed stage is seen in somewhat smaller shells, but the strong callous lining of the throat is usually not well developed. At an earlier stage, diameter 4.3 mm., more or less, the columellar tooth is conspicuously bifid, or in some shells trifid; there is a long and high entering lamella within the outer lip with generally one or two small laminæ above it, and the callous lining is heavy. In old individuals of *V. suppressus* there is no tooth within the outer lip, only the columellar nodule remains. The small laminæ above the larger outer tooth of the young stage disappear in *suppressus* at a much earlier stage than in *virginicus*.

Ventridens suppressus divisidens Pilbsry

Shell subglobose, depressed, pale horn-colored, polished, somewhat pellucid, moderately umbilicated; body whorl opaque, whitish near aperture, whorls 6-6½, wrinkled, spire convex; aperture sublunate, narrow beneath; within, two-toothed, columellar one tubercular or somewhat lengthened a short distance within base, outer one very shortly lamellar or tubercular, remote from columella, and situated within periphery; lip simple, acute, somewhat thickened within, extremities remote, joined by a very thin callus deposit; base slightly convex, indented; umbilicus moderate, deep, hardly exhibiting any inner volutions. Diameter 5.4-6.4 mm.; height 3.5-4 mm.

Type Locality: Marlinton, Pocahontas County, West Virginia (Pilsbry, 1946).

Range: West Virginia records; *Pendleton County;* Franklin (GKM). *Pocahontas County;* Marlinton (GKM).

Remarks: The teeth in *V. s. divisidens* are farther apart than in *V. suppressus* and the basal or peripheral one is usually quite small. It differs from *V. s. virginicus* by the simple, not bifid, columellar tooth.

Ventridens gularis gularis (Say)

(Plate 14, fig. 5)

Shell subglobose, pale yellowish horn-color; polished; pellucid, beneath the aperture whitish-yellow opaque; volutions six or seven, with promi-

nent, somewhat regular wrinkles; spire convex, a little elevated; suture moderate; labrum not reflected; throat far within upon the side of the labrum, bifid; teeth lamelliform, of which one is oblique and placed near the middle, and the other less elongate, placed near the base; umbilicus none. Breadth more than one-fourth of an inch (6 mm.).

Type Locality: Not designated (Say, 1821).

Range: Pennsylvania and Ohio, south to Alabama and Georgia.

West Virginia Records

Boone County; Peytona (M&R), Racine (M&R). *Braxton County;* Gassaway (GKM). *Fayette County;* Gauley Bridge (GRH). *Grant County;* Mount Storm (NDR). *Hampshire County;* Junction (NDR). *Jackson County;* (W. G. Binney). *Jefferson County;* Bardane (MSB). *Logan County;* Davin (NDR). *McDowell County;* Iaeger (M&R), Panther (M&R). *Mercer County;* Bluefield (M&R), Spanishburg (M&R). *Mingo County;* Williamson (M&R). *Nicholas County;* Craigsville (GKM), Summersville (GKM). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM). *Pocahontas County;* Mill Point (NDR). *Randolph County;* Cheat Bridge (GKM). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Remarks: In general form it resembles *V. ligera*, but may be distinguished by the absence of the umbilicus and by the presence of teeth, which are situated far within the aperture.

Ventridens gularis theloides (A. B. Brown)

(Plate 14, fig. 6)

Shell glossy, yellow, perforate, with moderately raised, dome-shaped spire, composed of 7½-8 narrow, closely coiled whorls; the last hardly regular at the periphery in adult shells; rather strongly striate above, nearly smooth beneath, with faint traces of spiral striæ near the umbilicus, where the base is rather conspicuously excavated. *Aperture somewhat triangular, the sloping basal lip being straight.* The peristome is acute, strengthened within by *a rather wide, low callus rim. Adult shells are without teeth or laminæ.* Young shells armed with two strong lamellæ within the aperture, the summit of the outer one curving towards the inner. Altitude 4½-5, diameter 7½-8 mm.

Type Locality: North Carolina (Brown, 1902).

Range: West Virginia; North Carolina; and Tennessee. West Virginia Record: *Wyoming County;* Oceana (M&R).

Remarks: It differs from *V. lawae* in the much narrower umbilicus; from *V. gularis* it differs in being toothless in the adult stage, and with a more excavated base and straighter basal lip.

Ventridens gularis decussatus (Pilsbry and Vanatta)

(Plate 14, fig. 7)

Shell somewhat dull, brownish, *narrowly umbilicate*, with moderate or high, dome-shaped spire, composed of 8 flat whorls, *the last angular at the periphery*. Closely, sharply and strongly striate above, less so beneath, where there are usually *traces of spiral striæ* near the periphery. Aperture lunate, peristome thin and acute, armed within with a blunt tooth on the middle of the columella, and *a high, short, erect lamella*, within the outer basal margin. Altitude 5.5 diameter 7.8 mm.

Type Locality: Mt. Mitchell, North Carolina (Pilsbry and Vanatta 1902).

Range: West Virginia and North Carolina. West Virginia Record: *Boone County;* Racine (M&R).

Remarks: It differs from *V. gularis* and the racial forms of that species in the strong sculpture, comparatively dull surface, the decussated and acute carination of the young shells, and the short, high, erect lamella of the adult stage. Compared with *V. collisellus*, the variety *decussatus* is seen to differ in the closer and flatter whorls of the spire, flattened instead of swollen base, and the carinated periphery. Young shells resemble *V. intertextus* in sculpture.

The young shells are biconvex, depressed, acutely angular or carinate, more strongly striate beneath than in the adults, and with the striæ on the outer half of the base *decussated by many impressed spirals*. The internal lamellæ are long.

Ventridens collisella (Pilsbry)

(Plate 14, fig. 8)

Shell rather solid, minutely perforate, above elevated and somewhat dome-shaped, below rather flattened, the periphery rounded. Surface glossy, especially beneath, the base being radially finely wrinkled, and with faint traces of spiral striations in the slightly excavated umbilical region; upper surface sculptured with irregular, arcuate wrinkle-riblets in the direction of growth-lines, and stronger towards the base. Whorls 7½, slightly convex, separated by very shallow sutures, which, under the lens, seemed margined below by the parietal transparence of the shell. Aperture mainly basal, lunate, with a lining of white callus a short distance within, heavier and bearing a small tooth on the columellar slope, and a rather short white lamella towards the outer part of the base. Lip edge thin and acute, suddenly expanded at the columellar insertion, half covering the umbilical perforation. Altitude 5⅔-7, diameter 8⅓ mm.

Type Locality: Knoxville, Knox County, Tennessee (Pilsbry, 1896).

Range: West Virginia; Virginia; North Carolina; Tennessee; and Alabama. West Virginia Record: *Mercer County;* Spanishburg (M&R).

Remarks: It is most nearly allied to *V. ligera* and *V. cerinoideus,* being smaller than the former, with different apertural armature, and larger, duller, and more elevated than the former.

Ventridens demissus (A. Binney)

(Plate 14, fig. 9)

Shell depressed-convex; epidermis yellowish horn-color, shining; whorls six, with minute lines of growth; spire obtuse; suture impressed; body-whorl expanded very little towards the aperture; aperture transverse, not large, a white, testaceous deposit within; lip thin, acute; base rather flat, smooth; umbilicus very small; umbilical region a little impressed. Greatest transverse diameter more than three-eighths of an inch (9¼ mm.).

Type Locality: Pennsylvania (Binney, 1843).

Range: Pennsylvania to Kansas, south to Texas and Florida.

West Virginia Records

Barbour County; Philippi (GKM). *Boone County;* Peytona (M&R), Racine (M&R), Seth (M&R). *Cabell County;* Barboursville (M&R). *Clay County;* Clay (GEW). *Fayette County;* Clifftop (GKM). *Grant County;* Mount Storm (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (GKM) (M&R). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW), South Charleston (NDR). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Myra (M&R), Sheridan (NDR), Sweetland (M&R). *Logan County;* Blair (NDR) (M&R), Davin (NDR), Sharples (M&R), Slagle (CG), Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), High Point (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Spanishburg (M&R). *Mineral County;* Ridgeley (AEO). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (M&R), Sweetsprings (M&R). *Nicholas County;* Lockwood (GKM), Richwood (NDR). *Pendleton County;* Franklin (GKM), Judy Gap (GKM), Upper Tract (NDR). *Pocahontas County;* Hillsboro (GKM), Mill Point (NDR). *Preston County;* Manheim (JHA). *Raleigh County;* Shady Spring (M&R). *Randolph County;* Huttonsville (MGN) (GKM). *Summers County;* Riffle (GKM). *Tucker County;* Parsons (GKM). *Upshur County;* French Creek (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (M&R). *Wirt County;* (WJF). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Remarks: The character of the surface and striæ is much the same as in *V. ligera;* and the base is nearly the same. It resembles *V. suppressus* externally, in everything except in size and in being less coarsely striate.

Ventridens ligera ligera (Say)

(Plate 14, fig. 10)

Shell subglobose, pale yellowish horn-color, polished; body whorl pellucid, yellowish white, opaque beneath near the aperture; volutions rather more than six, all except the apical one, wrinkled across; spire convex, a little elevated; umbilicus very small; suture not deeply impressed; labrum not reflected. Greater length, three-tenths, oblique length less than nine-twentieths, transverse diameter less than eleven-twentieths (7½ x 11¼ x 13¾ mm.).

Type Locality: Missouri (Say, 1821).

Range: Ontario; Maine to Minnesota, south to Texas and Georgia.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GEW) (GKM). *Boone County;* Peytona (NDR) (M&R), Racine (M&R). *Braxton County;* Frametown (GKM), Gassaway (GKM), Shadyside (GKM). *Brooke County;* Bethany (MGN) (CBW). *Cabell County;* Barboursville (GKM) (M&R), Lesage (M&R), Milton (CBW). *Calhoun County;* Grantsville (NDR). *Grant County;* Mount Storm (NDR). *Greenbrier County;* Alderson (NDR) (GKM), Renick (GRH), Renick Valley (NDR), Ronceverte (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Bloomery (MSB) (JPEM), Charles Town (MSB), Engle (MSB), Halltown (MSB), Harper's Ferry (MSB) (JPEM), Kabletown (MSB), Keystone (MSB), Loudoun Heights (JPEM), Meyerstown (MSB), Middleway (MSB), Morgan Grove (MSB), Ranson (MSB), Reedson (MSB), Shenandoah City (MSB), Shepherdstown (MSB), Summit Point (MSB). *Kanawha County;* Alum Creek (NDR), Charleston (GKM), Hudnall (CBW), St. Albans (UM), Tornado (GKM). *Lewis County;* Jackson's Mill (MRS. GKM) (GKM). *Lincoln County;* Myra (M&R), Sweetland (M&R). *Logan County;* Blair (NDR) (M&R), Davin (NDR), Sharples (M&R). *McDowell County;* Avondale (M&R), Panther (M&R). *Marion County;* Fairmont (NDR) (GRH), High Point (NDR), Mt. Harmony (NDR), Smithville (CBW). *Marshall County;* Kent (NDR). *Mason County;* Leon (NDR). *Mercer County;* Bluefield (M&R), Princeton (M&R), Spanishburg (M&R), Speedway (M&R). *Mineral County;* Keyser (IHM), Ridgeley (AEO). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Coopers Rock (MGN) (NDR), Morgan-

town (HHS), Smithtown (NDR), Sturgisson (NDR). *Monroe County;* Alderson (GRH) (GKM), Salt Sulphur Springs (M&R), Waitesville (M&R). *Morgan County;* Largent (NDR). *Nicholas County;* Belva (NDR), Richwood (NDR), Snake Den Mt. (NDR). *Ohio County;* Clinton (MGN), Wheeling (MGN) (NDR) (GRH) (CBW). *Pendleton County;* Circleville (NDR), Franklin (GKM), Onega (MGN), Upper Tract (NDR) (GKM). *Pleasants County;* St. Mary's (CBW). *Pocahontas County;* Dunmore Spring (GKM), Marlinton (MGN) (GKM), Mill Point (MGN) (GRH) (GKM). *Preston County;* Cheat Mt. (GRH), Manheim (JHA). *Putnam County;* Poca (GKM). *Raleigh County;* Daniels (M&R), Shady Spring (M&R). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Taylor County;* Grafton (FRW), Thornton (GRH). *Tucker County;* Parsons (MRS. GKM) (GKM). *Tyler County;* Friendly (CBW). *Upshur County;* French Creek (GKM). *Wayne County;* Falls of Big Sandy River (Sanderson Smith) (American Museum of Natural History). *Webster County;* Bolair (GKM) (M&R). *Wetzel County;* New Martinsville (CBW). *Wyoming County;* Baileysville (M&R), Oceana (M&R), Pineville (M&R).

Ventridens ligera stonei (Pilsbry)

(Plate 14, fig. 12)

Shell perforate, orbicularly convex; epidermis yellowish horn-color, shining; whorls 7, finely striated transversely, smooth below; suture not much impressed; aperture semilunate, rounded, peristome thin, acute; base and sides of outer whorl, within aperture, thickened and white; perforation moderate, umbilical region concave, broadly excavated. Greater diameter 16, lesser 14 mm.; height 10 mm.

Type Locality: New Castle County, Delaware (Pilsbry, 1889).

Range: New Jersey; Delaware; Maryland; and West Virginia.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R). *Cabell County;* Lesage (M&R). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (M&R). *Hampshire County;* Romney (GKM). *Jefferson County;* Harper's Ferry (NDR). *Kanawha County;* Tornado (GKM). *Logan County;* Stone Branch (NDR). *Marion County;* Fairmont (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R), Spanishburg (M&R). *Mingo County;* Williamson (M&R). *Monongalia County;* Coopers Rock (MGN) (NDR). *Nicholas County;* Richwood (NDR). *Pendleton County;* Circleville (NDR), Upper Tract (NDR)

(MGN). *Pocahontas County;* Hillsboro (GKM), Marlinton (GKM), Mill Point (NDR) (GKM). *Preston County;* Cascade (NDR). *Randolph County;* Cheat Bridge (NDR), Helvetia (VS), Huttonsville (MGN) (NDR) (GKM). *Summers County;* Riffle (GKM), Talcott (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Upshur County;* French Creek (GKM). *Webster County;* Bolair (GKM). *Wyoming County;* Oceana (M&R).

Remarks: This subspecies has a more concave and broadly excavated base than *V. ligera*, and the umbilicus is much wider.

Ventridens intertextus (A. Binney)

(Plate 14, fig. 11)

Shell sub-pyramidal; epidermis yellowish horn-color; whorls six to seven, with numerous fine, oblique striæ, and very minute, spiral striæ; intersecting each other; outer whorl with a narrow, light-colored band, and an ill-defined, brownish band below it; aperture rounded, a little transverse; lip thin, somewhat thickened within by a deposition of testaceous matter, slightly reflected at its junction with the base of the shell; umbilicus small, sometimes nearly obsolete; base whiter than upper surface. Greatest transverse diameter about three-fourths of an inch (18¾ mm.).

Type Locality: North Carolina (A. Binney, 1840).

Range: Ontario; Maine to Indiana, south to Louisiana and Florida.

West Virginia Records

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (M&R). *Cabell County;* Ona (M&R). *Doddridge County;* West Union (FRW). *Grant County;* Mount Storm (NDR). *Greenbrier County;* Organ Cave (NDR). *Kanawha County;* Hudnall (CBW). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Iaeger (M&R). *Marion County;* East Fairmont (NDR), High Point (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Cheat Mt. (HHS), Coopers Rock (CBW), Sturgisson (NDR). *Nicholas County;* Craigsville (GKM), Lockwood (GKM), Summersville (GKM). *Ohio County;* Wheeling (MGN) (CBW). *Preston County;* Cascade (NDR), Manheim (JHA). *Randolph County;* Helvetia (VS). *Taylor County;* Valley Falls (NDR). *Tucker County;* Parsons (GKM). *Upshur County;* French Creek (MRS. GKM) (GKM). *Wayne County;* Fort Gay (M&R), Genoa (M&R). *Wyoming County;* Oceana (M&R).

Remarks: This shell resembles some varieties of *V. ligera*. However, the spire is less high in the shell of the same size, has a smaller number of

whorls, and is more pyramidal in shape. The diameter, in full-grown specimens, is greater, and the base is flatter. The epidermis is darker and less shining, the shell is thicker and less pellucid, the deposit of testaceous matter within the aperture is less. The size of the umbilicus and the shape of the aperture are the same in both. The principal distinction consists in the spiral lines, which revolve on the whorls, intersecting the striæ of growth, but so minute as hardly to be perceptible to the naked eye. The whitish, narrow band, shaded below with rufous, apparent on the outer, and sometimes on the second whorl, generally aids in identification. Young specimens are much more depressed than those of *V. ligera* and *are sometimes distinctly carinated or angulated at the periphery.*

Additional localities for the Families Carychiidæ and Pupillidæ

Under the species of these families immediately following this heading are listed additional localities which are supplementary to those localities previously listed for these species in papers by Dr. S. T. Brooks and the present author which appeared in the *Annals of the Carnegie Museum*, vol. XXV, 1937, pp. 155-161 (*Carychiidæ*) and vol. XXVII, 1938, pp. 63-85 (*Pupillidæ*).

Family Carychiidæ

Carychium exile H. C. Lea

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (NDR) (M&R), Seth (M&R). *Cabell County;* Barboursville (M&R), Lesage (M&R), Ona (M&R). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GRH)) (GKM), Renick (GRH), Renick Valley (NDR). *Jefferson County;* Bolivar (MSB), Reedson (MSB). *Kanawha County;* Hudnall (CBW), Institute (GKM). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Stone Branch (NDR). *McDowell County;* Avondale (M&R). *Marion County;* Fairmont (NDR), Glady Creek (NDR), High Point (NDR), Kingmont (GRH). *Marshall County;* Bannon (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Speedway (M&R). *Mingo County;* Williamson (M&R). *Monroe County;* Alderson (GKM), Salt Sulphur Springs (M&R), Sweetsprings (GRH) (M&R), Waitesville (M&R), Willow Bend (M&R).

Morgan County; Berkeley Springs (NDR). *Nicholas County;* Summersville (GKM). *Pendleton County;* Circleville (NDR), Franklin (NDR). *Pocahontas County;* Mill Point (GRH) (GKM). *Randolph County;* Cheat Bridge (GKM). *Tucker County;* Parsons (MRS. GKM) (GKM). *Upshur County;* French Creek (GKM). *Wayne County;* Echo (M&R), Fort Gay (M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (M&R). *Wyoming County;* Oceana (M&R), Pineville (M&R).

Carychium exiguum (Say)

Cabell County; Ona (M&R). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* North Caldwell (GRH), Renick Valley (NDR). *Harrison County;* Bristol (NDR). *Jefferson County;* Leetown (MSB). *Logan County;* Stone Branch (NDR). *McDowell County;* Avondale (M&R), Iaeger (M&R), Panther (M&R). *Mercer County;* Spanishburg (M&R). *Monroe County;* Salt Sulphur Springs (NDR). *Ohio County;* Wheeling (NDR). *Pendleton County;* Circleville (NDR). *Pocahontas County;* Marlinton (GKM). *Preston County;* Cascade (NDR). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (NDR). *Wetzel County;* Silver Hill (NDR). *Wyoming County;* Baileysville (M&R).

Carychium nannodes Clapp

Boone County; Peytona (M&R), Seth (M&R). *Cabell County;* Lesage (M&R). *Lincoln County;* Branchland (M&R). *Logan County;* Davin (NDR). *McDowell County;* Avondale (M&R). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Speedway (M&R). *Monroe County;* Waitesville (M&R). *Wayne County;* Fort Gay (M&R). *Webster County;* Bolair (NDR).

Family Pupillidæ Turton

Genus Gastrocopta Wollaston

Gastrocopta armifera (Say)

Berkeley County; Hedgesville (NDR). *Cabell County;* Barboursville (GKM), Lesage (M&R). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (GKM) (M&R). *Jefferson County;* Bakerton (MSB), Charles Town (MSB), Harper's Ferry (NDR) (GWT) (EJC), Piperstown (MSB), Shenandoah City (MSB), Shenandoah Junction (HAP). *Marion County;* East Fairmont (NDR), Fairmont (NDR), High Point (NDR), Rivesville (NDR). *Mason County;* Leon (NDR). *Mercer County;* Spanishburg

(M&R). *Mineral County;* New Creek (NDR). *Monongalia County;* Coopers Rock (CBW). *Monroe County;* Gap Mills (M&R), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Ohio County;* Wheeling (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR), Upper Tract (NDR). *Wayne County;* Echo (M&R).

Gastrocopta contracta contracta (Say)

Barbour County; Nestorville (GKM), Philippi (GKM). *Boone County;* Peytona (GB) (M&R), Racine (M&R), Seth (M&R). *Cabell County;* Barboursville (NDR) (GKM) (M&R), Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Geenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (GKM) (M&R). *Jefferson County;* Bolivar (MSB), Harper's Ferry (NDR) (GWT) (EJC) (MSB), Millville (MSB). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW). *Lewis County;* Weston (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Stone Branch (NDR). *McDowell County;* Iaeger (M&R), Panther (M&R). *Marion County;* Curtisville (NDR), Fairmont (NDR), Glady Creek (NDR), High Point (NDR). *Mason County;* Leon (NDR), Point Pleasant (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Princeton (M&R), Speedway (M&R). *Mineral County;* New Creek (NDR). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Sturgisson (NDR), Uffington (NDR). *Monroe County;* Gap Mills (M&R), Salt Sulphur Springs (NDR) (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR), Largent (NDR). *Ohio County;* Wheeling (CBW). *Pendleton County;* Circleville (NDR), Franklin (NDR), Upper Tract (NDR). *Wayne County;* Echo (M&R). *Webster County;* Bolair (NDR). *Wyoming County;* Baileysville (M&R), Pineville (M&R).

Gastrocopta contracta climeana (Vanatta)

(Plate 15, fig. 1)

Shell rimate, ovate-conic, tapering from the last whorl to the obtuse apex, bluish-milky or spermaceti-colored, imperfectly transparent, glossy, marked with fine growth lines. Whorls 5⅓, very convex, the last half of the last whorl straightened, pinched at the base, impressed over the lower palatal plica, and on both sides of a low rounded ridge which stands a short distance behind the peristome. Aperture rounded, triangular, al-

most closed by large teeth. Angulo-parietal tooth joining lip, angularly bent to the right near the middle, L-shaped. Columellar lamella large, thin, very deeply placed, subvertical, the upper end curving forward. A subvertical callous stands in front of it, near the margin. Palatal plicæ two, connected by a low callous, the lower one obtuse, transverse, more deeply placed and larger than the tuberculiform upper plica. Peristome thin, well expanded, continuous. Altitude 2.29, diameter 1.43 mm.

Type Locality: Anderson Landing, on Sunflower River, near Confluence with the Yazoo, Sharkey County, Mississippi (Vanatta, 1911).

Range: West Virginia; Alabama to Texas, north to Arkansas. West Virginia Record: *Greenbrier County;* Alderson (NDR).

Remarks: The shell is similar to *contracta,* but the parietal tooth lacks the inner continuation, being L-shaped.

Gastrocopta holzingeri (Sterki)

Greenbrier County; Renick Valley (NDR). *Pendleton County;* Franklin (NDR).

Gastrocopta pentodon (Say)

Barbour County; Nestorville (GKM). *Boone County;* Peytona (GB) (M&R), Racine (M&R), Seth (M&R). *Cabell County;* Barboursville (M&R), Lesage (M&R), Ona (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Fayette County;* Clifftop (GKM). *Grant County;* Greenland Gap (NDR), Mount Storm (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (GKM) (M&R). *Jefferson County;* Gibsontown (MSB), Harper's Ferry (NDR) (MSB), Keystone (MSB), Meyerstown (MSB), Millville (MSB). *Kanawha County;* Alum Creek (NDR), Hudnall (CBW). *Lewis County;* Jackson's Mill (GKM). *Lincoln County;* Branchland (M&R), Myra (M&R), Sweetland (M&R). *Logan County;* Blair (M&R), Davin (NDR), Sharples (M&R), Stone Branch (NDR). *Marion County;* Fairmont (NDR), Glady Creek (NDR), High Point (NDR). *Mason County;* Leon (NDR), Point Pleasant (NDR). *Mercer County;* Bluefield (M&R), Oakvale (M&R), Speedway (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monongalia County;* Smithtown (NDR). *Monroe County;* Salt Sulphur Springs (NDR) (M&R), Sweetsprings (M&R), Waitesville (M&R). *Nicholas County;* Richwood (NDR), Snake Den Mt. (NDR). *Pendleton County;* Circleville (NDR), Franklin (NDR), Upper Tract (NDR). *Pocahontas County;* Mill Point (GKM). *Raleigh County;* Daniels (M&R), Shady Spring (M&R). *Randolph County;* Helvetia (VS), Huttonsville (GKM). *Summers County;* Talcott (GKM). *Tucker County;* Parsons (GKM). *Wayne County;* Fort Gay

(M&R), Genoa (M&R). *Webster County;* Bolair (NDR) (M&R). *Wetzel County;* Proctor (VS). *Wyoming County;* Pineville (M&R).

Gastrocopta tappaniana (C. B. Adams)

Boone County; Peytona (M&R). *Cabell County;* Barboursville (GKM). *Lincoln County;* Myra (M&R). *Logan County;* Blair (M&R), Sharples (M&R). *Mingo County;* Taylorsville (M&R), Williamson (M&R). *Monroe County;* Salt Sulphur Springs (M&R), Union (GKM), Willow Bend (M&R). *Pendleton County;* Franklin (NDR). *Raleigh County;* Daniels (M&R). *Taylor County;* Valley Falls (NDR).

Gastrocopta corticaria (Say)

Boone County; Racine (M&R), Seth (M&R). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (M&R). *Logan County;* Sharples (M&R). *McDowell County;* Panther (M&R). *Marion County;* High Point (NDR). *Mason County;* Leon (NDR). *Monongalia County;* Uffington (NDR). *Monroe County;* Salt Sulphur Springs (M&R,) Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Berkeley Springs (NDR). *Pendleton County;* Franklin (NDR). *Taylor County;* Valley Falls (NDR).

Gastrocopta procera (Gould)

Greenbrier County; Renick Valley (NDR). *Jefferson County;* Aldridge (MSB), Bardane (MSB), Bloomery (MSB), Bolivar (MSB), Kabletown (MSB), Kearneysville (MSB), Keystone (MSB), Leetown (MSB), Mechanicstown (MSB), Meyerstown (MSB), Middleway (MSB), Millville (MSB), Morgan Grove (MSB), Rippon (MSB), Summit Point (NDR).

Genus VERTIGO Mueller

Vertigo clappi Brooks and Hunt

Greenbrier County; Renick Valley (NDR). *Marion County;* Fairmont (NDR).

Vertigo ovata Say

Jefferson County; Meyerstown (MSB). *Logan County;* Sharples (M&R). *Marion County;* Mt. Harmony (NDR). *Mingo County;* Williamson (M&R). *Monroe County;* Salt Sulphur Springs (M&R), Willow Bend (M&R). *Pocahontas County;* Marlinton (GKM).

Vertigo gouldii (A. Binney)

Barbour County; Nestorville (GKM). *Boone County;* Racine (M&R). *Cabell County;* Barboursville (M&R). *Calhoun County;* Grantsville (NDR). *Clay County;* Clay (GKM). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (GKM). *Jefferson County;* Harper's Ferry (MSB), Meyerstown (MSB). *Kanawha County;* Alum Creek (NDR). *Lincoln County;* Myra (M&R). *Logan County;* Blair (M&R). *McDowell County;* Avondale (M&R). *Marion County;* Fairmont (NDR), Glady Creek (NDR). *Mason County;* Leon (NDR). *Mercer County;* Oakvale (M&R), Princeton (M&R). *Mineral County;* Burlington (GKM), New Creek (NDR). *Monongalia County;* Sturgisson (NDR), Uffington (NDR). *Monroe County;* Alderson (GKM), Gap Mills (M&R), Sweetsprings (M&R), Waitesville (M&R), Willow Bend (M&R). *Morgan County;* Largent (NDR). *Pendleton County;* Franklin (NDR). *Randolph County;* Cheat Bridge (GKM). *Webster County;* Bolair (NDR) (M&R). *Wyoming County;* Baileysville (M&R).

Vertigo tridentata Wolf

Jefferson County; Harper's Ferry (NDR), Shepherdstown (MSB), Skeetersville (MSB). *Kanawha County;* Tornado (GKM). *Lincoln County;* Branchland (M&R). *Marshall County;* Bannon (NDR). *Monroe County;* Salt Sulphur Springs (NDR), Sweetsprings (M&R), Waitesville (M&R). *Pendleton County;* Judy Gap (GKM).

Vertigo ventricosa (Morse)

(Plate 15, fig. 2)

Shell umbilicate, ovate, conic, smooth, polished; apex obtuse; suture deep; whorls four, convex. Aperture, semicircular, with five teeth, one prominent on the parietal margin, two smaller on the columellar margin, and two prominent within, contracting the aperture at the base; peristome widely reflected, the right margin flexuous, within thickened and colored. Length .07 inch, breadth .45 inch. (1.75 x 1.1 mm.).

Type Locality: Not designated (Morse, 1865).

Range: Prince Edward Island; Quebec; Maine to Michigan and Illinois; and West Virginia.

West Virginia Records

Monroe County; Willow Bend (M&R). *Raleigh County;* Daniels (M&R).

Remarks: V. ventricosa differs from *V. ovata* by the constantly smaller

size, absence of an angular lamella, and smaller number of teeth. It is of an auburn color, somewhat transparent, glossy, with only a trace of striation. Under a high power lens it shows microscopic punctation or granulation. The basal fold is usually quite small, though sometimes it is well developed.

Vertigo pygmaea (Draparnaud)

(Plate 15, fig. 3)

The shell is cylindric-oval, sunburn or chestnut-brown, glossy, having only weak traces of striation, but the surface appears densely weakly-pitted microscopically. The whorls are moderately convex, the last having a *strong rounded crest* a short distance behind the peristome, separated from it by a concavity, and somewhat paler colored than the rest of the shell. The parietal lamella is strong but rather short, median. Columellar lamella deeply placed, short, ascending inwardly. Both palatal folds are strong, the lower one longer, as usual. They stand on a strong callus. The basal fold is very small, rarely absent. There is often a low suprapalatal fold. The peristome is well expanded, somewhat reflected, colored like the shell. The outer lip is slightly incurved. Length 2, diameter 1.1 mm.; 5 whorls.

Type Locality: France (Draparnaud, 1801).

Range: Maine to Virginia, west to Ohio and Michigan.

West Virginia Records

Mineral County; New Creek (NDR). *Pendleton County;* Franklin (NDR).

Remarks: The strong, continuous crest behind the well expanded lip and the absence of a distinctly defined upper arc or sinulus of the outer lip are its more prominent features. *V. gouldii* is a paler, much more sharply striate shell with weaker crest and distinct sinulus. *V. ventricosa* has a weaker and interrupted crest.

Vertigo bollesiana (Morse)

(Plate 15, figs. 4, 5)

Shell minutely perforate, cylindrical ovate, delicately striated, subtranslucent; apex obtuse; suture well defined; whorls four, subconvex; aperture suborbicular, somewhat flattened on its outer edge; with five teeth, one prominent and rather curved on the parietal margin, two similar in form, the lower one smaller, on the columellar margin, and two slightly elevated lamelliform teeth within and at the base, peristome subreflected and thickened. Length .065 inch.; breadth .035 inch (1.6 x .9 mm.).

Type Locality: Orono, Maine (Morse, 1865).

Range: Maine to Virginia, west to Indiana and Michigan.

West Virginia Records

Braxton County; 4 miles south of the Lewis County Line (NDR). *Nicholas County;* Summersville (GKM). *Pendleton County;* Franklin (GKM).

Remarks: There is an extremely small crest close behind the lip, and a rather large oblique depression over the palatal folds. The basal fold is subcolumellar in position, and rarely is it absent. It is smaller, lighter colored and more transparent and delicate than *V. gouldii* and *less distinctly striated.* The teeth are smaller, especially the palatals.

Vertigo parvula Sterki

(Plate 15, fig. 6)

The shell is minute, subcylindric, tapering very little upwards, the summit obtuse; thin, subtransparent, slightly yellowish, smooth and glossy, becoming finely striate behind the outer lip. Whorls are moderately convex, the last whorl well rounded, slightly impressed behind the projection of the outer lip. The aperture is somewhat triangular, with three teeth: parietal lamella rather short and high; lower palatal fold rather high in front, rapidly becoming lower as it recedes, penetrating to the dorsal side. Peristome very little everted, slightly thickened, and having a distinct callus ridge within. The outer lip projects forward and is slightly bent inward above the middle. Length 1.55, diameter 0.85 mm.; barely 5 whorls.

Type Locality: Summit County; Ohio (Sterki, 1890).

Range: Ohio; West Virginia; North Carolina.

West Virginia Records

Boone County; Peytona (M&R). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Alderson (GKM), Renick Valley (NDR). *Logan County;* Davin (NDR). *McDowell County;* Avondale (M&R). *Monroe County;* Alderson (GKM). *Pendleton County;* Franklin (NDR) (GKM), Judy Gap (GKM). *Summers County;* Talcott (GKM).

Remarks: It is one of the rarest species, known by the small size, cylindric shape, and three well-developed teeth, the lower palatal being quite long and not marked externally by an impression. The auricle or point of the outer lip projects well forward but is not much bent inward. It is much smaller than *V. tridentata,* and more cylindric and lighter colored than *V. perryi,* with relatively larger teeth.

The species *Vertigo oscariana* Sterki recorded as occuring in West Virginia has been misidentified; it is *V. parvula* and all records for *V. oscariana* should be placed under this species.

Vertigo milium (Gould)

Grant County; Greenland Gap (NDR). *Greenbrier County;* Ronceverte (M&R). *Jefferson County;* Bolivar (MSB), Harper's Ferry (NDR). *Monroe County;* Sweetsprings (M&R), Willow Bend (M&R).

Genus COLUMELLA Westerlund

Columella edentula (Draparnaud)

Calhoun County; Grantsville (NDR). *Grant County;* Greenland Gap (NDR). *Greenbrier County;* Renick Valley (NDR). *Logan County;* Blair (M&R). *McDowell County;* Avondale (M&R). *Marion County;* High Point (NDR). *Mineral County;* New Creek (NDR). *Morgan County;* Berkeley Spring (NDR). *Pendleton County;* Franklin (NDR). *Wyoming County;* Baileysville (M&R).

Genus PUPOIDES Pfeiffer

Pupoides albilabris (Ward)

Grant County; Greenland Gap (NDR). *Greenbrier County;* Renick Valley (NDR), Ronceverte (M&R). *Jefferson County;* Engle (MSB), Harper's Ferry (NDR) (GWT) (MSB), Millville (MSB), Rippon (MSB). *Marion County;* Rivesville (NDR). *Mingo County;* Williamson (M&R). *Monroe County;* Salt Sulphur Springs (NDR) (M&R). *Pendleton County;* Upper Tract (NDR).

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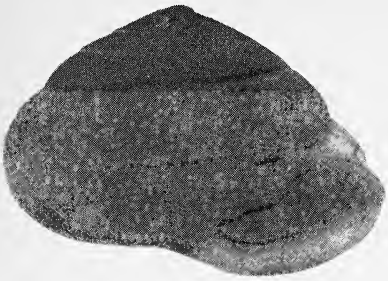
EXPLANATION OF PLATE 1

FIG. 1. *Hendersonia occulta* (Say) × 7.
FIGS. 2, 3. *Haplotrema concavum* (Say) × 1.25.
FIG. 4. *Cionella lubrica* (Mueller) × 6.3.
FIG. 5. *Pomatiopsis lapidaria* (Say) × 4.
FIG. 6. *Pomatiopsis prælonga* Brooks & MacMillan × 6.
FIG. 7. *Vallonia pulchella* (Mueller) × 7.3 (after F. C. Baker).
FIG. 8. *Vallonia excentrica* Sterki × 7.9 (after F. C. Baker).



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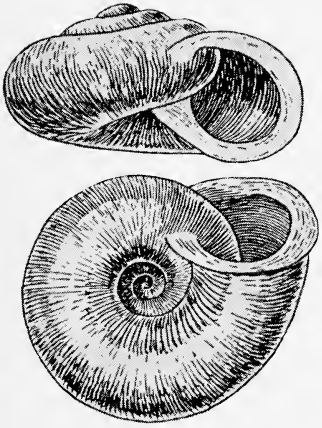

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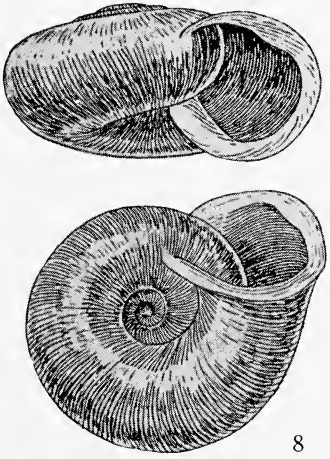

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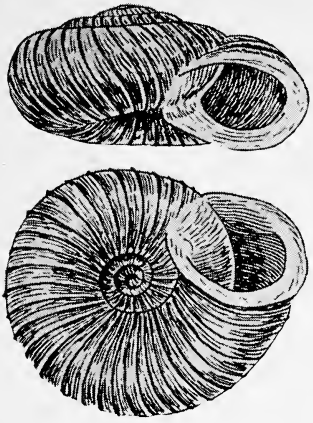
EXPLANATION OF PLATE 2

FIG. 1. *Vallonia costata* (Mueller) × 6.3 (after F. C. Baker).
FIG. 2. *Vallonia perspectiva* Sterki × 20 (Brooks, del.).
FIG. 3. Apertural folds and lamellæ of *Strobilops* (after F. C. Baker).
FIGS. 4, 5. *Strobilops labyrinthica* (Say) × 11.7 (after Pilsbry).



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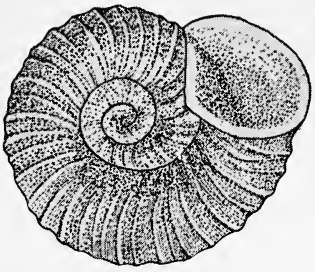

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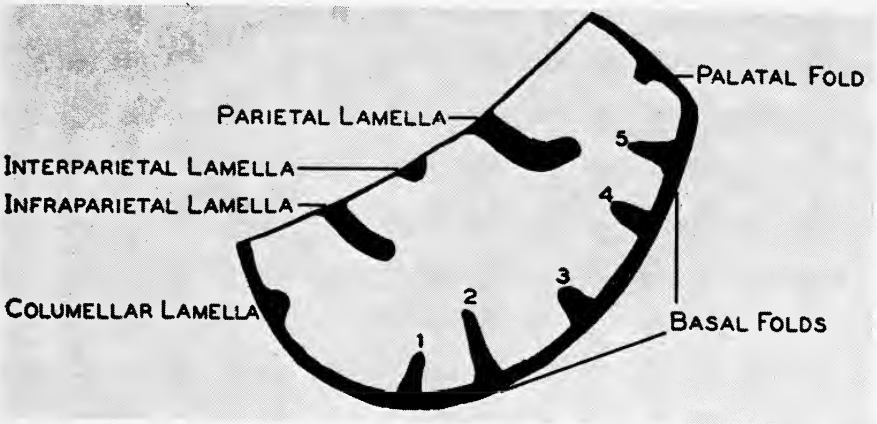
PALATAL FOLD
PARIETAL LAMELLA
INTERPARIETAL LAMELLA
INFRAPARIETAL LAMELLA
COLUMELLAR LAMELLA
BASAL FOLDS
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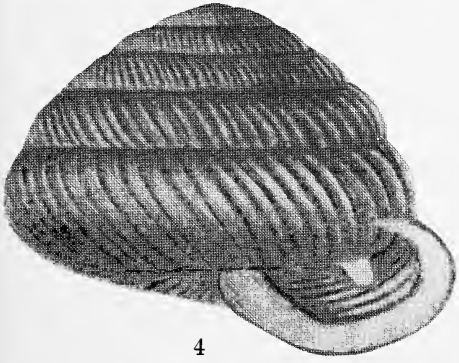

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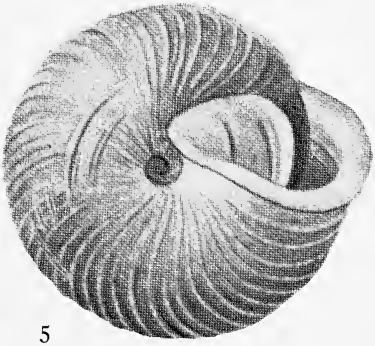

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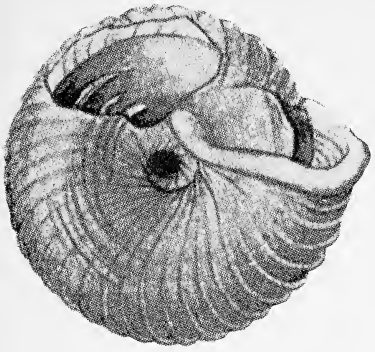
EXPLANATION OF PLATE 3

FIG. 1. *Strobilops labyrinthica parietalis* Pilsbry × 19.2 (after Pilsbry).
FIGS. 2, 3. *Strobilops affinis* Pilsbry × 11.8 (after Pilsbry).
FIG. 4. *Strobilops ænea* Pilsbry × 14 (after Pilsbry).
FIG. 5. *Succinea ovalis* Say × 4.7.
FIG. 6. *Succinea avara* Say × 8.25.



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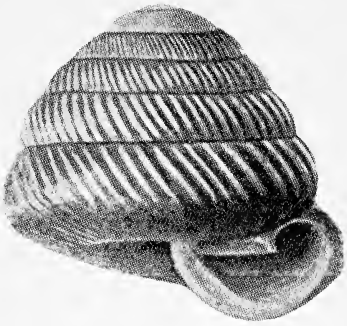

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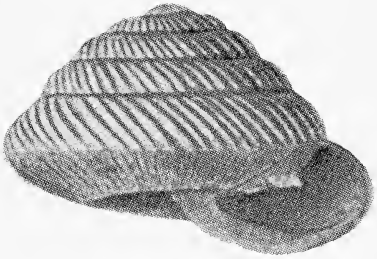

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EXPLANATION OF PLATE 4

FIG. 1. *Mesodon albolabris* (Say) × 1.8.
FIG. 2. *Mesodon albolabris dentatus* Tryon × 1.7.
FIG. 3. *Mesodon profundus* (Say) × 1.5.
FIG. 4. *Mesodon mitchellianus* (Lea) × 1.7.
FIG. 5. *Mesodon clausus* (Say) × 1.2.
FIG. 6. *Mesodon thyroidus* (Say) × 1.5.
FIG. 7. *Mesodon pennsylvanicus* (Green) × 1.5.
FIG. 8. *Mesodon appressus* (Say) × 1.7.
FIG. 9. *Mesodon zaletus* (A. Binney) × 1.1.
FIG. 10. *Mesodon sayanus* (Pilsbry) × 1.3.
FIG. 11. *Mesodon appressus perigraptus* (Pilsbry) × 1.2.
FIG. 12. *Triodopsis fraudulenta vulgata* Pilsbry × 1.9.
FIGS. 13, 14. *Triodopsis platysayoides* (Brooks) × 1.4.

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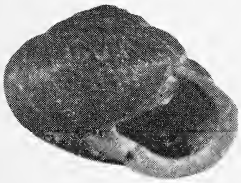

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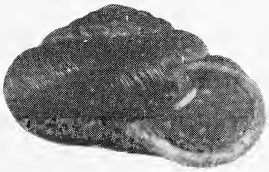

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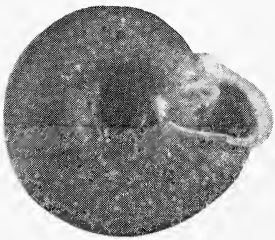

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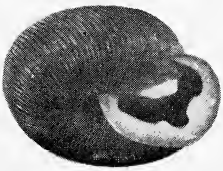

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EXPLANATION OF PLATE 5

FIG. 1. *Mesodon dentiferus* (A. Binney) × 1.8.
FIG. 2. *Triodopsis rugeli* (Shuttleworth) × 2.5.
FIG. 3. *Triodopsis denotata* (Ferussac) × 1.75.
FIG. 4. *Triodopsis tridentata* (Say) × 1.8.
FIG. 5. *Triodopsis tridentata juxtidens* (Pilsbry) × 1.9.
FIG. 6. *Triodopsis fraudulenta* (Pilsbry) × 1.8.
FIG. 7. *Stenotrema stenotrema* (Ferussac) × 3.8.
FIG. 8. *Triodopsis rugosa* Brooks & MacMillan × 4.9.
FIG. 9. Aperture of *Stenotrema*.
FIGS. 10, 11. *Stenotrema edvardsi* (Bland) × 1.4.
FIG. 12. *Stenotrema hirsutum* (Say) × 3.9.

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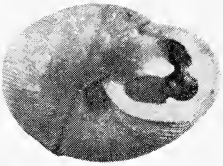

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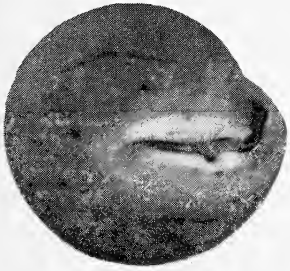

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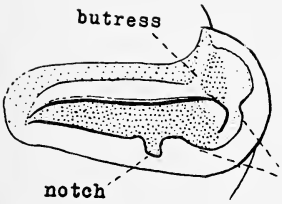

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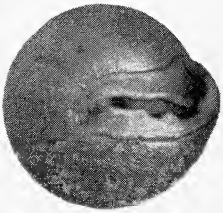

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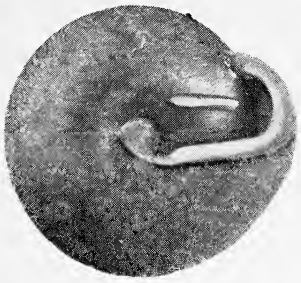
EXPLANATION OF PLATE 6

FIG. 1. *Stenotrema leai* (A. Binney) × 4.6.
FIG. 2. *Stenotrema fraternum* (Say) × 3.
FIG. 3. *Stenotrema fraternum cavum* (Pilsbry & Vanatta) × 3.7.
FIG. 4. *Punctum minutissimum* (Lea) × 13 (after F. C. Baker).
FIG. 5. *Punctum vitreum* H. B. Baker × 123 (after H. B. Baker).
FIG. 6. Sculptural details of last whorl of *Punctum vitreum* (after H. B. Baker).
FIG. 7. *Discus patulus* (Deshayes) × 9.3.
FIG. 8. *Discus patulus carinatus* MacMillan × 5.6.



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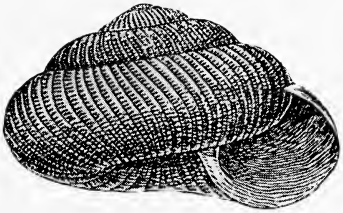

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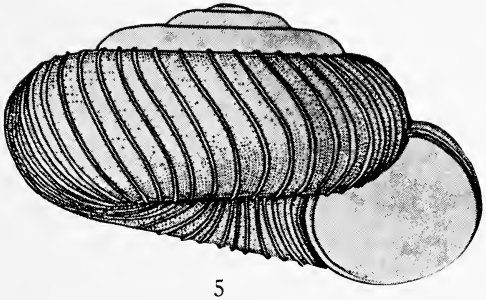

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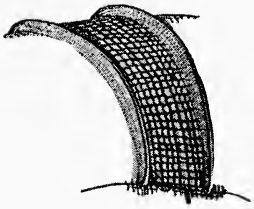

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EXPLANATION OF PLATE 7

FIG. 1. *Helicodiscus parallelus* (Say) × 9.3 (after F. C. Baker).
FIG. 2. *Discus cronkhitei* (Newcomb) × 5.5.
FIG. 3. *Anguispira alternata* (Say) × 1.9.
FIG. 4. *Anguispira alternata angulata* Pilsbry × 1.8.
FIGS. 5, 6. *Anguispira alternata mordax* (Shuttleworth) × 1.9.
FIG. 7. *Anguispira kochi* (Pfeiffer) × 1.9.
FIG. 8. *Euconulus chersinus polygyratus* (Pilsbry) × 8.25 (after F. C. Baker).
FIGS. 9, 10, 11. *Guppya sterkii* (Dall) × 10.

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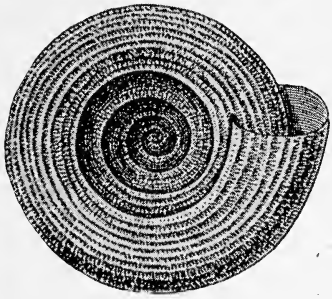

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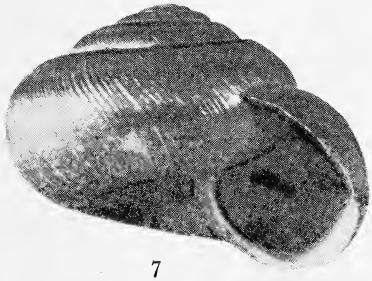

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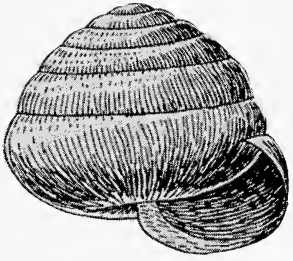

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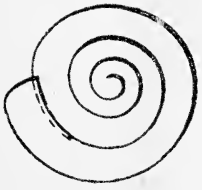

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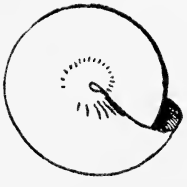

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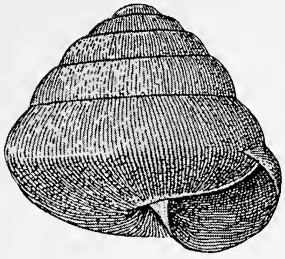
EXPLANATION OF PLATE 8

FIGS. 1, 2. *Euconulus fulvus* (Mueller) × 8.5 (after F. C. Baker).
FIG. 3. *Mesomphix inornatus* (Say) × 1.4.
FIGS. 4, 5. *Euconulus chersinus* (Say) × 9.4 (after F. C. Baker).
FIG. 6. *Omphalina cuprea* Rafinesque × 1.1.
FIG. 7. *Mesomphix rugeli oxycoccus* (Vanatta) × 1.2.
FIGS. 8, 9. *Euconulus chersinus dentatus* (Sterki) × 7.2.
FIG. 10. *Mesomphix perlævis vulgatus* H. B. Baker × 1.9.
FIG. 11. *Oxychilus draparnaldi* (Beck) × 4.
FIG. 12. *Oxychilus cellarius* (Mueller) × 4.7.
FIGS. 13, 14, 15. *Paravitrea multidentata* (A. Binney) × 7.6.
FIGS. 16, 17. *Paravitrea lamellidens* (Pilsbry) × 7.8.



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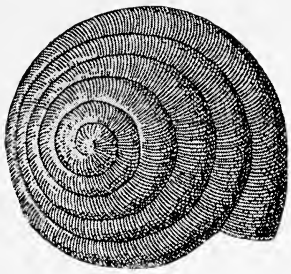

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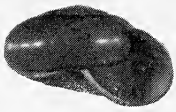

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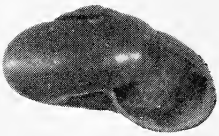

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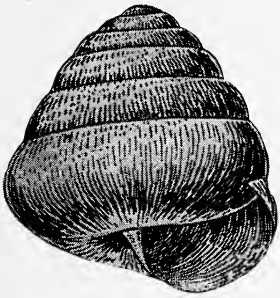

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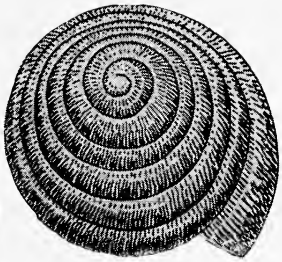

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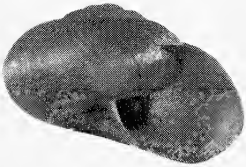

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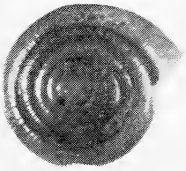

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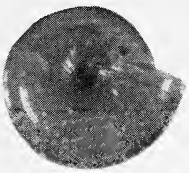
EXPLANATION OF PLATE 9

FIG. 1. *Paravitrea lamellidens* (Pilsbry) × 7.5.
FIGS. 2, 3. *Paravitrea capsella* (Gould) × 6.9.
FIGS. 4, 5. *Paravitrea placentula* (Shuttleworth) × 8.5.
FIGS. 6, 7. *Paravitrea placentula lacteodens* (Pilsbry) × 8.7.
FIG. 8. *Paravitrea petrophila* (Bland) × 6.8.
FIGS. 9, 10, 11. *Paravitrea reesei* J. P. E. Morrison × 8.1 (after Morrison).
FIG. 12. *Retinella electrina* (Gould) × 6.4.



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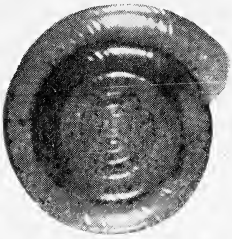

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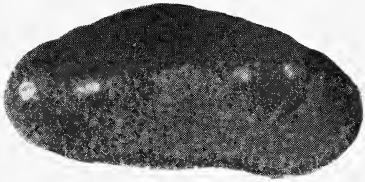

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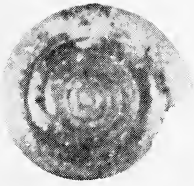

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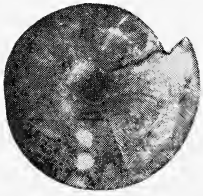

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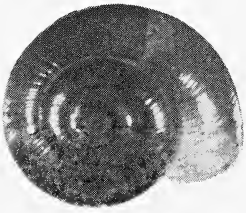

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EXPLANATION OF PLATE 10

FIG. 1. *Retinella electrina* (Gould) × 7.

FIGS. 2, 3. *Retinella binneyana* (Morse) × 7.9.

FIGS. 4, 5. *Retinella burringtoni* (Pilsbry) × 7.3.

FIGS. 6, 7. *Retinella circumstriata* (J. W. Taylor) × 7.9.

FIGS. 8, 9. *Retinella wheatleyi* (Bland) × 6.4.

FIGS. 10, 11, 12. *Retinella virginica* J. P. E. Morrison × 9.1 (after Morrison).

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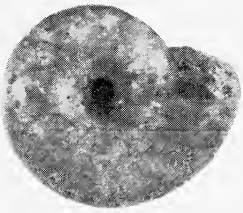

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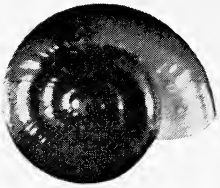

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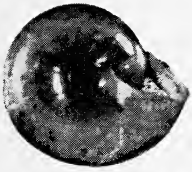

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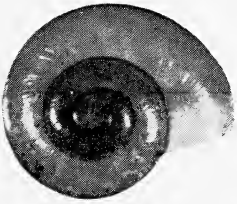

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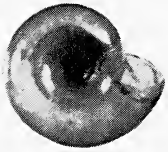

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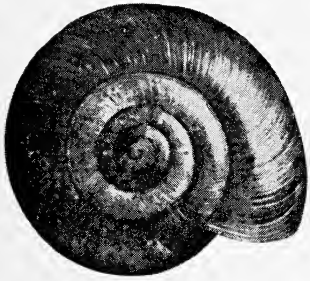

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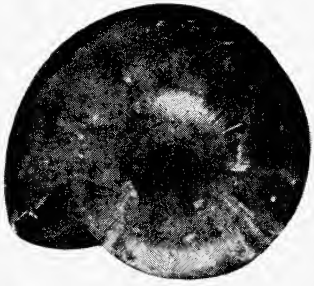

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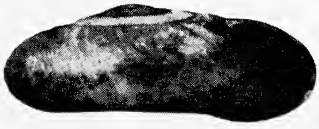
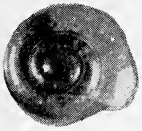


12

EXPLANATION OF PLATE 11

FIGS. 1, 2, 3. *Retinella lewisiana* (Clapp) × 7.
FIGS. 4, 5, 6. *Retinella raderi* (Dall) × 9.7.
FIGS. 7, 8. *Retinella rhoadsi* (Pilsbry) × 6.9.
FIGS. 9, 10. *Retinella rhoadsi austrina* H. B. Baker × 7.6.
FIGS. 11, 12. *Retinella indentata* (Say) × 6.5.
FIGS. 13, 14, 15. *Retinella carolinensis* (Cockerell) × 6.3.



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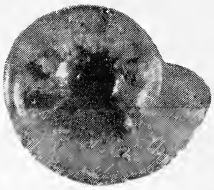

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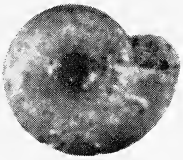

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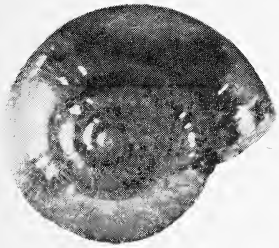

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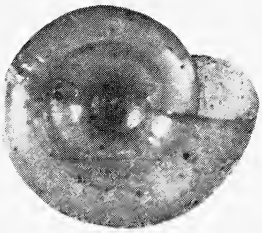

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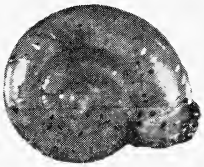

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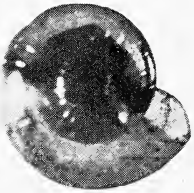

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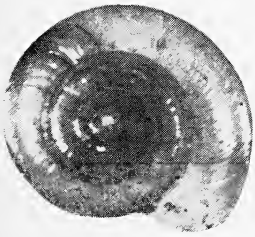

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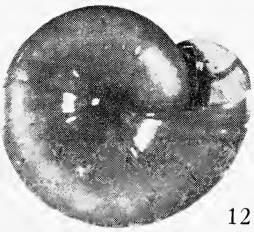

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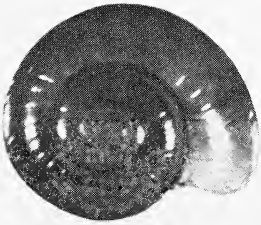

14

15

EXPLANATION OF PLATE 12

FIG. 1. *Retinella indentata paucilirata* (Morelet) × 7.4.
FIGS. 2, 3. *Retinella cryptomphala* (Clapp) × 6.
FIG. 4. *Retinella cryptomphala solida* H. B. Baker × 6.6.
FIGS. 5, 6. *Retinella sculptilis* (Bland).
FIGS. 7, 8. *Hawaiia minuscula alachuana* (Dall) × 9.5.
FIG. 9. *Hawaiia minuscula* (A. Binney) × 9.3 (after F. C. Baker).

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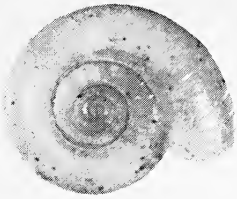

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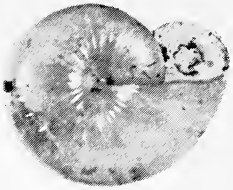

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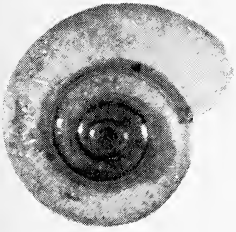

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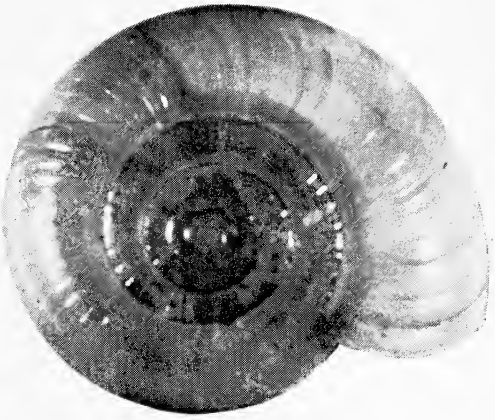

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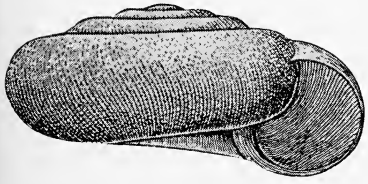

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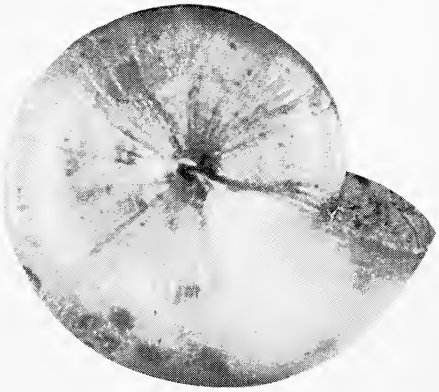
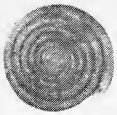


6

EXPLANATION OF PLATE 13

FIG. 1. *Retinella sculptiilis* (Bland) × 6.8.
FIGS. 2, 3, 4. *Gastrodonta interna* (Say) × 2.7.
FIG. 5. *Zonitoides elliotti* (Redfield) × 8.4.
FIGS. 6, 7. *Zonitoides arboreus* (Say) × 5.7.
FIGS. 8, 9. *Zonitoides nitidus* (Mueller) × 7.5.
FIG. 10. *Striatura exigua* (Stimpson) × 9.8 (after Morse).
FIGS. 11, 12, 13. *Striatura ferrea* Morse × 13 (after Morse).

1



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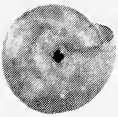

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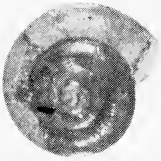

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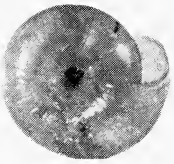

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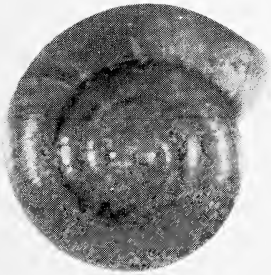

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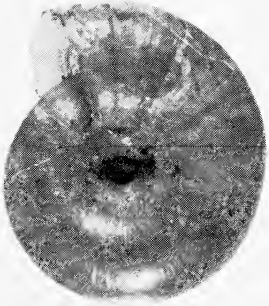

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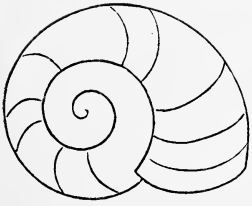

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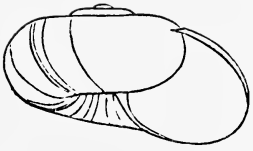

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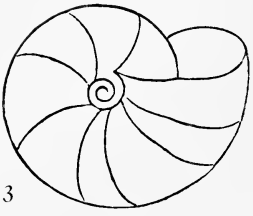
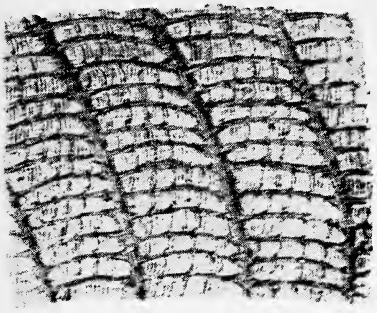


13

EXPLANATION OF PLATE 14

FIG. 1. Detailed view of sculpture of *Striatura exigua.*
FIG. 2. *Striatura milium* (Morse) × 12 (after F. C. Baker).
FIG. 3. *Ventridens suppressus* (Say) × 7.8.
FIG. 4. *Ventridens suppressus virginicus* (Vanatta) × 7.
FIG. 5. *Ventridens gularis* (Say) × 4.
FIG. 6. *Ventridens gularis theloides* (A. B. Brown) × 4.25.
FIG. 7. *Ventridens gularis decussatus* (Pilsbry & Vanatta) × 4.3.
FIG. 8. *Ventridens collisella* (Pilsbry) × 3.75.
FIG. 9. *Ventridens demissus* (A. Binney) × 2.9.
FIG. 10. *Ventridens ligera* (Say) × 1.5.
FIG. 11. *Ventridens intertextus* (A. Binney) × 1.8.
FIG. 12. *Ventridens ligera stonei* (Pilsbry) × 3.



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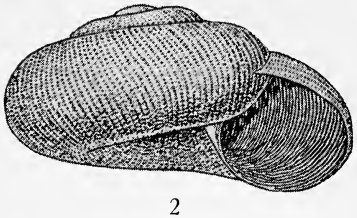

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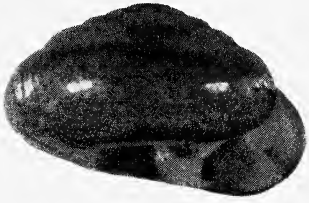

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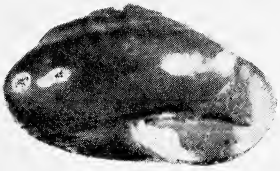

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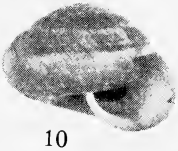

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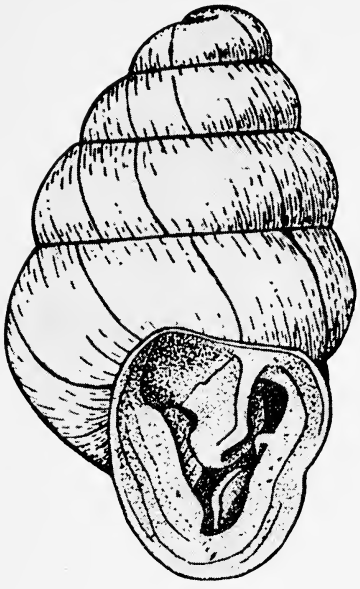
EXPLANATION OF PLATE 15

FIG. 1. *Gastrocopta contracta climeana* (Vanatta) × 32.7 (after Vanatta).
FIG. 2. *Vertigo ventricosa* (Morse) × 32.6 (after Pilsbry).
FIG. 3. *Vertigo pygmæa* (Draparnaud) × 27.75 (after Pilsbry).
FIGS. 4, 5. *Vertigo bollesiana* (Morse) × 27 (after Pilsbry).
FIG. 6. *Vertigo parvula* Sterki × 31 (after Pilsbry).



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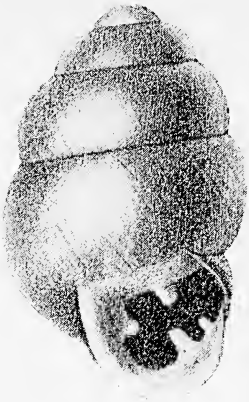

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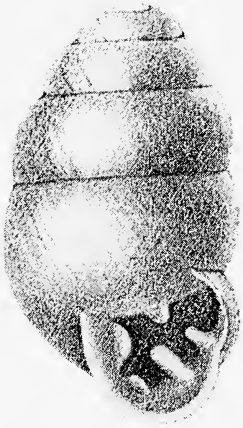

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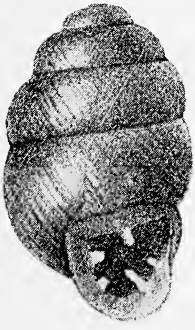

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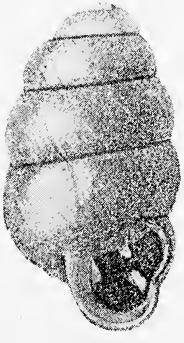

6

ART. 8. A REVIEW OF THE PILEATE THELEPHORACEÆ (FUNGI) OF WESTERN PENNSYLVANIA

By LeRoy K. Henry

(Plates 1-2)

The family Thelephoraceæ belongs to that class of basidiomycetes in which the spores are borne upon a smooth, or at most a rugose-wrinkled, hymenial (spore-bearing) surface. These fungi vary in habit from resupinate (expanded with the hymenial surface facing outward) through effuse-reflexed (expanded with the hymenial surface facing outward and turned back at the margin to form a cap) to pileate (having a cap bearing the hymenium on its underside).

Five genera are included here, of which *Hymenochæte* and *Stereum* resemble in habit some of the small leathery polypores of the genus *Polyporus;* some of the *Thelephora* have the appearance of *Clavaria*, but are darker in color; *Sparassis* looks like a greatly enlarged *Tremella*, but is not waxy; and *Craterellus* has the form of *Agaricus*, *i.e.*, with a definite cap and central stem.

Sparassis, *Hymenochæte*, and *Stereum* (with the exception of two species) grow upon decaying twigs, branches, logs, and roots, while *Thelephora* and *Craterellus* grow upon decaying organic matter in the soil.

This review is based upon the specimens from Western Pennsylvania now in the Herbarium of the Carnegie Museum. As the eastern boundary of Western Pennsylvania, I have arbitrarily chosen the eastern borders of Potter, Clinton, Centre, Huntingdon, and Fulton counties. The initials following the collection data of the rare or less frequent species, are to be interpreted as follows: L.K.H.—L. K. Henry; O.E.J.—O. E. Jennings; D.R.S.—D. R. Sumstine; M.B.K.—Marie B. Knauz; H.S.W.—H. S. Wieand.

Key to the Genera of the Pileate Thelephoraceæ

I. Fruiting-body resupinate to effused-reflexed to pileate.
  A. Hymenial layer brown to chocolate-brown and roughened by the setæ.....*Hymenochæte*
  B. Hymenial layer smooth, light brown, cream, white, smoky to orange.....*Stereum*

II. Fruiting-body usually erect to pileate.
  A. Fruiting-body leathery, resupinate, lacerate-lobed, dimidiate, or semi-pileate.....*Thelephora*

ued May 4, 1949.

B. Fruiting-body semi-fleshy, funnel-shaped, top-shaped, agaricoid, stipitate; hymenial layer wrinkled . . . . . *Craterellus*

C. Fruiting-body tough and elastic but fleshy, repeatedly branched into a thick mass of flat contorted-anastomosing branches, and growing from rotting roots or stump bases. . . . . *Sparassis*

KEY TO CRATERELLUS

I. Sporophore tubular with cavity extending nearly to the base of the stem; pileus and stem drab when fresh, darker when old; hymenium ashy drab, even or rugose-wrinkled . . . . . *C. cornucopioides*

II. Sporophore somewhat tubular; pileus yellowish brown to fuscus, 1.5 to 3 cm. broad; hymenium and stem yellow, even or rugose-wrinkled. . . . . *C. lutescens*

III. Sporophore not tubular or clavate; pileus convex then depressed to infundibuliform, egg-yellow, 2.8 to 8 cm. broad; stem solid, color of pileus; hymenium even or rugose-wrinkled . . . . . *C. cantharellus*

Craterellus cantharellus Schw. *ex* Fries (Plate 2, fig. 1)

Allegheny County: 1 mi. w. of Ben Avon Heights; Tarentum; Aspinwall; Sandy Creek; North Park; Imperial; ½ mi. s. of Smithdale; 2 mi. w. of Gibsonia; east branch of Big Sewickley Creek, 2 mi. n.e. of Duff City. *Armstrong County:* near Ford City; Kittanning. *Beaver County:* intersection of Beaver-Conway and Ambridge-Rochester roads; 2½ mi. s.w. of New Sheffield; Raccoon Creek Recreational Area. *Butler County:* 4 mi. n.e. of Harmony; Little Buffalo Creek at Monroe Station; 2 mi. s. of Leasuresville; near Slippery Rock; near Saxonburg; near Culmersville; Stone House on Rt. 8, at junction with Rt. 78. *Cambria County:* near Cresson. *Centre County:* near Woodward. *Clarion County;* Cook Forest; near Clarion; near Leeper. *Clearfield County:* State Game Lands 34, s. of Medix Run. *Crawford County:* French Creek near Cochranton. *Erie County:* Presque Isle. *Fayette County:* Ohiopyle; Killarney Park, s.e. of Normalville; Claircrest near Normalville; near Geneva. *Greene County:* Deep Valley. *Indiana County:* 2 mi. n.e. of Chambersville. *Lawrence County:* Elliot Mills, 5 mi. s.w. of Slippery Rock. *Somerset County:* near Trent; near Jennerstown; 3 mi. w. of Berlin; 2 mi. e. of Berlin. *Venango County:* 3 mi. n.e. of Emlenton; near Emlenton; 1 mi. n. of Lisbon. *Westmoreland County:* near Rector; Jones Mills; Rachelwood, 6 mi. s.e. of New Florence; near Laughlintown; Idlewild Park, Ligonier; Derry; Kiski Campus opposite Saltsburg; 2 mi. e. of Trafford; Lynn Run, 3 mi. s.e. of Rector; 1½ mi. e. of New Alexandria, off Rt. 22; 4 mi. e. of Waterford; Pike Run, n.e. of Hopewell; South Greensburg; Loyalhanna Creek dam, 2 mi. s. of Saltsburg.

Craterellus cornucopioides L. *ex* Pers. (Plate 2, fig. 2)

Allegheny County: 1 mi. n.e. of Mt. Nebo; Powers Run, opposite Verona; Warden Mine region, opposite Sutersville; North Park. *Armstrong County:* near Kittanning. *Beaver County:* Temple Hollow, 1 mi. n.w. of Aliquippa; intersection of Beaver-Conway and Ambridge-Rochester roads; 2½ mi. s.w. of New Sheffield. *Bedford County:* Sulphur Springs. *Blair County:* Yellow Spring, off Rt. 22 east of Altoona. *Butler County:* Dutilh Church near Criders Corners; Little Buffalo Creek at Monroe Station; 4 mi. n.e. of Harmony. *Centre County:* Pine Hall; Scotia, near Port Matilda; Woodward. *Clearfield County:* State Game Lands 34, s. of Medix Run. *Crawford County:* French Creek near Cochranton. *Erie County:* Weiss Library Woods, 8 mi. s.w. of Erie. *Fayette County:* Ohiopyle. *Forest County:* western part of Allegheny National Forest. *Somerset County:* near Trent. *Venango County:* 1 mi. n. of Lisbon; ½ mi. n. of Emlenton. *Westmoreland County:* 6 mi. s.e. of New Florence; Jones Mills; Derry; Idlewild Park near Ligonier; Forbes Forest, 3 mi. s.e. of Rector.

Craterellus lutescens Pers. *ex* Fries

Armstrong County: Kittanning, D.R.S. *Centre County:* Shafers Creek, M.B.K. *Forest County:* near Brookston, J. Kosinski. Rare.

KEY TO HYMENOCHAETE

I. Resupinate or reflexed.
  A. Fruiting-body effused, confluent, becoming reflexed, leathery, thin, light brown, concentrically ridged, silky fibrillose at first, becoming glabrous; hymenium not cracking, velvety, light brown..... *H. Curtisii*

II. Usually reflexed, sometimes resupinate.
  A. Fruiting-body thin, leathery, tobacco colored with orange-yellow margin; hymenium snuff-brown to sepia, deeply cracked where resupinate, with one system of radiating and branching cracks to each centimeter of area. *H. tabacina*
  B. Fruiting-body leathery, rigid, thick, concentrically sulcate, velvety, finally glabrous, brown, becoming dusky brown with an ochraceous-tawny margin; hymenium covered with little round elevations, light brownish black, with setae conspicuous under a lens..... *H. rubiginosa*

Hymenochæte Curtisii (Berk.) Morgan

Butler County: Saxonburg, D.R.S. *Somerset County:* 2 mi. w. of Berlin, M.B.K. Rare.

Hymenochæte rubiginosa Dicks. *ex* Lév.

Allegheny County: Coraopolis; 2 mi. e. of Upper Talley-Cavey; Frick Park; 1 mi. w. of Mt. Nebo; near Verona. *Armstrong County:* Kittanning.

Beaver County: along Rt. 18, 1 mi. n. of Mechanicsburg. *Bedford County:* Sulphur Springs. *Butler County:* near Saxonburg; Watson's Run, 2 mi. s. of Leasuresville. *Cambria County:* Ebensburg. *Centre County:* Woodward. *Clarion County:* Cook Forest. *Clearfield County:* State Game Lands 34, s. of Medix Run. *Indiana County:* near Homer City. *Somerset County:* Laurel Hill near Trent; near Somerset; Kooser State Park, near Bakersville. *Venango County:* 3 mi. n.e. of Emlenton; 1 mi. n.e. of Lisbon. *Westmoreland County:* near J. R. Mellon estate, 6 mi. s.e. of New Florence; near Latrobe; along Rt. 271, 4 mi. e. of Waterford; near Derry.

Hymenochæte tabacina Sowerby *ex* Lév.

Allegheny County: Warden Mine opposite Sutersville, H. Roslund. *Bedford County:* Sulphur Springs, D.R.S. *Cambria County:* Cresson, D.R.S. *Elk County:* s. of Kane, D.R.S. *Fayette County:* Ohoipyle, D.R.S. *McKean County:* Tionesta Tract near Brookston, L.K.H. *Venango County:* Little Scrubgrass Creek, s.e. of Suttons Mills, M.B.K. *Westmoreland County:* near Laughlintown, D.R.S. Infrequent.

Sparassis crispa (Wulf.) Fr. (Plate 2, fig. 3)

There is only one species of *Sparassis* in our region.

Clarion County: near Clarion, D.R.S. *Fayette County:* Killarney Park, near Mill Run, D.R.S.; foot of Laurel Hill east of Hopwood, Edna Higbee; New Geneva, D.R.S. Rare.

KEY TO STEREUM

I. Fruiting-body stipitate; growing on the ground.
   A. Pileus 1 to 2 cm. broad, brown or hazel on drying; stem 2 to 4 mm. thick. *S. diaphanum*
   B. Pileus less than 1 cm. broad, drying pallid; stem up to 1 mm. thick. *S. Burtianum*

II. Fruiting-body small, convex, or tuberculate, thick, cushion-shaped, not pileate, rarely up to 0.5 cm. broad.
   A. Fruiting-body red or reddish, waxy when fresh; growing on *Populus* only. *S. rufum*
   B. Fruiting-body white or yellowish, hard and rigid when fresh; growing on *Quercus* and *Castanea* only. . . . . *S. frustulosum*

III. Fruiting-body sessile, effused-reflexed to overlapping, or if resupinate more than 0.5 cm. broad.
   A. Sporophore hard and rigid when fresh.
      1. Fruiting-body brown, tomentose, concentrically sulcate and zoned with narrow zones that finally become black; hymenial surface even, bright cinnamon to buff; growing on dead logs of *Quercus*. This fungus reaches its northern limit of distribution in southern Pennsylvania. *S subpileatum*

B. Sporophore thin and flexible when fresh.
1. Fruiting-body usually overlapping, tobacco brown, more or less zonate, matted tomentose; hymenial surface white or dirty white...*S. fuscum*
2. Fruiting-body 2 to 6 cm. broad, less than 1 mm. thick, often laterally coalesced, gray, zonate, covered with a tomentum which wears away, exposing zones of hazel; hymenial surface gray to smoky or pale yellowish tan. Important in slash decay.....*S. fasciatum*

IV. Sporophore coriaceous when fresh.
A. Fruiting-body 1 to 2 cm. long and broad, gray, zonate in large specimens, hirsute or strigose; hymenial surface pallid, in age gray-smoky. *S. hirsutum*
B. Fruiting-body overlapping, 1 to 2 cm. broad and up to 1.5 mm. thick, pale yellowish or brown, hirsute, zonate or subzonate, usually crisped or folded; hymenial surface smooth, pale brown, becoming darker on drying, surface bleeding where wounded when fresh.....*S. gausapatum*
C. Fruiting-body 2 to 7 mm. broad, white or gray, soft-hirsute or hirsute-tomentose; hymenial surface yellow to buff, in age more gray-smoky. *S. ochraceoflavum*
D. Fruiting-body 0.5 to 1 cm. broad, gray-cinnamon-buff, strigose hairy at base, with radiating fibers, margin often crisped and folded, zonate, especially in age; hymenial surface cinnamon-buff to ochraceous-orange. Important in slash decay.....*S. rameale*
E. Fruiting-body gray, villose, zonate; hymenial surface pallid to gray or smoky; growing on conifers, usually *Tsuga*.....*S. sanguinolentum*
F. Fruiting-body 1 to 1.5 cm. broad, whitish or gray, silky with radiating fibrils; hymenial surface pallid to wood colored; chiefly on dead wood of *Carpinus*.....*S. sericeum*

V. Fruiting-body usually resupinate.
A. Fruiting-body occasionally with a narrow tomentose, brown, reflexed margin; hymenial surface dark brown with a nearly white margin when young, finally darkening. Not common in Pennsylvania....*S. versiforme*
B. Fruiting-body at times with a narrow reflexed margin, pubescent and brown in color; hymenial surface velvety, dark brown with a conspicuous white margin. Rare in Pennsylvania.....*S. albobadium*
C. Fruiting-body sometimes with a narrow reflexed, violaceous-gray to pale buff, tomentose margin; hymenial surface pale gray-lavender to lilac-lavender but fading.....*S. roseocarneum*
D. Fruiting-body corky when fresh, rarely reflexed; hymenial surface white to dirty white, typically much cracked.....*S. Murrayi*

Stereum albobadium (Schw.) Fries

Centre County: State Game Lands 23, 3 mi. s.e. of Philipsburg, L.K.H., 5032. *Westmoreland County:* near Laughlintown. D.R.S. Rare.

Stereum Burtianum Peck

Fayette County: Ohiopyle, D.R.S.; 3 mi. n.e. of Seaton's (Deer) Lake,

L.K.H. *Westmoreland County:* Lynn Run, 3 mi. s.e. of Rector, O.E.J.; J. R. Mellon estate, 6 mi. s.e. of New Florence, O.E.J. Rare.

Stereum diaphanum (Schw.) Cooke

Allegheny County: near Shades Ravine, 2 mi. e. of Trafford, O.E.J. *Westmoreland County:* J. R. Mellon estate, 6 mi. s.e. of New Florence, O.E.J. Rare.

Stereum fasciatum Schw. (Plate 1, fig. 1)

Allegheny County: near Aspinwall; Frick Park, Pittsburgh; ½ mi. s.e. of Wildwood; Falls Run, Glenshaw; 1 mi. n.e. of Ben Avon Heights; Warden Mine region, opposite Sutersville; near Large; w. of Bradford Woods; Narrows Run, Moon Twp.; ravine n.w. of Saunders; Carnegie; Emsworth; 1 mi. n.w. of Mt. Nebo; Laschell's Hollow; North Park; Bellevue Reservoir; Beaver Grade Road near Montour; Black's Run, n. of Oakmont; ½ mi. s. of Smithdale; near Imperial; 4 mi. e. of Monongahela; Fleming Park; Tom's Run, Dixmont; Flaugherty Run at crossing of Rt. 51, 1½ mi. n.w. of Carnot. *Armstrong County:* Kittanning. *Beaver County:* 1 mi. s. of Fombell; Legionville Hollow, Economy; Mudlick, near Beaver; 2½ mi. s.w. of New Sheffield; along Rt. 151, 3-4 mi. from junction with Rt. 18; along Rt. 30, 3 mi. w. of Clinton. *Bedford County:* Sulphur Springs; Felton's Mill along Raystown Branch of Juniata River, s.e. of Everett. *Butler County:* near Saxonburg; near Butler; 4 mi. n.e. of Harmony; Watson's Run, 2 mi. s. of Leasuresville; Nixon Station on Butler Short Line; 1 mi. s.e. of Whitestown; along Rt. 528, ¼ mi. s.e. of junction with Rt. 8; near Slippery Rock; n. edge of Zelienople; Marwood; Kroll's Mills, 1 mi. n.e. of West Liberty. *Cambria County:* near Cresson; Ebensburg. *Centre County:* Pine Hall; State College; Woodward; State Game Lands 33, 3 mi. s.e. of Philipsburg. *Clarion County:* Cook Forest. *Clearfield County:* State Game Lands 34, s.of Medix Run; 1 mi. s. of Westover. *Crawford County:* Conneaut Lake; Linesville; Pymatuning Swamp, Hartstown. *Erie County:* Erie; Presque Isle; Corry; Mercyhurst College, s. of Erie; near Wellsburg. *Fayette County:* New Geneva; Ohiopyle; Killarny Park, s. of Normalville. *Forest County:* 1 mi. n.w. of Brookston. *Fulton County:* Sideling Hill Park. *Lawrence County:* Muddy Creek Falls at mouth of Muddy Creek; Rock Point near Elwood City. *McKean County:* Tionesta Tract near Brookston; valley below Mt. Jewett. *Mercer County:* 2 mi. n.e. of Grove City. *Somerset County:* Kooser State Park, near Bakersville; near Jennerstown; 3 mi. w. of Berlin; St. Clair. *Venango County:* 1 mi. n.e. of Lisbon; 3 mi. n.e. of Emlenton. *Warren County:* Tionesta

Tract, near Brookston. *Washington County:* along Buffalo Creek near junction with Buck Run; vicinity of Hanlin Station; vicinity of Houston; along Raccoon Creek, 1½ mi. s. of Murdocksville; New Eagle; near Amity. *Westmoreland County:* Laurel Hill, 1 mi. e. of Kregar; along Conemaugh River across from Saltsburg; 1½ mi. e. of New Alexandria, off Rt. 22; 1 mi. e. of Mt. Pleasant; Derry; Latrobe; Seward; 4 mi. e. of Waterford, on Rt. 271; near Congruity; Loyalhanna Creek Dam, 2 mi. s. of Saltsburg; near Laughlintown; South Greensburg; Jones Mills; 6 mi. s. e. of New Florence; Idlewild Park, near Ligonier; Lyons Run, e. of Trafford; gorge of Jacobs Creek.

Stereum frustulosum (Pers.) Fries

Allegheny County: Tom's Run, Dixmont; Frick Park, Pittsburgh; Flaugherty Run at crossing of Rt. 51, 1½ mi. n.w. of Carnot; Carnegie; along Rt. 910, 3 mi. s.e. of Bakerstown; near Sandy Creek; 1 mi. n.e. of Ben Avon Heights. *Armstrong County:* Kittanning; Watson's Run across from Johnetta. *Beaver County:* woods at intersection of Beaver-Conway and Ambridge-Rochester roads; Legionville Hollow at Economy; along Rt. 51, 4 mi. w. of Beaver. *Butler County:* near Saxonburg; near Zelienople; 4 mi. n.e. of Harmony; Nixon Station on Butler Short Line. *Centre County:* Woodward. *Crawford County:* Conneaut Lake. *Erie County:* near Erie. *Fayette County:* Ohiopyle. *Indiana County:* along Crooked Creek, 2 mi. n.e. of Chambersville. *Lawrence County:* Westminster College near New Wilmington; Kennedy's Mills on Slippery Rock Creek, s. of Harlansburg. *Somerset County:* near Jennerstown. *Venango County:* 3 mi. n.e. of Emlenton; 1 mi. n.e. of Lisbon; along Allegheny River, 1 mi. n. of Perry Run. *Washington County:* along Raccoon Creek, 2 mi. s. of Murdocksville; near Burgettstown; 1 mi. s.e. of Houston. *Westmoreland County:* Laurel Hill, 6 mi. s.e. of New Florence; Forbes Forest, 3 mi. s.e. of Rector; along Conemaugh River across from Saltsburg; Shades Ravine, 2 mi. e. of Trafford.

Stereum fuscum (Schrad.) Quel.

Allegheny County: Schenley Park, Pittsburgh, D.R.S.; Frick Park, Pittsburgh, D.R.S. *Armstrong County:* Kittanning, D.R.S. *Westmoreland County:* Kingston, D.R.S.; Derry, D.R.S. Infrequent; not collected since 1910.

Stereum gausapatum Fries (Plate 1, fig. 2)

Allegheny County: Frick Park, Pittsburgh; Schenley Park, Pittsburgh; Guyasuta Hollow, near Aspinwall; Carnegie; 2 mi. n.e. of Mt. Nebo; 1 mi. n.e. of Ben Avon Heights; south branch of Little Sewickley Creek,

n.e. of Sewickley; near Bakerstown; North Park; along Rt. 910, s.w. of Bakerstown; Flaugherty Run at crossing of Rt. 51, 1½ mi. n.w. of Carnot; ½ mi. s.e. of Wildwood. *Armstrong County:* Kittanning. *Beaver County:* woods at intersection of Beaver-Conway and Ambridge-Rochester roads; along Rt. 30, 3 mi. w. of Clinton; mouth of Potato Garden Run; Raccoon Creek Recreational Park. *Bedford County:* Bedford Springs, along Rush Creek, 8 mi. s.e. of Everett. *Butler County:* near Saxonburg; Nixon Station on Butler Short Line; near Zelienople; near Butler; 4 mi. n.e. of Harmony; Kroll's Mills, 1 mi. n.e. of West Liberty. *Centre County:* Woodward; State College Campus; 8 mi. n.w. of State College. *Clarion County:* near Clarion; Cook Forest. *Clearfield County:* State Game Lands 34, s. of Medix Run. *Fayette County:* Ohiopyle; near Somerfield. *Forest County:* Cook Forest. *Mercer County:* near Transfer. *Somerset County:* 3 mi. w. of Berlin; Kooser State Park, near Bakersville. *Venango County:* 3 mi. n.e. of Emlenton. *Washington County:* 2 mi. n.e. of Burgettstown; vicinity of Hanlin Station. *Westmoreland County:* Shades Ravine, 2 mi. e. of Trafford; Jones Mills; Idlewild Park, near Ligonier; near Laughlintown; near Waterford.

Stereum hirsutum (Willd.) Fries

Allegheny County: Falls Run, Glenshaw, L.K.H., 3030; 2½ mi. e. of Ambridge, E. H. Graham; near Wildwood, C. K. Henlen. *Clarion County:* near Clarion, D.R.S. *Westmoreland County:* Laurel Hill along Rt. 271, 4 mi. e. of Waterford, L.K.H., 5213; near Laughlintown, D.R.S. Infrequent.

Stereum Murrayi (B. & C.) Burt

Clarion County: near Clarion, D.R.S. *McKean County:* near Kane, D.R.S. *Somerset County:* Kooser State Park, near Bakersville, D.R.S. Rare here, but supposedly common in the mountainous regions.

Stereum ochraceoflavum Schw.

Beaver County: woods at intersection of Beaver-Conway and Ambridge-Rochester roads, L.K.H., 5254. *Fayette County:* near Somerfield, D.R.S. Rare in our collections, but supposed to be common in Pennsylvania.

Stereum purpureum (Pers.) Fries

Cambria County: near Cresson, Aug. 24, 1907, D.R.S. Rare here, but supposed to be fairly common in Pennsylvania.

Stereum rameale Schw. (Plate 1, fig. 3)

Allegheny County: ½ mi. s.e. of Wildwood; 1 to 2 mi. n.w. of Mt. Nebo; 1 mi. n.e. of Leetsdale; near Carnot; Frick Park, Pittsburgh; Powers Run,

opposite Verona; out Audubon Road from Magee Road; Falls Run, Glenshaw; 1 mi. w. of Mt. Nebo; 1 mi. n.e. of Ben Avon Heights; along Beaver Grade Road, near Montour Run; south branch of Little Sewickley Creek, n.e. of Sewickley; near Bakerstown; Bellevue Reservoir; Flaugherty Run at crossing of Rt. 51, 1½ mi. n.w. of Carnot; Union Ave. between Bellevue and Westview; along Rt. 910, 3 mi. s.e. of Bakerstown; along Rt. 930, 1 mi. n.e. of Stoops Ferry; along Montour Road, 2 mi. w. of Gibsonia; 1½ mi. n.e. of Allison Park. *Armstrong County:* Kittanning. *Beaver County:* 1 mi. s. of Fombell; along Raccoon Creek, 2 mi. s.w. of New Sheffield; woods at intersection of Beaver-Conway and Ambridge-Rochester roads; along Rt. 30, 3 mi. w. of Clinton. *Bedford County:* 6 mi. n.e. of Everett; Sulphur Springs, along Brush Creek, 8 mi. s.e. of Everett. *Butler County:* near Culmerville; 1 mi. s.e. of Whitestown; near Butler; Watsons Run, 2 mi. s. of Leasuresville; 4 mi. n.e. of Harmony; Nixon Station on Butler Short Line; Marwood; near Saxonburg; Little Buffalo Creek at Monroe Station; Kroll's Mills, 1 mi. n.e. of West Liberty; along Rt. 528, ¼ mi. s.e. of junction with Rt. 8; Slippery Rock; near Zelienople; Stone House on Rt. 8, about 2 mi.n. of Muddy Creek crossing. *Cambria County:* near Cresson; 1½ mi. e. of Patton. *Cameron County:* along Rt. 872, 10 mi. n.e. of Sinnemahoning. *Centre County:* Woodward; State Game Lands 33, 3 mi. s.e. of Philipsburg. *Clarion County:* Cook Forest; 4 mi. n.e. of Parkers Landing. *Clearfield County:* State Game Lands 34, s. of Medix Run. *Crawford County:* Conneaut; Hartstown; near Linesville. *Erie County:* Mercyhurst College, s. of Erie; Presque Isle. *Fayette County:* New Geneva; Ohiopyle; Claircrest. *Forest County:* Cook Forest; 1 mi. n.w. of Brookston. *Indiana County:* along Crooked Creek, 2 mi. n.e. of Chambersville. *Lawrence County:* near New Wilmington; Muddy Creek Falls at mouth of Muddy Creek; Wayne, near Elwood. *McKean County:* near Kane; Tionesta Tract near Brookston. *Mercer County:* 2 mi. s.w. of Mercer. *Somerset County:* near Jennerstown; near Trent; Laurel Hill, 10 mi. e. of Indian Creek Reservoir; ½ mi. n.e. of Pleasant Union (3 mi. s.e. of Wittenburg). *Venango County:* along Allegheny River, 1 mi. n. of Perry Run; Little Scrubgrass Creek, n.e. of Suttons Mills; 3 mi. n.e. of Emlenton. *Warren County:* Tionesta Tract near Brookston. *Washington County:* along Buffalo Creek, near junction with Buck Run; vicinity of Houston; along Raccoon Creek, 1½ mi. s. of Murdocksville. *Westmoreland County:* along Conemaugh River across from Saltsburg; Kiski Campus near Saltsburg; Laurel Hill, 1 mi. e. of Kregar; Shades Ravine, 2 mi.e. of Trafford; along Loyalhanna Creek at dam, 2 mi. s. of Saltsburg; Rock Run, Forbes

Forest, 3 mi. s.e. of Rector; Congruity, 4 mi. e. of Delmont; Chestnut Ridge, Hillside; Jones Mills; South Greensburg; near Laughlintown; Loyalhanna Gorge, 2 mi. s.e. of Kingston; along Rt. 271, 4 mi. e. of Waterford; J. R. Mellon estate, 6 mi. s.e. of New Florence.

Stereum roseocarneum (Schw.) Fries

Butler County: near Butler, D.R.S. Rare here, but supposed to be rather common in Pennsylvania.

Stereum rufum Fries

Clearfield County: State Game Lands 34, s. of Medix Run, L.K.H., 3485. *Crawford County:* Pymatuning Swamp, Blair Swamp Road, F. H. Beer. *McKean County:* 4 mi. n.e. of Clermont, H. Roslund. Rare.

Stereum sanguinolentum Alb. & Schw.

Allegheny County: Falls Run, Glenshaw, L.K.H., 3031. *Lawrence County:* Muddy Creek Falls at mouth of Muddy Creek, L.K.H., 263. Rare here, but supposed to be rather common in Pennsylvania.

Stereum sericeum Schw. (Plate 1, fig. 4)

Allegheny County: ½ mi. s.e. of Wildwood; Powers Run, opposite Verona; Frick Park, Pittsburgh; 1 to 2 mi. n.w. of Mt. Nebo; along Beaver Grade Road near Montour Run; Flaugherty Run at crossing of Rt. 51, 1½ mi. n.w. of Carnot; along Rt. 910, 3 mi. s.e. of Bakerstown; vicinity of Warden Mine, opposite Sutersville. *Armstrong County:* Kittanning. *Beaver County:* Mudlick, near Beaver; along Rt. 18, 1 mi. n. of Mechanicsburg; woods at intersection of Beaver-Conway and Ambridge-Rochester roads; mouth of Potato Garden Run, near Murdocksville; along Rt. 51, 4 mi. w. of Beaver; Temple Hollow, 1 mi. n.w. of Aliquippa. *Bedford County:* Sulphur Springs. *Butler County:* Marwood; Nixon Station on Butler Short Line; 4 mi. n.e. of Harmony; along Rt. 528, ¼ mi. s.e. of junction with Rt. 8; Watsons Run, 2 mi. s. of Leasuresville; Little Buffalo Creek at Monroe Station; 1 mi. s.e. of Whitestown; Kroll's Mills, 1 mi. n.e. of West Liberty; near Saxonburg; Stone House on Rt. 8, 2 mi. n. of Muddy Creek crossing; 3 mi. n.e. of Harmony, along Little Connoquenessing Creek. *Cameron County:* along Rt. 872, 10 mi. n.e. of Sinnemahoning. *Elk County:* along Rt. 555, 2 mi. e. of Medix Run; Middle Fork of Clarion River, Jones Twp. *Erie County:* Corry. *Fayette County:* Killarney Park, s. of Normalville; Ohiopyle. *Forest County:* near Brookston. *Indiana County:* near Glen Campbell; along Crooked Creek, 2 mi. n.e. of Chambersville. *Lawrence County:* near New Wilmington. *Somerset County:* near

Trent. *Venango County:* 1 mi. n.e. of Lisbon. *Washington County:* vicinity of Hanlin Station. *Westmoreland County:* Forbes Forest, 3 mi. s.e. of Rector; Chestnut Ridge, Hillside; Derry; Shades Ravine, 2 mi. e. of Trafford; near Waterford; 6 mi. s.e. of New Florence.

Stereum subpileatum B. & C.

Westmoreland County: Lynn Run, Forbes Forest, 3 mi. s.e. of Rector, 1924, O.E.J. Rare. Reaches its northern limit of distribution in southern Pennsylvania.

Stereum versiforme B. & C.

Allegheny County: Keown, along Babcock Blvd., Sept. 8, 1940, D.R.S. Rare.

KEY TO THELEPHORA

I. Sporophore soft-leathery, usually with central stem; pileus composed of narrow branching, flattened or cylindrical divisions.
   A. Fruiting-body 2 to 6 cm. high, branched, glabrous, with fetid odor. *T. palmata*
   B. Fruiting-body 3 to 5 cm. high, branched, minutely pubescent, no fetid odor; stem villose ..... *T. anthocephala*

II. Sporophore leathery, usually with a central stem; pileus more or less funnel-shaped, cup-shaped, or fan-shaped, often splitting radially into divisions; hymenium brown to smoky-brown.
   A. Fruiting-body 1.5 to 3 cm. high, smoky drab to ashy; pileus funnel-shaped, deeply cleft into narrow divisions; stem villose ..... *T. multipartita*
   B. Fruiting-body 6 mm. to 2.5 cm. high, pallid to tawny-olive; pileus funnel-shaped, or divided into triangular divisions, or fan-shaped... *T. regularis*
   C. Fruiting-body 1.5 to 5 cm. high, smoky-purple; pileus funnel-shaped, often double by growth of smaller pilei from disk of the principal pileus or by wedge-shaped lobes rising from its upper surface; stem central, villose ..... *T. caryophyllea*
   D. Fruiting-body 2.5 to 6 cm. high, dirty-whitish with a brown center; pileus cup-shaped, composed of many small pilei which rise from a common base, or with interior of cup filled with small pilei and lobes; upper surface roughened with masses of fibers; stem central, when present. *T. vialis*

III. Sporophore effuse-reflexed, semicircular or horizontally expanded.
   A. Hymenium pale cinnamon-buff.
      1. Fruiting-body 2 to 4 cm. in diameter, leathery, spongy when dry, usually semicircular and somewhat imbricated, sometimes effused-reflexed, fibrous-tomentose with thick margin, sessile or nearly so, cinnamon-buff ..... *T. albido-brunnea*

B. Hymenium rusty-brown to smoky.
1. Fruiting-body in clusters, 5 to 8 cm. in diameter, soft, whitish, then red-rusty, drying chestnut-brown; pilei imbricated, fibrous with matted fibers and adnate squammules, margin whitish, fimbriate at first, becoming entire and concolorous with pileus; stems lateral and growing together ..... *T. intybacea*
2. Fruiting-body in clusters, 5 to 8 cm. in diameter, leathery-soft, dark smoky to fawn colored, semi-circular or encrusting and effused-reflexed; pilei more or less imbricated, fibrous-squamulose and usually strigose, margin fibrous-fimbriate; sessile or with a short stem-like base ..... *T. terrestris*

Thelephora albido-brunnea Schw.

Butler County: 4 mi. n.e. of Harmony, L.K.H. 556. *Westmoreland County:* J. R. Mellon estate, 6 mi. s.e. of New Florence, D.R.S. Rare.

Thelephora anthocephala Bull. *ex* Fries

Allegheny County: Frick Park, Pittsburgh; Guyasuta Hollow, near Aspinwall. *Armstrong County:* Kittanning. *Bedford County:* Sulphur Springs. *Fayette County:* Ohiopyle. *Indiana County:* Juneau. *Westmoreland County:* Jones Mills.

Thelephora caryophyllea Schaeff. *ex* Fries (Plate 2, fig. 4)

Allegheny County: Frick Park, Pittsburgh; ravine at Glenshaw; North Park. *Armstrong County:* Kittanning. *Butler County:* 4 mi. n.e. of Harmony. *Elk County:* near Kane. *Fayette County:* Ohiopyle. *Mercer County:* near West Middlesex. *Westmoreland County:* Rock Run, 3 mi. s.e. of Rector; 1½ mi. e. of New Alexandria, off Rt. 22.

Thelephora intybacea Pers. *ex* Fries

Armstrong County: Kittanning, D.R.S. *Beaver County:* Temple Hollow, 1 mi. n.w. of Aliquippa, S. Ristich. *Clarion County:* near Leeper, D.R.S. *Erie County:* Presque Isle, O.E.J.

Thelephora multipartita Schw.

Butler County: Harmony, July 21, 1904, R. J. Plaum. *Centre County:* Milheim, July 5, 1935, D.R.S. Rare.

Thelephora palmata Scop. (Plate 2, fig. 5)

Allegheny County: near Wildwood; Frick Park, Pittsburgh; 1 mi. n.e. of Ben Avon Heights; Sandy Creek; Powers Run, opposite Verona; Douthett, near Warrendale; Coraopolis. *Armstrong County:* Kittanning. *Beaver County:* Temple Hollow, 1 mi. n.w. of Aliquippa; intersection of

Beaver-Conway and Ambridge-Rochester roads. *Butler County:* 4 mi. n.e. of Harmony; Little Buffalo Creek at Monroe Station. *Cambria County:* Ebensburg. *Centre County:* Woodward; Alan Seegar region. *Elk County:* along Rt. 555, 2 mi. e. of Medix Run. *Erie County:* 1½ mi. e. of Wattsburg; Weiss Library Woods, 8 mi. s.w. of Erie. *Fayette County:* Ohiopyle; 3 mi. n.e. of Seaton's (Deer) Lake. *Somerset County:* ½ mi. n.e. of Pleasant Union (3 mi. s.e. of Wittenburg). *Venango County:* 3 mi. n.e. of Emlenton. *Warren County:* Benson's Swamp, 5 mi. e. of Columbus. *Westmoreland County:* Ligonier; Nawakwa Lodge, Forbes Forest, 3 mi. s.e. of Rector; Jones Mills; South Greensburg; Latrobe; Laurel Hill, along Rt. 271, 4 mi. e. of Waterford.

Thelephora regularis Schw.

Allegheny County: 1 mi. n. of Ben Avon Heights, L.K.H., 1213; McKinley Park, West End, Pittsburgh, G. E. Wheeler; vicinity of Warden Mine, opposite Sutersville, L.K.H., 3329. *Armstrong County:* Kittanning, D.R.S. *Butler County:* near Slippery Rock, D.R.S.; 4 mi. n.e. of Harmony, L.K.H., 4165. *Venango County:* 1 mi. n.e. of Lisbon, L.K.H., 1079.

Thelephora terrestris Ehrh. *ex* Fries

Allegheny County: Camp Meeting Extension Road, n.w. Sewickley Twp., E. M. McClelland. *Erie County:* Presque Isle, O.E.J. Rare.

Thelephora vialis Schw.

Bedford County: Pa. Turnpike, 3 mi. e. of Kegg, O.E.J. *Fayette County:* Gibbon's Glade, L.K.H.; 2 mi. n.e. of Seaton's (Deer) Lake, L.K.H. *McKean County:* near Kane, D.R.S. *Westmoreland County:* Derry, D.R.S.; Laurel Hill, east of Rector, O.E.J.; Idlewild Park, near Ligonier, D.R.S.; J. R. Mellon estate, 6 mi. s.e. of New Florence, O.E.J.

SUMMARY

A generic key and descriptive keys to thirty-two species of the pileate Thelephoraceæ have been provided, and distributional records in Western Pennsylvania are given for each species.

The records of distribution show that many counties in the northwestern, eastern, and southwestern sections of Western Pennsylvania are either not represented at all or are represented by collections made at only one or two localities.

In order to obtain a more complete record of the distribution of the family, additional collecting in these areas will be necessary.

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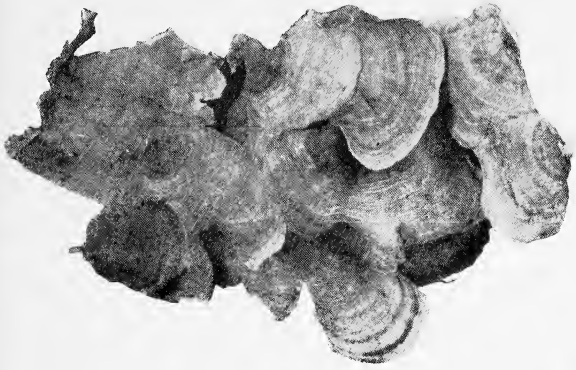
EXPLANATION OF PLATE 1

FIG. 1. *Stereum fasciatum* Schw. × 7/8.
FIG. 2. *Stereum gausapatum* Fries. × 4/5.
FIG. 3. *Stereum rameale* Schw × 4/5.
FIG. 4. *Stereum sericeum* Schw. × 5/7.



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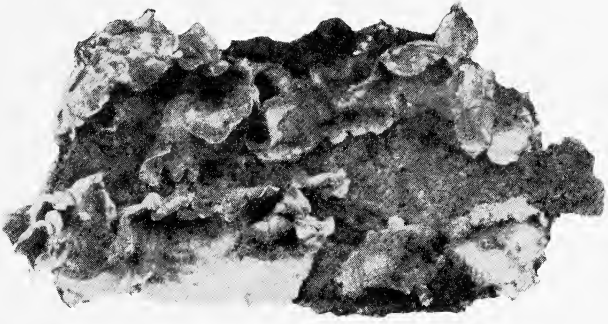

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EXPLANATION OF PLATE 2

FIG. 1. *Craterellus Cantharellus* Schw. ex Fries. × 2/3.
FIG. 2. *Craterellus cornucopioides* L. ex Pers. × 5/6.
FIG. 3. *Sparassis crispa* (Wulf.) Fr. × 2/3.
FIG. 4. *Thelephora caryophyllea* Schaeff. ex Fries. × 2/3.
FIG. 5. *Thelephora palmata* Scop. × 5/6.

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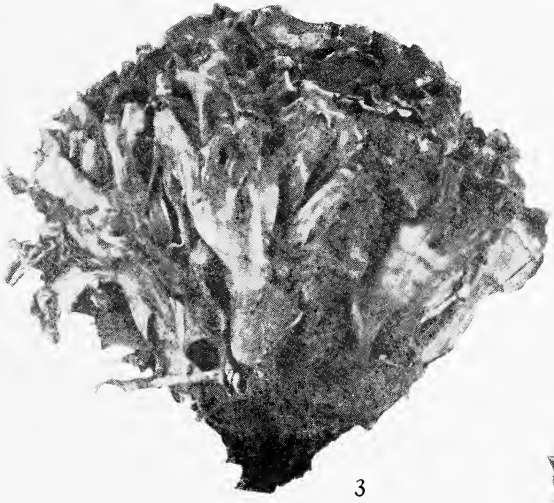

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ART. 9. LARVAL DEVELOPMENT OF *NECTOPHRYNOIDES TORNIERI* (ROUX), WITH COMMENTS ON DIRECT DEVELOPMENT IN FROGS

By Grace L. Orton

(Plates 1-3)

The African bufonid genus, *Nectophrynoides*, to which three species are now referred, comprises the only known ovoviviparous frogs. The two East African (Tanganyika Territory) species have long been known; *vivipara* was described by Tornier (1905), who referred it to the genus *Pseudophryne*, and *tornieri* was described and referred to *Nectophryne* by Roux (1906). Noble (1926) proposed a new genus, *Nectophrynoides*, for these two species, associating them principally because of their unusual mode of development. The third form, *occidentalis*, was described by Angel (1943), from Mt. Nimba in French Guinea, near the Liberian border.

The remarkable type of development of these frogs was discovered early, but until recently little detailed information on embryonic stages was available. Brief notes on embryos of *N. vivipara* were published by Tornier (1905) and of *N. tornieri* by Krefft (1911) and Noble (1927). Counts of uterine embryos were listed by Barbour and Loveridge (1928). The study of *occidentalis* by Angel and Lamotte (1944) is, however, the only detailed account of the development of these frogs that has come to my attention.

In the present paper, several stages in the early development of *tornieri* are described and compared with *occidentalis*, and some comments on direct development in relation to larval characters are presented.

Acknowledgments.—Through the courtesy of Mr. Arthur Loveridge and Mr. Benjamin Shreve of the Museum of Comparative Zoölogy I have had the opportunity to examine several series of embryos of *Nectophrynoides tornieri* in the MCZ collection. Preliminary study of this material was made in connection with my doctoral studies under the direction of Dr. Norman Hartweg, during tenure of a University Fellowship at the University of Michigan. Larvae in the University of Michigan Museum of Zoology (UMMZ) collection cited in this paper were also studied at that time. The *Nectophrynoides* material was re-examined in 1948. I am also indebted to Mr. Karl P. Schmidt for the recent opportunity to study

sued June 28, 1949.

larvae of *Rhinoderma darwinii* in the collection of Chicago Natural History Museum (CNHM).

I. Larval Development of Nectophrynoides tornieri

The material studied is divisible into five rather well-differentiated "stages" of development. Some are anatomically younger than the developmental stages of *N. occidentalis* described by Angel and Lamotte (1944), and provide more definite information on certain larval characters. My studies are not as detailed as those of Angel and Lamotte for I made no serial sections, determining internal characters only by simple microdissection.

The actual ages of the embryos are not known. In the numerical stage designations of the series, the term "stage" is used only to facilitate reference to particular specimens, and is not intended to have an exact morphological significance.

First Stage.—(Pl. 1, fig. 1) In this, the earliest stage available, the embryo is already well-formed; head structures are becoming differentiated, distinct limb bud anlagen are present, and there is a long thin tail. There is a large and rather ovoid (probably round in life) yolk mass. Unpigmented eye and ear capsules are visible, and the nasal pits are present. Jaw structures are still in a very rudimentary condition, and the mouth is not yet open. There is no external indication of adhesive organs. Two pairs of short but very distinct external gills are present. The front leg buds are still external. The long, thin, tail appears to be composed chiefly of notochordal tissue and very low, ridge-like, dorsal and ventral fins. Some of the specimens have a few faint melanophores on the body, but they are otherwise unpigmented. Total length ± 5.5 mm.

Second Stage.—(Pl. 1, fig. 2) The larvae of the second group are considerably advanced over the first series, particularly in the development of the head structures. The eyeballs are well differentiated and quite heavily pigmented. The mouth is a small, simple, transverse, slightly crescentic, opening. The opercular folds are of varying extent in different specimens and well illustrate the process of enclosure of the forelimb buds and formation of the spiracle. The morphological relations appear to be entirely as in a normal aquatic tadpole. In the least well-developed specimens the operculum already encloses the gill arch region and the base of the foreleg bud on each side, and forms a transverse fold entirely across the throat. In more advanced specimens fusion of the edge of the opercular fold with the body wall ventro-caudad to the foreleg buds is underway, forming an

opercular cavity and progressively reducing the size of its external opening (Pl. 2, figs. 1-4). The final step in this sequence of events is the refinement of the opercular opening remaining on the left side to form the spiracle. This is completed in specimens in the third stage (Pl. 2, fig. 5). In the gill region of specimens of the second stage, three small gill arches and two open gill slits can be seen. The first two arches each bear a single tiny gill rudiment. The leg buds are much better developed than in the first stage, and the tail is longer. There is a fine network of melanophores over the head and back. Total length ± 6 mm.

Third Stage.—(Pl. 1, fig. 3; MCZ 12513) The specimens in the third stage show further advances. Developmentally, they appear to agree most closely with Angel and Lamotte's Stage 1+ ("1 *bis*") of *N. occidentalis*. The eyes are very large and the facial region is small, embryonic in proportions. The small mouth shows definite though rather simple indications of larval structure. There are no beaks, labial teeth, or papillae, but there is a short fleshy ridge representing the larval lower lip. The sides of the upper jaw overhang the lateral part of the lower jaw (Pl. 3, fig. 1). The jaw region of one specimen was dissected, and it was found that the general pattern of the cartilages and muscles is essentially larval, although the proportions are, of course, much modified. The quadrate is shorter than in aquatic tadpoles, but a distinct processus muscularis is present. A small flat orbitohyoideus muscle connects it with the ceratohyal, which is of larval form and position. The other jaw muscles are more clearly shown in the fourth stage, and will be discussed in detail under that heading. Two pairs of open gill slits were found in the specimen dissected. There is a small but distinct spiracle on the left side. The dorsal surfaces of the head, body, and base of the tail, are finely speckled with melanophores. The leg buds are somewhat elongated, the posterior pair showing an indication of foot and leg segments. The tail is long and thin, with low rudiments of dorsal and ventral fins. Total length ± 6 mm.

Fourth Stage.—(Pl. 1, fig. 4; MCZ 12515) These larvae are approximately equivalent to Angel and Lamotte's Stage 2 of *N. occidentalis*. The general proportions are much the same as in the third stage, the principal changes visible externally being the larger and better developed legs and greater transparency of the skin. A very small sinistral spiracle is present; the nostrils are quite large; the mouth is still small. The legs and digits are well developed. The long rat-like tail has about 17 somites; the first 10-12 of them are well developed, the rest are rather irregular. The low, thin caudal fins are transparent and appear to contain an extensive vascular

network. The jaw region of one specimen was dissected (Pl. 3, figs. 2-4). The arrangement of the jaw cartilages and muscles was found to be essentially larval, as in the third stage, but the details were more easily worked out in the present specimen because of its somewhat larger size. The various structures are small and modified in proportions, in correlation with the embryonic contours of the entire head. The posterior part of the quadrate is quite short, the processus muscularis being not far anterior to the otic capsule. The processus muscularis is quite well differentiated although, as would be expected, its size relative to other cranial structures is much smaller than in aquatic tadpoles. The orbitohyoideus muscle is thin and transparent, and the underlying origins of the suspensorioangularis and ceratohyoangularis can be seen through it. The pterygoideus and the adductor mandibulae posterior longus have separate, laterally-adjacent origins, and the latter muscle appears to be differentiated into two slips distally, as in most aquatic tadpoles. Small adductor m. subexternus and articularis muscles are present, and have normal origins. All of the adductor muscles seem to insert on the lower jaw. In most aquatic tadpoles certain of these muscles insert on the upper labial cartilage, their insertions shifting to Meckel's cartilage during metamorphosis. A narrow strap-like subhyoideus muscle and a thin crescent-shaped intermandibularis are present in the normal larval positions. The lower jaw is differentiated into the typical Meckelian and lower labial segments, but histological studies will be needed to determine whether these cartilages are separate or fused, and whether there is a distinct upper labial cartilage. The specimen dissected appeared to have three open gill slits on each side. On the left side, the first gill arch was larger than the others and bore two rows of minute gill rudiments; on the right side the first two gill arches were of approximately equal size and bore no distinct traces of gills. A typical larva in this series has a total length of 10 mm., head and body length 4 mm.

Fifth Stage.—(Pl. 1, fig. 5; MCZ 12512) In this series, metamorphosis is well underway and the specimens are approximately in Angel and Lamotte's Stage 3 of *occidentalis*. The forelegs have emerged; anterior to each a small slit remains, connecting the gill arch region with the outside. The head proportions are still embryonic, with relatively huge eyes, but the mouth has begun to enlarge. The rudimentary lower lip has disappeared. The long, thin, rat-like tail is still present. The hind legs show traces of dark banding, but the body is still rather weakly pigmented. The total length at this stage is ± 11 mm., snout-vent length ± 4.5 mm.

Discussion

It is instructive to re-assemble the notes on external characters in the form of a routine diagnosis so the larval stage of *N. tornieri* can be more easily compared with conventional tadpoles: Head and body narrow; head small; facial region of embryonic proportions, with very small jaws; eyes very large. Spiracle very small and inconspicuous, sinistral. Tail long, thin, rat-like in proportions, consists principally of a well-developed notochord partly concealed by about 17 small somites basally and with very low ridge-like dorsal and ventral fins. Mouthparts greatly simplified; mouth very small, jaws devoid of horny beaks, with or without a short flap-like rudiment of lower lip; no tooth ridges, labial teeth, or papillae. Dorsum weakly pigmented with fine network of melanophores. Tail colorless or with a few scattered melanophores basally. Maximum total length before metamorphosis ± 11 mm.

Although *tornieri* is ovoviviparous and undergoes direct development, it is evident that few of the important characters of the tadpole stage have actually been lost. There is no external indication of adhesive organs, labial teeth, or horny beaks in the material studied. Anatomically, these structures are relatively superficial, and they are commonly lost in species that undergo direct development or other modifications of the life history. On the other hand, *tornieri* has a distinct trace of a larval lower lip (at least in some specimens), the internal structure of the jaw region is essentially larval in pattern, a spiracle is present and its development is essentially typical. Tiny but distinct gill arches, gill slits, and external gills develop. Although the general proportions of the head, body, and tail have become greatly modified, it is clear that this species still retains the more fundamental characters of the tadpole stage in recognizable condition and still undergoes an extensive metamorphosis. Anatomically, there is a well-defined tadpole stage even though it is no longer free-living.

Angel and Lamotte emphasized the absence of a spiracle in *N. occidentalis*. From the figures and description of their Stages 1 and 2, however, it is obvious that opercular folds develop in that species, for the foreleg buds are internal. During the growth of the operculum in the period preceding their Stage 1, a spiracle would therefore have been present, although it may subsequently have closed completely. Developmentally, the spiracle of the tadpole is merely the excurrent opening remaining after most of the free margin of the opercular fold has fused with the body wall below and behind the gill region. The size of the spiracle depends on how complete this fusion is; the more complete the fusion, the smaller the

spiracle. It is possible that vestiges of gill arches and associated structures will also be found in younger embryos of *occidentalis* when such specimens become available. The internal structure of the jaw region of embryonic *occidentalis* is not yet known. It will be of considerable interest to learn how much (if any) of the larval arrangement of cartilages and jaw muscles is still retained in that species. Angel and Lamotte reported no indication of any external buccal structures.

Angel and Lamotte noted that in the stages of *occidentalis* available to them the ovarian eggs are very minute (diameter 0.2 mm.), and there is no trace of a large yolk mass in the embryo. Although there is a wide developmental gap between the ovarian egg with a diameter of 0.2 mm. and an advanced embryo with a total length of 4.5 mm., the next stage available to them, they concluded that the egg remains poorly equipped with yolk and that virtually all nourishment must therefore be provided through maternal tissues. Description of the intervening stages (the mature ovum and pregastrular phases of embryonic differentiation) in this species will be awaited with great interest.

II. Comments on Direct Development in Frogs

In recent years there has been an increasing interest in problems relating to direct development in frogs. Lutz (1947, 1948) has reviewed the general field, with particular reference to the complex frog fauna of southeastern Brazil. She emphasized, among other points, the extensive parallelism shown in various unrelated groups of frogs that have independently achieved specialized developmental patterns, and the tendency for nonfunctional larval structures to be reduced or entirely lost in non-aquatic types of larvae that have an increased yolk supply. These trends result in a more or less direct transition from generalized embryo to frog without the intervention of a specialized free-swimming larval stage.

The fate of larval structures in non-aquatic development differs widely among different species, and various degrees of retrogression of these structures can be demonstrated. In a typical aquatic life history, critical early phases in the formation of tadpole structures are completed so rapidly and at such a small larval size that they are difficult to study. In the comparatively larger embryos of non-aquatic forms, these early phases (especially in the jaw and branchial regions) are prolonged and the relative growth rates are altered, with the result that the structural relations are somewhat clarified. Some of the problems in tadpole anatomy on which this situation affords evidence are discussed below.

1. The Tadpole Operculum and Spiracle

The anatomical relations of the operculum and spiracle to the underlying structures in the tadpole are complex, but can be better understood by comparing the developmental sequence in typical aquatic tadpoles with that in various specialized non-aquatic frog embryos. The so-called operculum of the typical tadpole has a dual origin. It is derived principally from the transverse dermal fold growing backward from the hyoid region, but a low ridge-like fold across the anterior part of the belly is incorporated into the completed structure. The latter fold develops posterior to the level of the foreleg region and extends vertically to a point above it, so that the fusion of the two components of the operculum encloses not only the gill chamber, but with it the area in which the foreleg will develop. Ordinarily, the process is carried to completion, leaving only a small excurrent opening, the spiracle. In frogs with an abbreviated larval history, the development of the operculum and spiracle may remain fairly typical or it may be arrested at some point short of completion. The process is completed in *Nectophrynoides tornieri* (Pl. 2, figs. 1-5), *Rhinoderma darwinii*, *Pipa aspersa*, and *Pipa pipa;* in the latter two forms, symmetrically paired spiracles develop, as in aquatic larvae of other Pipidae and of *Rhinophrynus*.

In certain forms in which the operculum remains incomplete, the homology of the dermal vestiges in the branchial region has been questioned. Lynn (1942) suggested that the small dermal fold over the base of the foreleg bud in *Eleutherodactylus* embryos is not homologous with the operculum of the typical aquatic tadpole. In various forms of *Gastrotheca* and related genera of "marsupial" hylids, a graded series of departures from the complete pattern of opercular formation can be demonstrated, and these help to interpret conditions in *Eleutherodactylus*. As is now well known from the work of Noble (1927) and others, some marsupial hylids have an aquatic larval stage and others have direct development, but in all known forms the young are carried on the back of the female during at least the early phases of development. All, so far as known, have the same highly diagnostic peltate (*cf.*, nasturtium leaf) type of external gills, which form a thin vascular sheet enveloping the embryo. Because of the comparatively large size attained by these embryos and the relatively slow (apparently) completion of branchial development, they are excellent material for the study of operculum formation. Several series of embryos of *Gastrotheca* sp. examined (*e.g.*, UMMZ 68165) were found to have larval body and tail proportions and buccal apparatus and to have dis-

tinct leg buds before operculum formation was completed. The long-delayed closure of the operculum in these larvae is evidently associated with prolonged functioning of the relatively huge peltate external gills. In these large pre-hatching larvae, the composite origin of the operculum and its relation to the gill arches and to the already well-formed foreleg buds are very clearly shown.

In the exceptionally large embryos of *Hemiphractus divaricatus* (UMMZ 92106), the various structures are much modified in proportions and somewhat displaced by the relatively huge yolk mass (its diameter ± 10 mm.). In the stage studied, there is a short, rather thick, flap-like fold across the throat and overlapping the bases of the long gill stalks; laterally the fold thins out somewhat and forms a deep pocket surrounding the base of each foreleg bud. The structural relations here, although much altered in proportions, are not basically different from conditions in the young pre-swimming larvae of *Gastrotheca* described above. The developmental sequence in the series of *Gastrotheca* is in turn only proportionately different from that of an ordinary tadpole with a typical larval history. The differences are in degree only; the structures involved are the same in each of these forms.

In embryos of *Eleutherodactylus cooki* (UMMZ 73550), the presence of a short dermal fold over the base of the foreleg bud and the absence of a transverse opercular fold across the throat were observed, as described by Lynn (1942) and other authors for other species in this genus. Morphologically, this condition appears to be but a further simplification of the opercular pattern noted above for *Hemiphractus divaricatus*. The transverse part of the composite operculum has become entirely suppressed and all that remains is the pocket-like fold over the base of the foreleg anlage. If the composite origin of the tadpole operculum is granted, it is probable that the dermal fold over the foreleg bud in *Eleutherodactylus* is homologous with the postero-lateral part that normally encloses the foreleg within the gill chamber, and thus the fold may be correctly interpreted as an opercular vestige.

As noted above, the spiracle is not always formed in non-aquatic frog embryos. Theoretically, it could be eliminated from the phenotype either by complete closure of the opercular folds, or by their failure to close at all, leaving a wide gap through which the branchial region and foreleg buds remain exposed. Examples of the latter type include *Eleutherodactylus* and *Hemiphractus*. In such forms the forelegs are more or less fully visible externally throughout their development. Absence of a spiracle

as the result of complete opercular closure has been reported in *Sooglossus* (Brauer, 1898), *Breviceps* (de Villiers, 1929 a), *Anhydrophryne* (Hewitt, 1929), and *Arthroleptella* (Power and Rose, 1929; de Villiers, 1929 b), and has been tentatively suggested for *Zachaenus parvulus* by Lutz (1944). In *Nectophrynoides tornieri* and *Rhinoderma darwinii* the spiracle is so small and inconspicuous that high magnification and careful handling are required in order to locate it. Consequently, it is suggested that a spiracle may prove to be present in some of the forms listed above.

2. Modification of the Mouthparts

The mouthparts of frog tadpoles are a highly complex mechanism that has undergone many remarkable evolutionary changes. In species having non-aquatic development, there is a trend toward loss of the typical larval buccal structures (*vide* Lutz, 1948), but the degree to which this has been accomplished differs widely between different species. Study of these modified types of mouthparts suggests not only some features relating to sequence of loss of structures, but also some possible clues to the origin of certain parts of the buccal apparatus.

In the simplification of the mouthparts in non-aquatic larvae, the end result may be structurally similar in forms having no close taxonomic affinity. That similarity should, however, be interpreted with reference to the type of larval mouthparts occurring in related free-swimming tadpoles. For example, the absence of beaks and labial teeth in embryos of *Pipa pipa* does not necessarily mean that they have been secondarily lost in the course of modifying the life history of this species, for these structures are likewise absent from all known free-swimming pipid tadpoles. Similarly, beaks and labial teeth are not known to occur in aquatic larvae of the Microhylidae, and would therefore not be expected in terrestrial embryos of microhylids.

Loss of the labial teeth in relation to direct development involves both the disappearance of the rows of pigmented labial teeth themselves and the tooth ridges upon which they are borne. Histologically, the teeth, and probably also the beaks, may remain after there is no longer any readily observable external indication of their presence. Noble (1927) figured and discussed the small non-horny labial tooth remnants revealed in sections through the lip of larval *Rhinoderma darwinii*. The jaws of *Rhinoderma* are typically larval in form and proportions. They tend to be sheathed with an opaque white layer which, although not hardened, is visually different from adjacent surfaces. The internal jaw structures of *Rhinoderma*

have not yet been described. The head contours are typically larval, however, especially the region of the processus muscularis of the quadrate and the orbitohyoideus muscle, as can be seen through the partly transparent skin (CNHM 3684).

In non-aquatic embryos in which the beaks and labial teeth are no longer externally apparent, more or less well-defined traces of the larval lips may still remain. *Rhinoderma darwinii* (CNHM 3684) has nearly typical lips with normal marginal papillae, and across the lower lip are either two or three papillose, fringe-like, remnants of labial tooth ridges. In *Hemiphractus divaricatus* (UMMZ 92106), the original larval lips are reduced to a narrow papilla-edged labial fold along the sides of the upper jaw and continuing along the base of the lower jaw for a varying distance, reaching the symphysis in some specimens. In this form the upper jaw is greatly simplified. The small lateral papillae are borne directly on the edge, the separate dermal margin (upper lip) having been lost. In a series of embryos of *Cryptobatrachus fuhrmanni* (UMMZ 47409), a still further reduction is found, and all that remains of the external mouthparts is a very short labial fold bearing a few papillae laterally and none at all on its very low median continuation along the lower jaw. Morphologically, this is a further step in the trend toward reduction of the mouthparts shown by *Hemiphractus divaricatus*.

In *Nectophrynoides tornieri* the maximum development of external mouthparts in the material examined is shown in specimens (MCZ 12513) having a short fleshy fold along the base of the lower jaw, clearly a vestige of the lower lip of typical aquatic tadpoles (Pl. 3, fig. 1). It is not equally well developed in all specimens in this series, and is probably both transient in the individual and of variable occurrence in the species. In *Eleutherodactylus* this morphological trend has apparently reached its logical conclusion, for no larval lip structure has been demonstrated in this genus (see especially Lynn, 1942). It is probable, however, that the peculiar horny egg tooth in *Eleutherodactylus* embryos is a specialized derivative of the upper beak of a typical aquatic tadpole, judging from its position and from Lynn's (1942) note on its histological structure in *E. nubicola*.

The greatly reduced lip rudiments in embryos such as *Hemiphractus* are structurally much like the simple labial folds of pipid tadpoles. In these tadpoles, in turn, there is a close resemblance to the type of labial folds characterizing salamander larvae and many of the fishes. At this point, the factual basis for comparison becomes rather tenuous, but the temptation cannot be resisted to suggest that the origin of the complex

lips of the specialized aquatic tadpole can be traced to the simple lateral labial folds that are of such widespread occurrence among the lower vertebrates. The convergent development of complex lips in certain South American catfishes and stream-dwelling Asiatic cyprinids provides supporting evidence of a possible homology of these structures in amphibians and fishes. Young larvae of the Australian lungfish possess labial folds very similar in form and position to those of salamander larvae.

Very little has been published on the internal anatomy of the jaw region of non-aquatic larvae, but the scant published data that I have found, together with the brief exploratory studies made during my doctoral research at Michigan, suggest that in these specialized forms the cartilages and muscles of the jaw region tend to become simplified. This would, of course, be expected, in view of the reduction of other larval structures in direct development. In some forms the jaw pattern is essentially that of a typical tadpole. The general trend towards simplification seems to include the following features: basal part of the quadrate shortens, returning the suspensorium to more nearly the adult position (*Cryptobatrachus*, *Nectophrynoides*); Meckelian and lower labial cartilages lose their movable articulation with each other and become a more or less continuous band of cartilage (*Cryptobatrachus*, *Nectophrynoides*); the upper labial cartilage is reduced in size and distinctness, and eventually becomes indistinguishable from the general cartilage field of the trabecular region; the quadratocranial commissure fails to develop in some forms, including *Eleutherodactylus nubicola* (Lynn, 1942); the processus muscularis of the quadrate becomes greatly reduced in size but, with its orbitohyoideus muscle, it tends to retain a typically larval appearance (*e.g.*, in *Pipa pipa*, *Cryptobatrachus fuhrmanni*, *Nectophrynoides tornieri*); it is absent in *Eleutherodactylus nubicola*.

Suppression of larval characters is more nearly complete in *Eleutherodactylus* than in any other frogs with non-aquatic development that have been reported thus far. Closely related genera that are known or suspected to have non-aquatic larvae, especially *Syrrhophus*, *Tomodactylus*, and *Microbatrachylus*, should provide valuable comparative data when their early stages are discovered.

The occurrence of direct development in frogs of very diverse taxonomic relationships indicates that it is not a single phylogenetic trend, but rather is a general tendency that has evolved independently in unrelated stocks. Thus far it is known in a relatively small number of species, but these are

distributed through 10 of the 13 families[1] that are currently considered valid.

It is worthy of emphasis that among tadpoles there is evidence of evolutionary trends of opposite nature. In one direction is the important general tendency toward elimination of the tadpole stage through direct development, while in the opposite direction is the widespread tendency toward ever greater complexity of the tadpole stage, as in the extremely specialized larvae of *Hyla claresignata*, *Rana rugulosa*, *Staurois*, and many others. Although this is on a small taxonomic scale (a single order), it appears to be an excellent example of the random nature of evolutionary trends.

SUMMARY AND CONCLUSIONS

Several early stages in the development of the ovoviviparous frog, *Nectophrynoides tornieri*, are briefly described and compared with similar stages of *N. occidentalis* reported by Angel and Lamotte (1944). Although the embryos of *tornieri* are highly modified in many respects, they develop numerous tadpole characters, and in their structural plan as a whole they are definitely larval. Small external gills, gill arches, and gill slits develop; typical opercular folds form and enclose the gill region and foreleg anlagen; a spiracle develops; a rudimentary lower lip is present, at least in some specimens; and there is a typical larval arrangement of internal jaw structures. Other details of body and tail structure are also mentioned.

Discrepancies between larval characters of *tornieri* reported here and those of *occidentalis* described by Angel and Lamotte (1944) are at least in part due simply to the availability of earlier stages of the former species, in which the development of the jaw and branchial regions can be more clearly traced. The internal position of the forelegs in *occidentalis* indicates that in this species, as in *tornieri*, larval opercular folds and at least a transitory spiracle develop.

The problem of direct development in frogs is discussed, with a detailed account of modifications of the operculum and spiracle and the mouthparts in non-aquatic larvae. The process of opercular development and spiracle formation is compared in typical aquatic tadpoles and in embryos of forms with direct development. It is concluded that the structures concerned and their anatomical relations are the same in both

[1] Examples known in Pipidae, Microhylidae, Ascaphidae, Pelobatidae, Leptodactylidae, Bufonidae, Atelopodidae (*Rhinoderma*), Dendrobatidae (*Sminthillus*), Hylidae, and Ranidae; probably occurs in some Rhacophoridae; unknown in Rhinophrynidae and Discoglossidae.

life history types. Successively more simplified departures from the typical process are traced in several species having direct development, including *Nectophrynoides tornieri*, *Gastrotheca* sp., *Cryptobatrachus fuhrmanni*, *Hemiphractus divaricatus*, and *Eleutherodactylus* sp. When these forms are studied in morphological sequence, it is seen that they conform to a common developmental pattern. The complex dual origin of the tadpole operculum is discussed; the dermal fold above the foreleg bud in *Eleutherodactylus* is considered to be a remnant of the postero-lateral, non-hyoidean, part of the composite operculum.

In the non-aquatic larvae of frogs with direct development, there is a tendency toward simplification of the mouthparts. The beaks and labial teeth fail to harden or to form pigment, and eventually fail to develop at all; the lips and papillae are small and of simplified structure, and in extreme cases become reduced to narrow labial folds. The internal parts of the jaw apparatus tend to retain a larval pattern after the external structures have been lost, but even the jaw cartilages and muscles may by-pass the larval plan (as in *Eleutherodactylus*). It is suggested that the horny egg tooth of *Eleutherodactylus* was probably derived from the upper beak of the aquatic tadpole.

Comparison is made between the basic lip structure of tadpoles and the closely similar labial folds of salamander larvae and certain fishes, and it is suggested that these structures are probably homologous.

In direct development, the tadpole may be entirely lost ecologically, but a substantial part of the larval structural pattern usually develops. Thus, a tadpole stage, with a more or less extensive metamorphosis, is still present anatomically even though all outward evidence of it disappears before hatching occurs.

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EXPLANATION OF PLATE 1

Several stages in larval development of
Nectophrynoides tornieri (lateral views).

FIG. 1. "Stage 1." Total length ± 5.5 mm. Small external gills present; operculum not yet distinct; foreleg bud external.

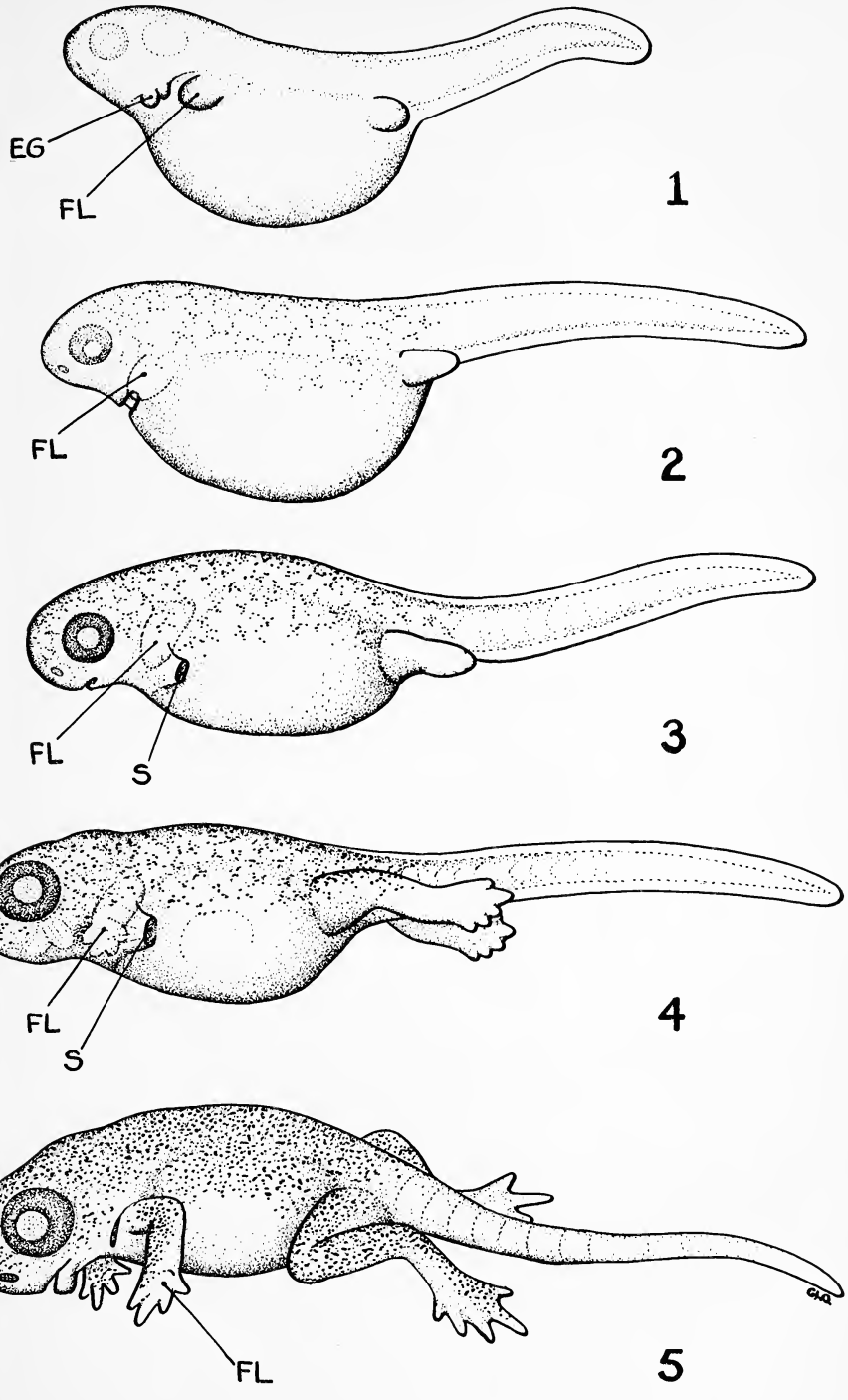
FIG. 2. "Stage 2." Total length ± 6 mm. Operculum well developed, partly encloses foreleg bud.

FIG. 3. "Stage 3." Total length ± 6 mm. Spiracle formation completed, foreleg bud internal.

FIG. 4. "Stage 4." Total length 10 mm. Front leg visible through thin skin of closed operculum.

FIG. 5. "Stage 5." Total length ± 11 mm. Metamorphosis has begun; front leg has emerged from opercular cavity; mouth enlarging.

EG, external gill; FL, front leg; S, spiracle.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EXPLANATION OF PLATE 2

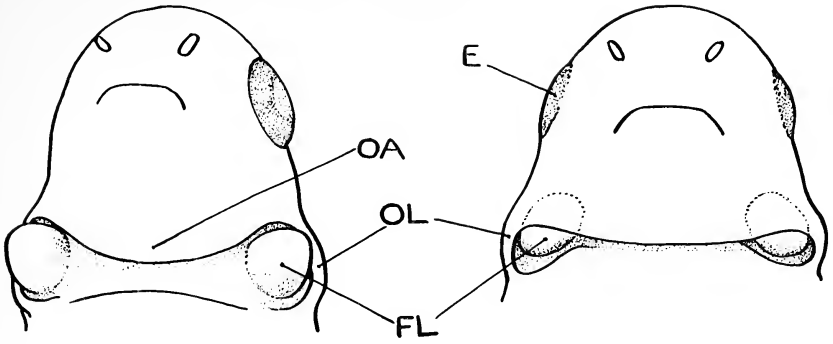
Development of operculum and spiracle in larval *Nectophrynoides tornieri* (ventral views).

FIG. 1. Opercular folds distinct; gill arch region concealed, but both front leg buds still exposed.

FIGS. 2-4. Stages in closure of operculum. Fig. 2 shows slight advance beyond condition in Fig. 1; in Figs. 3 and 4 right foreleg bud is entirely covered, but left foreleg bud remains visible through wide gap in operculum.

FIG. 5. Operculum closure completed, spiracle formed; both foreleg buds concealed.

E, eye; FL, foreleg bud; OA, opercular fold (anterior part); OL, opercular fold (lateral part); S, spiracle.



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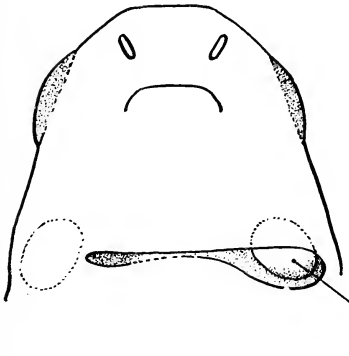

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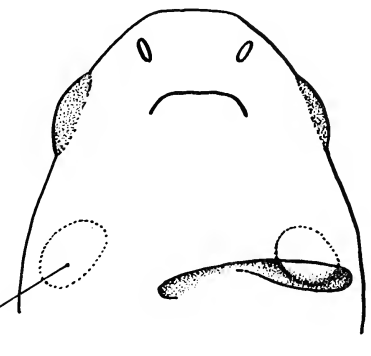

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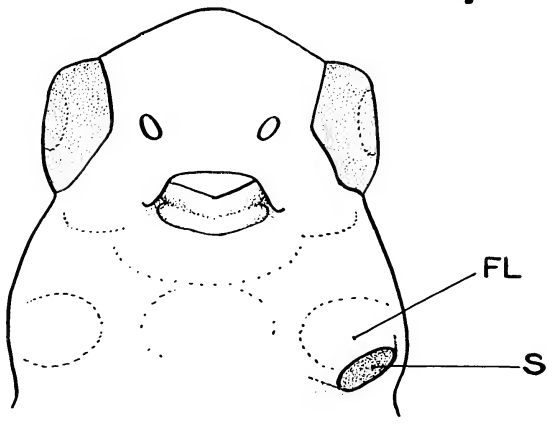

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EXPLANATION OF PLATE 3

Anatomy of jaw region in
larval *Nectophrynoides tornieri*

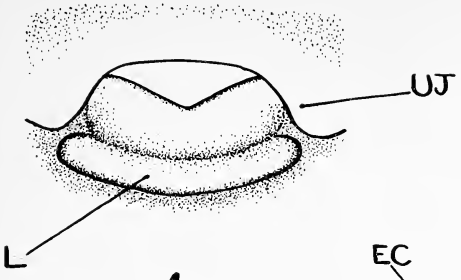
FIG. 1. Maximum development of external mouthparts. Jaw arrangement conforms closely to typical larval pattern, but accessory labial structures are lacking except for narrow rudiment of lower lip. "Stage 3," total length ± 6 mm.

FIG. 2. Jaw region dissected (lateral view). Jaw cartilages and muscles have distinctly larval arrangement. Position of right eye indicated. "Stage 4," total length 10 mm.

FIG. 3. Jaw region dissected (antero-lateral view). Muscles of adductor mandibulae group conform to typical larval pattern. Right eye removed. "Stage 4," total length 10 mm.

FIG. 4. Lower jaw and throat dissected (ventral view). Throat muscles very small, but follow typical larval arrangement. "Stage 4," total length 10 mm.

AMA, M. adductor mandibulae articularis; AMP, M. adductor mandibulae posterior longus; AMS, M. adductor mandibulae subexternus; CA, M. ceratohyoangularis; CH, ceratohyal; E, eye; EC, ear capsule; FL, front leg bud; GA, gill arch; GH, M. geniohyoideus; GS, gill slit; IG, internal gill rudiments; IM, M. intermandibularis; L, rudimentary lower lip; MC, Meckel's cartilage; N, nostril; OH, M. orbitohyoideus; PMQ, processus muscularis of quadrate; PT, M. pterygoideus; SA, M. suspensorioangularis; SH, M. subhyoideus., UJ, side of upper jaw.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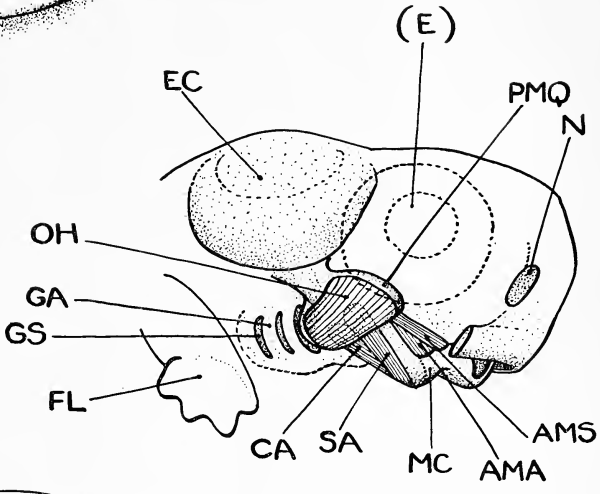
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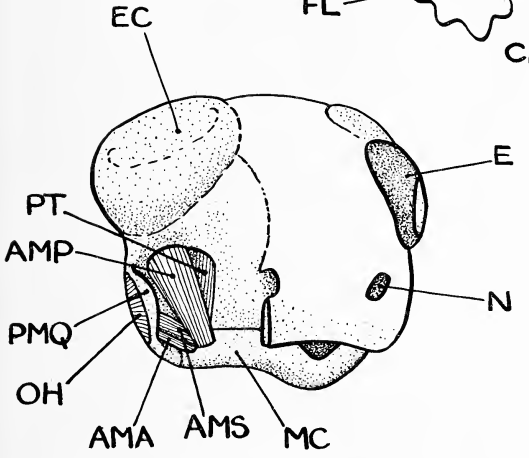
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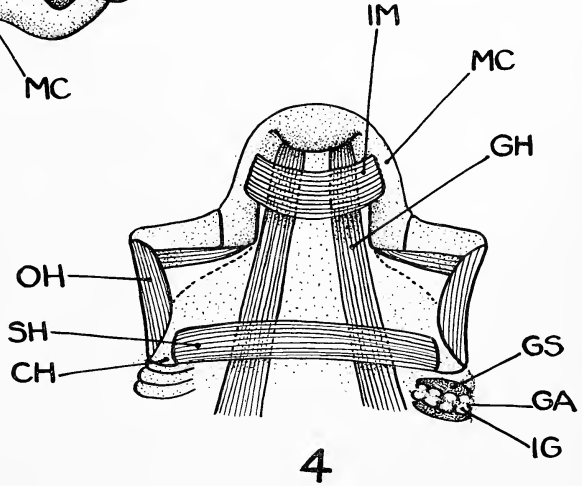
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ART. 10. DESCRIPTION OF A NEW RACE OF THE SALAMANDER *PSEUDOBRANCHUS STRIATUS* (LE CONTE)

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and
John W. Crenshaw, Jr.[1]
Emory University Field Station; Newton, Georgia

The population of *Pseudobranchus* that occurs in northern and western Florida and southwestern Georgia appears to be a homogeneous one which differs from both *Pseudobranchus striatus striatus* and *P. s. axanthus* and we propose for it the name,

Pseudobranchus striatus spheniscus, new subspecies

Type: Carnegie Museum, no. 29,015, adult female, collected on July 4, 1948, by George B. Rabb and James E. Mosimann.

Type locality: Seven miles south of Smithville, Lee County, Georgia.

Paratypes: Twenty-two, as follows:[2] *Florida;* CM 21,440-41, from 30 miles north of Lake City, Columbia County; CM 21,466, from 12.2 miles west of Wewahitchka, Gulf County; DBUF 1,855 (4 specimens), from Lake Iamonia, Leon County; DBUF 52, from Tallahassee, Leon County; and CM 20,160 (2 specimens), from 5.4 miles south of Telogia, Liberty County. *Georgia;* CAS 15,246 (3 specimens) from Mossy Pond, western Baker County; USMN 128,140-44 and UMMZ 99,390 (3 specimens) from Putney Pond, northwestern Baker County; and AMNH 34,626, from Lakeland, Lanier County.

[1] We are indebted to Doris M. Cochran, C. M. Bogert and M. Graham Netting for the loan of material, to Horton H. Hobbs and George B. Rabb for aid in collecting, and to Melvin H. Goodwin for making possible the junior author's work at the Emory Field Station at Newton, Georgia.

[2] AMNH, American Museum of Natural History; CAS, Chicago Academy of Sciences; CM, Carnegie Museum; DBUF, Department of Biology, University of Florida; UMMZ, University of Michigan Museum of Zoology; USNM, United States National Museum.

A 62 mm. specimen from Berrien County, Georgia (originally USNM 62,095), was examined by the senior author several years ago, and although it is in poor condition and somewhat faded, enough of its characters could be distinguished to indicate that it is representative of this new race. It has since been sent on exchange to the Instituto Miguel Lillo, Tucumán, Argentina.

Issued November 21, 1949.

Diagnosis: A slender *Pseudobranchus* with a narrow, wedge-shaped head; the lateral stripes are distinct and tan in color, tending to continue forward through the eye to the tip of the snout. It differs from *striatus striatus* in its more slender body and narrower head. The lateral stripes are narrower and the coloration more somber. From *s. axanthus* it differs in having the lateral stripes tan rather than gray and tending to continue through the eye to the tip of the snout, and in having the head narrow and wedge-shaped rather than broad and truncate.

Description of type: Head elongate, sides of head nearly straight but tapering anteriorly to region of eyes, thence tapering more abruptly to a sharply rounded snout; no pronounced swelling in parietal region. Head acute in profile, slightly arched. Mouth small, ventral in position, posterior angle of mouth separated from a line dropped from anterior border of eye by about the diameter of an eye. Outline of upper jaw convex as seen from side, due to pendulous upper lip; upper jaw projecting beyond lower. No canthus rostralis. Loreal region convex. Nostril, an elongate, longitudinal slit, ventrolateral in position, its anterior corner about on a line with anterior portion of mouth, not visible from above. Internarial distance (ventrally) about twice diameter of eye. Eye small, not protruberant, without eyelids but completely covered by a thin membrane, its diameter about 2/5 its distance from posterior corner of nostril. Interorbital distance about 4 times diameter of eye. Head width 14.0 times in body length; head length 7.68 times in body length.

Body slender, nearly circular in cross section; no constriction in neck; a narrow mid-dorsal groove; a shallow, longitudinal depression along center of lateral stripe; a shallow mid-ventral groove extending posteriorly to base of tail. Costal grooves 34, distinct, connecting across abdomen and extending well up on sides. Vent a short longitudinal slit.

Tail 1.5 times in snout-to-vent length, ovoid in vertical cross section at base; gradually becoming more and more compressed to flat tip. A narrow fin on distal 2/3 of dorsal surface of tail and a similar fin on distal ¼ of ventral surface of tail, fins connecting around tip of tail. Fins never so broad as tail musculature.

Forelimbs present, minute. Fingers three, short, stout, 2-1-3 in order of decreasing length, not webbed. Minute horny caps covering tips. No metacarpal tubercles present.

External gills three. Gills on both sides compacted and covered by an investing integument so that they do not hang free; extending posteriorly on both sides to base of forelimbs.

Tongue small, well back in mouth, its acutely-pointed anterior-half free. A black horny sheath present at anterior end of each jaw, that of upper jaw very short, oval in shape and arched, that of lower jaw a well-developed transverse ridge, curving backward at its outer ends. Lower jaw with rather long, recurved, sharply pointed, well-separated teeth, arranged in two rather irregular rows on the anterior portion of each mandible. Two elongate patches of prevomerine teeth, beginning slightly behind horny sheath in upper jaw. Internal nares long, longitudinal openings slightly diagonal in position, each deeply buried in a fold of tissue that is apparently capable of tight closure.

Measurements of type (in millimeters): Head length (tip of snout to base of foremost gill), 9.5; body length, 73.0; tail length, 55.5; total length, 138.0; forelimb length, 4.0; head width (maximum), 5.2; body width (maximum), 5.4; body depth (maximum), 5.5.

Coloration of type (preserved): Top of head and dorsum dark brownish gray. Head without any distinct markings but with a faint indication of a light stripe from nostril to base of gill on each side. A yellowish brown stripe about 1 mm. in width extending along each side from base of gill posteriorly to base of tail where it becomes broken and continues as an indistinct broken line to tip of tail; another more yellowish stripe extends from base of arm on each side posteriorly to the region of the vent. This ventrolateral stripe extends on to the ventral surface of the forelimb. The distance between the lateral and ventrolateral stripes on each side is about equal to the width of the two stripes. The area between them is grayish black. The venter is a dark gray with indistinct scattered light spots of yellowish fuscous. There is no discernible mid-dorsal stripe but the dorsal margin of the tail fin is edged with fuscous.

Variation: Most of the variation in the typical series seems to be due to age and state of preservation. Eleven of the specimens are definitely immature. The narrow, wedge-shaped head is the most striking characteristic and is apparent in all specimens from the smallest to the largest. In the largest specimen, the type, the head stripes are not so prominent as they are in the other specimens of the series, but nevertheless more prominent head stripes seem to be characteristic of this race.

Remarks: This new race is apparently much more difficult to collect than is *axanthus*. The senior author has on numerous occasions taken more *axanthus* in a single afternoon from some of the hyacinth-filled ditches and marshes around Gainesville, Florida, than there are specimens of *spheniscus* in the type series. This is certainly not due to intensity of

collecting alone since he has made several trips to northwestern Florida for the express purpose of searching for *spheniscus* but has been able to collect only one specimen. Intensive collecting in Baker County, Georgia, by the junior author, in a region where *spheniscus* is known to occur, has produced only eleven specimens. We believe this difference may be due in part to a difference in the habits of the two forms. *P. s. axanthus* is abundant among masses of vegetation, especially in the roots of water hyacinths, in the large marshes of peninsular Florida, but *spheniscus* generally occurs in small to medium, shallow, limesink ponds, abounding in pond cypress (*Taxodium ascendens*) and black gum (*Nyssa biflora*). In so far as we know, the water hyacinth is not found in much of the area. It certainly does not occur in any of the ponds in Baker and Lee Counties, Georgia, from which specimens of *P. s. spheniscus* were collected. Although much time was spent in seining masses of *Cabomba* and *Myriophyllum* just beneath the surface, no specimens were collected in this manner. All but one of the southwestern Georgia specimens were collected by seining and examining bottom detritus. The other was unearthed from the mud bottom of a dried-up pond. Several of the Florida specimens were taken by Dr. Horton H. Hobbs while collecting crayfishes with a dip net. From our limited knowledge of this form we suspect that it has a tendency to remain burrowed in decaying bottom vegetation.

ART. 11. A REVIEW OF THE ELVELLACEÆ (FUNGI) OF WESTERN PENNSYLVANIA

By LeRoy K. Henry

(Plates 1-2)

The family Elvellaceæ, to which the morels and their relatives belong, is placed in the order Pezizales of the Ascomycetes. The fungi in this order are commonly called cup fungi (Discomycetes) because their fruiting bodies are usually disk- or cup-shaped. However, the fruiting bodies of the members of this family are fleshy and consist of a distinct stipe (stem) and a pileus (cap). The pileus is located at the top of the stipe, with its margin either free or partly attached to the stipe, and it may be bell-shaped, saddle-shaped, or subglobose. The hymenium (spore-bearing surface) is even, ridged and pitted, convoluted, or irregularly folded, and it covers the outer surface of the cap. The stipe is usually hollow and may be very slender or short and stout, with the surface even, pitted, ridged, or fluted.

These are chiefly spring fungi, appearing in open woods, orchards, or along flood-plains, in April or May.

The morels and elvellas are edible, with the exception of one doubtful species known as the false morel and formerly called *Gyromitra esculenta*, but now identified with *Elvella infula*. This false morel can readily be distinguished from the true morels by the somewhat convoluted character of the cap and its chestnut-red coloring. There has been disagreement in the literature concerning the edibility of this mushroom; some mycophagists claim no ill effects from eating it and others report that they were poisoned by it. Individual differences may account for these conflicting statements. Also, the amount of poison may vary in plants from different localities, or there may be two closely related species involved, the one edible and the other poisonous. The true morels make a very tasty dish, provided one can find enough of them at any one time.

This family contains five genera in eastern North America, three of which are represented in the Pennsylvania Herbarium of Carnegie Museum. The majority of the Herbarium collections were contributed by D. R. Sumstine, O. E. Jennings, and L. K. Henry.

For this paper, as the eastern boundry of Western Pennsylvania, I have arbitrarily chosen the eastern borders of Potter, Clinton, Centre, Huntingdon, and Fulton counties.

Issued December 19, 1949.

KEY TO THE GENERA OF THE ELVELLACEÆ

Outer surface of pileus consisting of deep or shallow pits formed by longitudinal or transverse ridges..... *Morchella*

Outer surface of pileus even, ribbed, or convoluted.

Pileus bell-shaped, edge free from stipe..... *Verpa*

Pileus lobed, irregularly subglobose, or saddle-shaped; surface even or convoluted..... *Elvella*

MORCHELLA (Morels)

Pileus subglobose or elongated, blunt or acute at tip, the margin closely joined to the stipe at its base in all but one species. Surface of pileus traversed by irregularly branching ribs, forming rounded or elongated pits which are lined with the yellow to brown hymenium. Stipe cylindrical, usually lighter in color than the pileus, often enlarged at the base. All of our six species are edible.

KEY TO MORCHELLA

Base of pileus free from the stipe; plant 4-5 inches high; cap bell-shaped, up to 3 cm. long; ribs whitish; pits 5-10 mm. in diameter, yellow within; stem 8-10 cm. long, white or yellowish, irregularly pitted at base and tapering upward..... *M. hybrida*

Base of pileus joined to the stipe.

Ribs of the pileus much darker than the interior of the pits; pileus narrowly conic and acute at apex, 2-5 cm. long; plant 2-3 inches high; pits elongated, 4-10 mm. long, yellowish within; ribs black on edge; stipe of uniform thickness..... *M. angusticeps*

Ribs of pileus similar in color to the interior of the pits (yellowish) or of a lighter color.

Pileus large, 4-8 cm. or more long at maturity.

Pits large, irregular, up to 1 cm. broad, usually shallow; plant 7-8 inches high; ribs thin; stipe stout, distinctly enlarged at base, 10-11 cm. long..... *M. crassipes*

Pits small, deep; ribs thick; stipe slightly enlarged and irregularly pitted at base.

Plant 2-4 inches high; pits irregular, 5-10 mm. in diameter; ribs irregularly branching; pileus subglobose, generally a little longer than broad..... *M. esculenta*

Plant 3-5 inches high; pileus elongated or strongly attenuated upwards; pits elongated, 5-10 mm. long; ribs more or less longitudinally disposed..... *M. conica*

Pileus small, not exceeding 2-3 cm. in length at maturity; pits elongated, ashy to blackish within; ribs longitudinally disposed, whitish; stipe whitish, irregularly pitted..... *M. deliciosa*

Morchella angusticeps Peck (Plate 1, fig. 4)

Allegheny County: Coraopolis. *Washington County:* 5 mi. s.e. of Houston. Rare.

Morchella conica Pers. (Plate 1, fig. 5)

Allegheny County: Frick Park, Pittsburgh; 4 mi. e. of Monongahela. *Armstrong County:* Kittanning. *Beaver County:* 1 mi. n. of Mechanicsburg; Raccoon Creek region; woods at intersection of Beaver-Conway and Sewickley-Rochester roads. *Erie County:* Presque Isle. *Fayette County:* Ohiopyle. *Greene County:* 10 mi. s.e. of Waynesburg. *Lawrence County:* near New Castle. *Somerset County:* Ursina. *Venango County:* 3 mi. n. of Lisbon. *Washington County:* Charleroi. *Westmoreland County:* near Ligonier; Hillside.

Morchella crassipes (Vent.) Pers. (Plate 1, fig. 3)

Allegheny County: near Saunders; flood-plain of Lyons Run; yard in Pittsburgh. *Armstrong County:* Kittanning. *Cambria County:* near Cresson. *Centre County:* 1 mi. s. of Boalsburg. *Crawford County:* near Linesville; near Hartstown. *Washington County:* Washington car-line near Center Church; near New Eagle. *Westmoreland County:* 3 mi. s.e. of Rector; Hillside.

Morchella deliciosa Fries (Plate 1, fig. 2)

Allegheny County: Warden Mine region opposite Sutersville; 2.5 mi. n.e. of Ambridge at Turkey Foot. *Beaver County:* 2 mi. above mouth of Raccoon Creek. *Butler County:* under a Peony, 4 mi. n.e. of Harmony. *Crawford County:* near Hartstown. *Washington County:* near Riverview. *Westmoreland County:* Kiski Campus near Saltsburg.

Morchella esculenta (L). Pers. (Plate 1, fig. 6)

Allegheny County: Frick Park, Pittsburgh. *Armstrong County:* Kittanning. *Butler County:* 4 mi. n.e. of Harmony; near Renfrew; Winfield

Junction. *Erie County:* Presque Isle. *Fayette County:* Ohiopyle. *Somerset County:* near Ursina. *Washington County:* 5 mi. s.e. of Houston; vicinity of Hanlin Station. *Westmoreland County:* Ligonier; Hillside.

Morchella hybrida (Sow.) Pers. (Plate 1, fig. 1)

Allegheny County: near Wildwood; 2 mi. n. of Saunders; near Pittsburgh; Frick Park, Pittsburgh. *Armstrong County:* Kittanning. *Butler County:* Marwood. *Crawford County:* Hartstown. *Fayette County:* Ohiopyle. *Indiana County:* 2 mi. n.e. of Clarksburg. *Washington County:* Charleroi; Van Voorhis. *Westmoreland County:* Hillside.

VERPA

Pileus bell-shaped, yellow to brownish, white beneath, often with a reflexed margin, free from the stipe, 2-3 cm. long by 1-2 cm. in diameter. Spore-bearing surface (hymenium) folded into longitudinal and branching ribs, yellow to brownish. Stipe nearly cylindrical, hollow, even, white or slightly cottony, 6-8 cm. long.

Verpa bohemica (Krombh.) Schröt. (Plate 2, fig. 6)

Beaver County: Pine Grove, J. A. M. Stewart; Raccoon Creek State Park. L.K.H. Rare.

ELVELA (HELVELLA)

Pileus mitre-shaped, saddle-shaped or subglobose, even or irregularly convolute, the margin reflexed and free or more or less joined to the stipe. Stipe slender or stout, even, pitted or strongly fluted, white, yellow or smoky. None of the five species in our region can be considered common.

KEY TO ELVELA

Stipe distinctly fluted, stout and usually enlarged at the base; surface of pileus even or convoluted.

Pileus and stipe remaining cream or yellowish.....*E. crispa*

Pileus becoming dark brownish-black; stipe yellowish, becoming smoky.....*E. mitra*

Stipe not distinctly fluted but even or irregularly pitted.

Stipe very slender, usually not over 5 mm. in diameter; surface of pileus even or more or less convolute.

Pileus yellowish to dark brown, 2-3 lobed, free from the stipe; stipe yellowish, 5-10 cm. long.....*E. elastica*

Stipe stout, usually 1-5 cm. in diameter; surface of cap more or less convoluted.

Pileus 6-8 cm. broad, chestnut-red, mitre-shaped, saddle-shaped or variously convoluted; stipe 6-8 cm. long, white to yellowish even or more or less pitted; spore ellipsoid, smooth. *E. infula* (*G. esculenta*)

Pileus 5-12 cm. broad, chocolate-brown, irregularly lobed and folded; stipe usually even, white, 8-13 cm. long; spores large, rough, fusoid, strongly pointed..... *E. underwoodii*

Pileus 5-12 cm. broad, brown to brownish black, irregularly lobed and folded, often reticulate; stipe deeply pitted, 8-10 cm. long, whitish; spores large, rough and ellipsoid.. *E. caroliniana*

Elvela caroliniana (Bosc.) Nees. (Plate 2, fig. 4)

Butler County: Ribold; Criders Corners.

Elvela crispa (Scop.) Fries (Plate 2, fig. 1)

Armstrong County: Kittanning; across Buffalo Creek from West Winfield. *Cambria County:* near Cresson. *Warren County:* s. of Tidioute. *Westmoreland County:* near Rector.

Elvela elastica Bull. (Plate 2, fig. 3)

Bedford County: Sulphur Springs. *Centre County:* near Woodward. *Westmoreland County:* 3 mi. s.e. of Rector.

Elvela infula Schaeff. [*Gyromitra esculenta* (Pers.) Fr.] (Plate 2, fig. 5)

Allegheny County: Kennywood Park; 3 mi. s.e. of Bakerstown. *Butler County:* 4 mi. n.e. of Harmony. *Venango County:* 1 mi. n. of Lisbon.

Elvela underwoodii Seaver (*E. brunnea* Underw.) (Plate 2, fig. 2)

Allegheny County: Swissvale; Library; Kennywood Park; Pittsburgh. *Armstrong County:* Kittanning. *Butler County:* near Saxonburg.

EXPLANATION OF PLATE 1

All figures are one-half natural size

FIG. 1. *Morchella hybrida* (Sow.) Pers.
FIG. 2. *Morchella deliciosa* Fries
FIG. 3. *Morchella crassipes* (Vent.) Pers.
FIG. 4. *Morchella angusticeps* Peck
FIG. 5. *Morchella conica* Pers.
FIG. 6. *Morchella esculenta* (L.) Pers.

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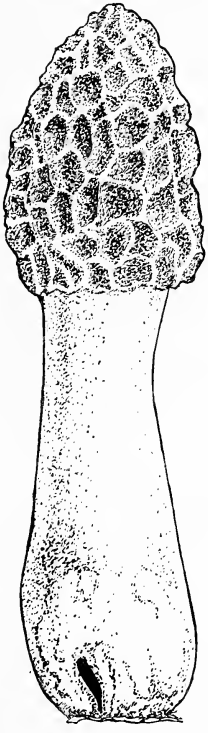

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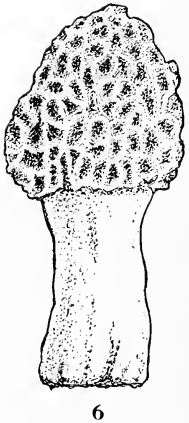

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EXPLANATION OF PLATE 2

All figures are one-half natural size

FIG. 1. *Elvela crispa* (Scop.) Fries
FIG. 2. *Elvela underwoodii* Seaver
FIG. 3. *Elvela elastica* Bull.
FIG. 4. *Elvela caroliniana* (Bosc) Nees
FIG. 5. *Elvela infula* Schaeff.
FIG. 6. *Verpa bohemica* (Krombh.) Schröt.

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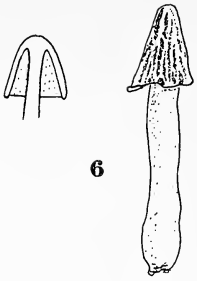

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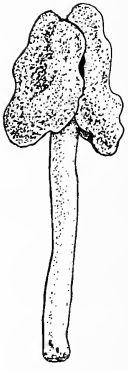

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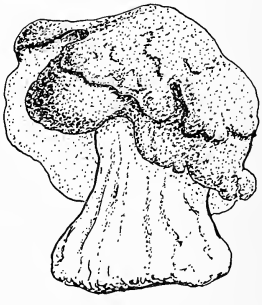

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ART. 12. A NORTHERN RACE OF RED-TAILED HAWK[1]

By W. E. Clyde Todd

(Plate 1)

Buteo jamaicensis subsp. Red-tailed Hawk.

Buteo borealis (not of Gmelin) Couper, Canadian Sport. and Nat., 1, 1881, 80 (Mingan R., Quebec, nesting, *fide* Smyth).—Palmer, Proc. U. S. Nat. Mus., 13, 1890, 261 (Mingan Is., Quebec, summer).—De Puyjalon, Hist. Nat. à l'usage Chasseurs Canadiens, 1900, 420 ([Canadian] Labrador).—Macoun, Cat. Canadian Birds, pt. 2, 1903, 230 (Moose R., near James Bay, Ontario, June, *fide* Spreadborough).—Macoun and Macoun, Cat. Canadian Birds, ed. 2, 1909, 251 (Missanabie River, Ontario, *fide* Spreadborough).—Williams, Canadian Field-Nat., 34, 1920, 123 (Hamilton Rapids [Groundhog R.], Pike Creek [Mattagami R.], and Missanabie R. [mouth], Ontario, August).—Baillie, Canadian Field-Nat., 43, 1929, 172 (Couper's record).—Eidmann, Zoogeographica, 2, pt. 2, 1934, 241 (Matamek region, Quebec, habitat).—Lewis, Canadian Field-Nat., 49, 1935, 114 (Couper's record).—Ricker and Clarke, Contr. Royal Ontario Mus. Zool., 16, 1939, 7 (L. Nipissing, summer).

"Red-tailed Hawk" Audubon (M. R.), Audubon Journ., 1, 1897, 394 ([Wapitagun], Quebec, July).—Townsend, Bull. Geogr. Soc. Philadelphia, 11, 1913, 48 (Natashquan R. [40+ mi. from mouth], July; Audubon and Palmer's records).—Eidmann, Verh. Orn. Ges. Bayern, 21, 1937, 161 (Trout Lake and Matamek River region, Quebec, August-September).

Buteo borealis borealis Townsend, Auk, 30, 1913, 6 (Natashquan R., Quebec, summer; plum.).—Lewis, Auk, 39, 1922, 512 (Mingan and "Piashte Bay" [Baie Johan Beetz], Quebec, June).—Snyder, Univ. Toronto Biol. Ser., 32, 1928, 22 (Ghost R., L. Abitibi, Ontario, June).

Buteo jamaicensis borealis Godfrey, Nat. Mus. Canada, Bull. 114, 1949, 16 (Lakes Mistassini and Albanel, Quebec, June-September).

The Red-tailed Hawk is the New World representative of the European Buzzard, *Buteo buteo*. It is one of the commoner Hawks of North America, where it enjoys an extensive range, from the Isthmus of Panama north to the limit of trees. Throughout this range it splits up into a number of geographic races, whose inter-relationships are rendered all the more puzzling because of an innate tendency in the species to dichromatism—a tendency which is manifest in varying degrees, and which greatly complicates the discrimination of the several forms. Individual and seasonal variations are other factors which must inevitably be taken into account.

Until rather recently the species has been known as *Buteo borealis*,

[1]The present account is an excerpt from the writer's manuscript report on the birds of the Labrador Peninsula. It has been prepared to show the style of treatment to be followed. Comment and criticism are invited.

Issued April 25, 1950.

from *Falco borealis*, Gmelin, 1788. The specific name was based on the "American Buzzard" of Latham (1781). Oddly enough, "Carolina" is the only definite locality these authors cite; this has now been restricted to South Carolina—an incongruous type-locality for a supposedly northern bird. On the same page, some lines before, Gmelin also named a *Falco jamaicensis*, based on the "Cream-colored Buzzard" of Latham (1788), said to be from Jamaica. His description is by no means clear, and many authors have ignored this name as unidentifiable. This would be the safe and sane course, but most recent authorities (including the American Ornithologists' Union Committee, following Peters, 1931) have chosen to resurrect *jamaicensis* as the specific name for the Red-tailed Hawk. Latham's description may be construed to apply to an immature example of this species in an albinistic condition, and in any event it could scarcely pertain to any other species than the small Red-tailed Hawk of Jamaica and certain other West Indian islands. There is indeed some justification for ranking this insular form as a species distinct from the continental bird. At one time I shared this view, but I now think that we shall have to consider them conspecific. The unfortunate outcome of this decision is that, following the rule of line anteriority, we are compelled to use the utterly inappropriate name *Buteo jamaicensis borealis* for a bird which was first described from South Carolina.

To the critical and discriminating study made by the late Percy A. Taverner (Victoria Mem. Mus. Bull. No. 48, 1927, 1-20, 3 pls; and Condor, 38, 1936, 66-71), we are indebted for much light on this interesting group. His object was to clarify the relationships and taxonomy of the forms found in Canada, and particularly in western Canada. He discussed the western race *calurus* at some length, but it is interesting to note that the latest authorities (Hellmayr and Conover, Field Mus. Zool. Ser., 13, pt. 1, no. 4, 1949, 96-97) synonymize this name with *borealis*. After an independent study of the series available to me I find myself in disagreement with this conclusion. Aside from the greater tendency to melanism in *calurus*, the race is characterized by its richer coloration as compared with *borealis*. Taverner treated the eastern Red-tailed Hawk as a single entity; he had no suspicion that more than one race might be involved, nor had other authors—and this in spite of the observed extent of variation. In view of the scarcity of breeding specimens from critical areas, this is not surprising. During a recent study of the Red-tailed Hawks in the collection of the Carnegie Museum I was interested to find that our two specimens from near the northern limit of the species' range stood out from Pennsylvania breeding birds by easily discernible characters.

Through the courtesy of Mr. W. Earl Godfrey of the National Museum of Canada I have been permitted to examine three additional specimens showing the same peculiarities. These five examples (breeding birds) appear to represent a hitherto unrecognized race of this species, which may be called

Buteo jamaicensis abieticola, subsp. nov.

NORTHERN RED-TAILED HAWK

Type, No. 57,348, Collection Carnegie Museum, adult female; Sainte Margaret Falls (above Clarke City), Quebec, May 25, 1917; Olaus J. Murie. (Taken with a set of two eggs.)

Subspecific characters.—Similar to *Buteo jamaicensis borealis* of the eastern United States and southern Canada, but underparts more heavily streaked; throat and upper breast darker colored (more brownish, less rufescent); upperparts (including wings externally) darker colored (more blackish); and subterminal black band on tail averaging wider.

Range.—Apparently the spruce-fir belt of Canada, north (at least west of Hudson Bay) to the limit of trees.

Comparison was first made with seven breeding specimens from western Pennsylvania, but later these were supplemented, through the courtesy of the authorities of the U. S. National Museum, by two specimens from the vicinity of Washington, D. C., and one from Mount Mitchell, North Carolina. The last comes from as near the type-locality of *borealis* as any we can get, and it agrees closely with the Pennsylvania birds. It is fair to presume, therefore, that the form represented by these specimens is the one to which the name *borealis* rightfully belongs. None of the recognized synonyms of *borealis* as commonly understood can possibly apply to the northern race here described, since they all come from "Carolina" or "Virginia," and the descriptions and figures are not pertinent.

The characters apparent in the present race seemed, on first reading, to be those given by Grinnell for his *Buteo borealis alascensis* (Univ. California Pub. Zool., 5, 1909, 211), described from Glacier Bay, Alaska. Of this form I have seen no Alaskan specimens, but through the courtesy of the authorities of the Chicago Natural History Museum I have before me seven specimens from British Columbia which presumably represent this form correctly. When Grinnell described *alascensis* he compared it with *calurus*, and very properly so, since in it the characters of *calurus* are merely carried to an extreme. The rufescent shading of the underparts is a marked character. In any case, *alascensis* has nothing to do with the new race.

Besides the type from Quebec, we have a June specimen from Quatre Fourches Channel, Peace River Delta, Alberta, and I have seen three more (National Museum of Canada) from Lac la Nonne, Alberta. These five breeding specimens of *abieticola*, coming as they do from widely separated points in the north country, suggest an extensive breeding range for this form—a range probably co-extensive with the spruce and fir forests of this area. Here the birds must be only summer residents, migrating southward for the winter. If so, it would be reasonable to expect to find a certain proportion of fall- and winter-taken specimens from the northern United States referable to this race. Examination of a series of specimens shot by gunners some years ago at "Hawk Mountain," near Drehersville, Pennsylvania, and preserved as skins by Dr. George M. Sutton, fully bears out this expectation. These birds were migrants from the north, and were actually taken in migration. Laid out side by side with seasonably comparable specimens from other parts, they show the characters of *abieticola* to even better advantage than do the breeding adults. A few of our fall and winter birds are indeterminate, and might be referred to one form as easily as to the other, but the general difference between the two is well marked. In immature plumage, however, the difference is thus far unsettled, in part because of lack of material. All we can say is, that in young birds, probably northern-reared, the general coloration appears to be darker and the markings on the underparts to be heavier, but there is a great deal of variation in these respects in the specimens examined.

MEASUREMENTS

No.	Sex	Locality	Date	Wing	Tail	Bill	Tarsus
57,348	♀	Ste. Margaret Falls, Quebec	May 25, 1917	387	195	37.5	82
101,899	♀	Quatre Fourches Channel, Alberta	June 8, 1927	407	210	37	83
21,263*	♀	Lac La Nonne, Alberta	May 26, 1926	415	218	37	86
21,696*	♀	" " " "	July 20, 1926	422	224	37	86
21,250*	♂	" " " "	May 26, 1926	360	216	37.5	82
23,819	♀	Hardin Co., Iowa	Mar. 24, 1905	418	233	37	80
102,681	♂	Towanda, Pennsylvania	Nov. 17, 1925	354	196	34.5	77
102,686	♂	"Hawk Mountain," Pa.	Oct. 22, 1927	353	190	36	79
102,687	♂	" " "	Oct. 22, 1927	344	192	35	75
102,688	♀	" " "	Oct. 22, 1927	373	211	36	78
102,690	♀	" " "	Oct. 23, 1927	382	213	38	80
103,560	♂	" " "	Oct. 22, 1927	363	204	34	74

*Collection National Museum of Canada.

While there is thus no significant difference in size between *borealis* (as here restricted) and *abieticola*, the above table of measurements reveals that Alberta specimens run a little larger than eastern birds. It will be noted that the migrants taken in Pennsylvania agree in smaller size with the type-specimen from the north shore of the Gulf of St. Lawrence. A female from Iowa, taken on March 24, is so palpably an example of *abieticola* that I am constrained to believe that it must have been a migrant on its way north.

In his "Labrador Journal," Audubon records finding a tail-feather of a young Red-tailed Hawk near Wapitagun, on the north shore of the Gulf of St. Lawrence, in July, 1838. Had the record remained unconfirmed (as it did for many years) it would be open to question, since it is just possible that this particular tail-feather might have come from an Osprey instead. In 1881, the Canadian naturalist William Couper published, in a rare and little-known journal which he edited, a circumstantial account of the finding of a nest on the Mingan River by Sir Greville Smyth. "It contained two young, which could feed themselves at the end of July." "There is no reason to question this" (H. F. Lewis). In the summer of 1890, William Palmer saw two on the Mingan Islands. The Audubon and Palmer records were the only ones known to Townsend and Allen when they wrote their list of Labrador birds in 1907. Later Townsend himself met with the species on a tributary of the Natashquan River, some forty miles from its mouth. Just one bird was seen, whose dark coloration he remarked at the time. "No nest could be found although the bird's actions suggested young."

This brings us down to 1917, the year when our party from the Carnegie Museum was camped just above the first falls on the Ste. Margaret river, ready to begin the ascent of that stream as the first stage in the crossing of the Labrador Peninsula. A pair of Red-tailed Hawks was in evidence across the river from our camp, and their nest was located on May 25. After lunch our whole party (five Indians, three whites) crossed over to investigate. The nest was built of sticks and twigs, about fifty feet up on a thirty-inch birch tree. The men built a blind of young spruce trees below in which Mr. Murie concealed himself, while the rest of us left the vicinity. Scarcely had we reached camp again before we heard the report of his gun, and upon returning we found that he had brought down the parent bird as she returned to the nest. Obviously she could not count. The men felled an adjacent tree against the nest-tree, and Mr. Murie climbed up and brought down the two incubated eggs the nest contained. Thus was the type-specimen of the present new race obtained.

On May 27 another individual was noted about nine miles upstream, and on June 6 still another on the Grand Portage, beyond Lac au Poëlon. More recently, Harrison F. Lewis has published June sight records for this species from Mingan and Baie Johan Beetz, and H. Eidmann one for the Matamek region. I do not know the source of the English Bay record to which A. C. Bent (Bull. 167, U. S. Nat. Mus., 1937, 162) refers. Thus far the species has not been traced farther eastward along the north shore than the mouth of the Little Mecatina River, where it was noted by Harold S. Peters (MS.) on June 25, 1938. It is not known to reach Newfoundland. For Anticosti Island there is only Joseph Schmitt's notation that it is a rather rare *permanent* resident—on its face a questionable statement.

The northern limit of the range of this species in the Peninsula remains to be worked out. While we failed to find it on the Ste. Margaret River beyond 50° 44′ N., I have a sight record from Gull Lake on the Hamilton River at 53° N., July 17, 1939. From this point to Lake Mistassini and Lake Albanel, where, according to W. Earl Godfrey, it was the "most frequently observed hawk" in the season of 1947, from June 20 to September 4, is a long jump. Unfortunately no specimens were taken. To the westward of Mistassini our party made four records in 1914. One was noted along the railroad, eighteen miles west of the Bell River, on May 28, by O. J. Murie. One was seen on the Bell River near Kanikwanika Island on June 2; several on Chensagi Lake on June 9; and one at the fifth portage (west of Nemiskau) on the Rupert River on June 24. On July 8, we saw one at East Main; this is the farthest north I have ever observed it on James Bay. These are presumptive breeding records, as are also some of those we have from the southern shores of James Bay and from the rivers of northern Ontario, and which were made on sundry Carnegie Museum expeditions. Spreadborough observed the species below Moose Factory on June 6, 1896, and also on the Missanabie River. G. M. Sutton saw two at Moose Factory on June 4, 1926 and one on June 13. The species certainly does not nest on Moose Island, although it must do so at no great distance. It was repeatedly observed in late August and again in October 1923, by our party at several points along the Abitibi River, and Williams (1920) saw individuals in August along the Mattagami and Groundhog Rivers.

Spring records are also available for the Missanabie River. These were made by our party in 1926, as follows: above Skunk Island, May 27, one; Long Portage to Soweska River, May 31, three pairs and four single birds; Soweska River (mouth) to about 50° 29′ N., two. In 1912, I saw a single individual about six miles east of Cochrane on May 21, and on September

26, 1935, R. L. Fricke saw one along the road near Ramore. L. L. Snyder has recorded the species from Lake Abitibi in summer. Although no specimens appear to be available from this general region, I refer all these records, south to Lake Nipissing, to the race herewith described—this on geographical considerations.[2] Probably the Churchill record given by Taverner and Sutton (1934) belongs here also, since it is this form that occurs in northern and central Alberta, as actual specimens show.

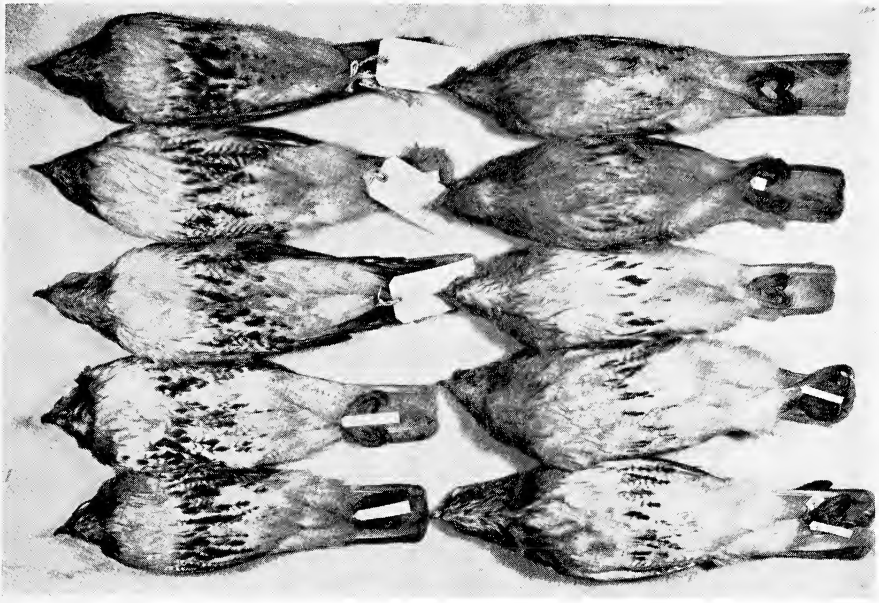
Dr. Arthur C. Twomey tells me that in the spring of 1942 he discovered a nesting pair of Red-tailed Hawks about fifteen miles southeast of Aklavik, in the Mackenzie Delta, but was unable to secure them. Presumably they also were of the present race, the range of which extends far to the northward in this part of Canada.

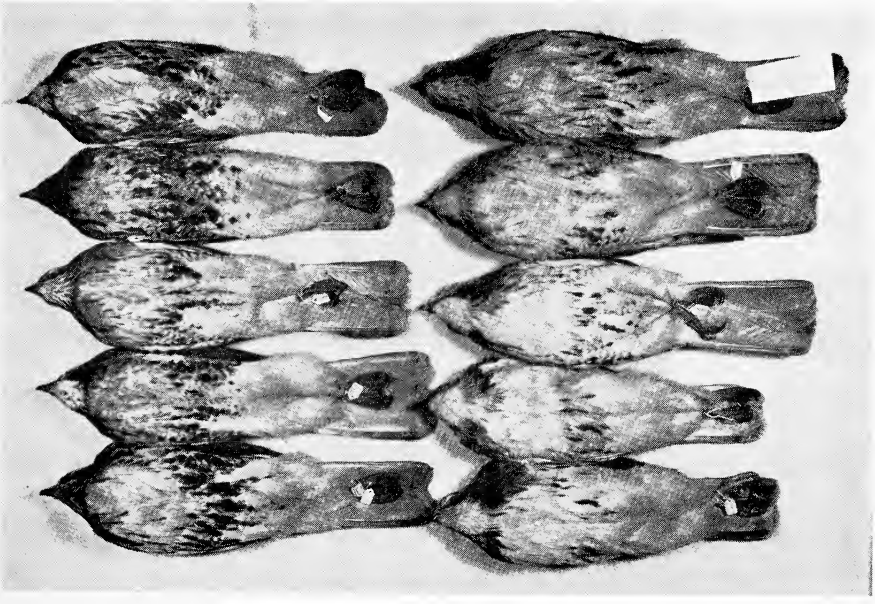
The general habits of this northern race of Red-tailed Hawk are the same as those of the eastern bird, and its eggs are indistinguishable. Townsend's remarks on a melanistic individual he observed on the Natashquan River (1913) raise the question whether melanism is confined to the race *calurus*. Compare also, in this connection, the remarks of Rand (Auk, 65, 1948, 424).

[2] Since the above was written, the Royal Ontario Museum of Zoology has sent me for examination six specimens from western Ontario (Port Arthur, Amyot, Schreiber) and eastern Manitoba (Deer Lodge, Portage la Prairie, Lake St. Martin). Three were taken in the breeding season, and three in October. Despite some obvious variation, and a suggestion of *krideri* influence in the Lake St. Martin bird, all these are clearly referable to the new race upon comparison. In the Deer Lodge specimen, dated October 15, the characters reach an extreme.

EXPLANATION OF PLATE 1

Left-hand row: *Buteo jamaicensis abieticola.*
Right-hand row: *Buteo jamaicensis borealis.*
Upper engraving: breeding specimens.
Lower engraving: autumn specimens.
The type of *Buteo jamaicensis abieticola* is the lowermost bird in the left-hand column of the upper engraving.





ART. 13. A NEW RACE OF PAROQUET OF THE SPECIES *ARATINGA ASTEC* FROM THE REPUBLIC OF HONDURAS

By Arthur C. Twomey

A comprehensive survey of the bird life of the Republic of Honduras was begun by the author in 1947 and 1948 and will continue until the country can be adequately covered.

This extensive field research by the Section of Birds of Carnegie Museum has been made possible by the generosity and continued interest of Dr. Matthew T. Mellon, who has encouraged the author in every phase of this work. During my first preliminary studies of the 1947 and 1948 collections, a distinct race of *Aratinga astec* has appeared that warrants subspecific recognition. In appreciation of Dr. Mellon's unfailing support it is an honor to name this new race for him.

Aratinga astec melloni subsp. nov. Mellon's Paroquet.

Type: No. 133,003, Collection Carnegie Museum, adult male; La Ceiba, Honduras, April 30, 1948; Arthur C. Twomey and R. W. Hawkins.

Paratypes: No. 133,007 C.M., from the type locality, April 30, 1948; No. 132,540 C.M., Trujillo, Honduras, March 30, 1948; No. 132,540 C.M., Trujillo, Honduras, March 31, 1948; No. 133,528 C.M., Coyoles, Honduras, June 16, 1948; No. 133,730 C.M., San Esteban, Honduras, June 30, 1948.

Subspecific characters

Differs from *Aratinga astec astec* from Costa Rica in being decidedly paler on the breast, abdomen and flanks, the green being duller and more suffused with a grayish undertone, the olivaceous cast to the breast and throat duller; the back is paler with an olivaceous cast on the crown, back and interscapular regions in contrast to the brighter green of *Aratinga astec astec.* Similar to *Aratinga astec vicinalis* but is duller and lacks the bright greens on abdomen and back. Specimens from British Honduras are intermediate between *Aratinga astec vicinalis* and *Aratinga astec melloni.*

Average Measurements

Based on six specimens: wing, 132-139 (135); tail, 109-113 (112.5); culmen, 19-20 (19.7); tarsus, 12-15 (13.5).

Issued April 28, 1950.

SPECIMENS EXAMINED

All specimens listed below are contained in the collection of the Carnegie Museum.

Aratinga astec melloni—Honduras: La Ceiba, 2; Trujillo, 1; San Esteban, 1; Coyoles, 1.

Aratinga astec vicinalis—Mexico: Estado de Tamaulipas, 1.

Aratinga astec vicinalis (intermediate with *A. a. melloni*)—British Honduras: Manatee Lagoon, 6; Duck Run (Benque Ceiba), 1.

Aratinga astec astec—Costa Rica: El Hogar, 3; Guapiles, 4.

Present known range: North coast of Honduras inland to Olancho.

ART. 14. A STUDY OF THE SALAMANDER, *AMBYSTOMA CINGULATUM*, WITH THE DESCRIPTION OF A NEW SUBSPECIES

By Coleman J. Goin
University of Florida

(Plate 1)

Ambystoma cingulatum Cope belongs to the group of salamanders of the genus *Ambystoma* which have the plicæ of the tongue diverging from a median furrow rather than radiating from the posterior base of the tongue. Included in this group are *cingulatum*, *annulatum*, *texanum* (*sensu lato*), *mabeei*, and probably *schmidti* of Mexico. In addition to the character of the tongue, *annulatum*, *texanum*, and *cingulatum* are further characterized by multiple rows of teeth on the jaws, and in *cingulatum* and *annulatum* the individual tooth terminates in a rounded knob rather than in a point. *A. cingulatum* differs from *annulatum* in its smaller size, much narrower head, and in that the pattern is not composed of just a few pronounced annuli.

Although it has been more than eighty years since *A. cingulatum* was first described by Cope (1867: 205), remarkably little new information has been added to the original description, primarily because no one seemed to know where to look for the species. Within the past several years two persons have independently found how to collect the form and a fair amount of recent material has thus become available. Wilfred T. Neill, formerly of Augusta, Georgia, and now with Ross Allen's Reptile Institute, has been successful in collecting the species on the Atlantic Coastal Plain of Georgia and South Carolina, and Mr. Harvard E. Nygren, a student of the University of Florida, has discovered a population of *cingulatum* just north of Pensacola in Escambia County, Florida. Both of these gentlemen have kindly collected fresh material for me. More recently, since the habitat of the species has become known, other interested persons have collected specimens. There has thus been made available to me more than five times as much material as any previous worker has had.

Examination of this recent material, much of which I have seen alive, and re-examination of specimens heretofore available in collections, revealed that *cingulatum* is made up of two well-differentiated subspecies, one on the Atlantic Coastal Plain and the other on the Gulf Coastal Plain. Since the type locality for *cingulatum* is Grahamville, South Caro-

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lina, this name must be applied to the Atlantic Coast form. No name appears available for the Gulf Coast population and I therefore take pleasure in naming it in honor of my distinguished friend, Dr. Sherman C. Bishop.

Ambystoma cingulatum bishopi, subsp. nov.

RETICULATED SALAMANDER

(PLATE 1)

1917. *Ambystoma cingulatum* Stejneger and Barbour, *A Check List of North American Amphibians and Reptiles*, 1st ed., p. 8 (part).—Dunn, Bull. Mus. Comp. Zoöl., Vol. LXII, no. 9, 1918, p. 458.—Löding, Geol. Surv. Ala., Mus. paper no. 5, 1922, p. 11.—Stejneger and Barbour, *A Check List of North American Amphibians and Reptiles*, 2nd ed., 1923, p. 4 (part).—Stejneger and Barbour, *A Check List of North American Amphibians and Reptiles*, 3rd ed., 1933, p. 4 (part).—Wright, Proc. Nat. Acad. Sci., Vol. XXI, no. 6, 1935, pp. 340, 341 (part).—Wright, Science, Vol. LXXXI, no. 2106, 1935, p. 463 (part).—Stejneger and Barbour, *A Check List of North American Amphibians and Reptiles*, 4th ed., 1939, p. 7 (part).—Carr, Univ. Fla., Biol. Sci. Ser., Vol. III, no. 1, 1940, pp. 30, 46 (part).—Orton, Copeia, 1942, no. 3, pp. 170, 171.—Bishop, *Handbook of Salamanders*, 1943, pp. 113, 123-126 (part).—Stejneger and Barbour, Bull. Mus. Comp. Zoöl., Vol. XCIII, no. 1, 1943, p. 9 (part).—Allen and Neill, A checklist of the amphibians and reptiles of Florida, 1949, p. 1 (part).

1940. *Ambystoma texanum* Carr, Univ. Fla., Biol. Sci. Ser., Vol. III, no. 1, pp. 30, 46.

Type: Carnegie Museum, no. 29,137, adult female, collected about five miles north of Pensacola, Escambia County, Florida, May 7, 1949, by Harvard E. Nygren, and preserved on December 8, 1949.

Paratypes[1]*:* Sixty-two, as follows: Alabama: Mobile Co., Mobile; USNM 42,861, 57,389-90. Florida: Calhoun Co., Scott's Ferry; ERA-WTN 14,004 (32); Escambia Co., Pensacola; DBUF 34; about 5 mi. N. Pensacola, AMNH 54,742, ANSP 26,274-75, SCB, 1,546-47, CM 29,138-144, CAS, 15,550-51, DBUF, 2,627, CJG 1,869 (alive), MCZ 26,754-55, Tulane 11,824, UMMZ 100,982-83; Jackson Co., near Cottondale; UMMZ 77,062 (2); Mariana; UMMZ 73,989. Georgia: Baker Co., 1.5

[1] ERA-WTN, E. Ross Allen-Wilfred T. Neill collection; AMNH, American Museum of Natural History; ANSP, Academy of Natural Sciences of Philadelphia; SCB, personal collection of Sherman C. Bishop; CM, Carnegie Museum; CAS, Chicago Academy of Sciences; JWC, personal collection of John W. Crenshaw; DBUF, Department of Biology, University of Florida; CJG, personal collection of Coleman J. Goin; MCZ, Museum of Comparative Zoölogy; Tulane, Department of Zoology, Tulane University; USNM, United States National Museum; UMMZ, University of Michigan, Museum of Zoology.

mi. NNE junction of Early, Miller, and Baker counties; JWC 293; Early Co., junction of Colquit-Blakely and Hilton-Damascus roads; UMMZ 100,695.

Diagnosis: An *Ambystoma* with multiple rows of knob-like teeth on both jaws and on the vomers and with a dorsal pattern of reticulations formed by narrow, orange-gray lines on a chocolate-black background; ventrally the pattern may be described as tiny gray flecks on a dark background giving a salt and pepper appearance. From *Ambystoma cingulatum cingulatum* it differs in its more robust build, in having a ventral pattern salt and pepper in appearance rather than a series of discrete white spots on a dark background, in having a more reticulate dorsal pattern, and in showing a tendency toward having the vomerine teeth arranged in two rows rather than three, and fewer in number (average 13.2 in each patch in *bishopi*, 15.6 in each patch in *cingulatum*).

Description of Type: Skin smooth on dorsum and venter, heavily wrinkled on sides between axilla and groin. No large glands present. No discernible rows of mucous pores on head.

Head (as seen from above) somewhat elongate, the sides nearly parallel behind the eyes, in front of eyes tapering to a rounded snout; as seen from side, somewhat depressed, only slightly arched above; snout projecting beyond tip of lower jaw. Outline of mouth nearly straight posteriorly, curving down anteriorly; angle of mouth below posterior margin of eye. No canthus rostralis. Nostrils small, semicircular, anterior in position being located nearly at tip of snout; distance between nostril and anterior corner of eye equals length of eye; distance between nostrils equals about two-thirds length of eye. Eye moderate in size, distance from tip of snout just slightly exceeding length of eye. Upper eyelid fitting over lower eyelid both anteriorly and posteriorly. A distinct groove passes downward and backward from posterior corner of eye to behind base of jaw where it forks, one branch extending downward and the other branch curving upward and posteriorly, nearly reaching the gular fold on the side of the head. The gular fold extends well up on the side of the neck on each side, ventrally it forms a very obtuse angle directed anteriorly. Head width 5.42 times in body length; head length 3.35 times in body length.

Body somewhat slender for an *Ambystoma*, very slightly flattened dorsoventrally. No pronounced constriction at neck. A narrow mid-dorsal groove; a broad but shallow mid-ventral groove. Costal grooves 15, extending dorsally to the mid-dorsal groove and connecting across the

venter. Costal folds between adpressed toes, two. Vent a short, slightly elevated slit; internal lips folded.

Tail shorter than head and body; 1.22 times in head and body length; not constricted at base; ovate in cross section at base becoming gradually compressed to flattened tip. No tail fins present; posterior fourth of tail slightly keeled above.

Fore limbs moderately stout; fingers four, moderately slender, unwebbed; 3-2-4-1 in order of decreasing length; no metacarpal tubercles present. Hind limbs moderately stout; toes five, moderately slender, unwebbed, 4-3-2-5-1 on right foot; second toe on left foot amputated; no metatarsal tubercles present.

Tongue moderate, slightly free on sides, with a longitudinal median depression from which the plicæ originate. Premaxillary-maxillary teeth rounded, knob-like, arranged in several ill-defined rows, a maximum of four rows in the middle of the upper jaw, tapering to two rows posteriorly. Mandibular teeth similar in structure but more uniformly arranged in rows, essentially three rows present at mandibular symphysis, but at one or two points a fourth row can be discerned; tapering to one or two rows posteriorly. Vomerine teeth rounded, knob-like, arranged in two elongate patches between posterior margins of internal nares; distance between patches about one-half the width of an internal naris; neither patch extending laterally to behind the naris; fourteen teeth in left patch, eleven teeth in right patch. Internal nares moderate, rounded.

Coloration (preserved): Ground color above, blackish; dorsal pattern consisting essentially of reticulations which are formed in the following manner: on each side, from the angle of the jaws to the base of the tail, there is a creamish-yellow, lichen-like area interspersed with gray vermiculations. Between the axilla and groin there arises from this creamish-yellow area a series of narrow, gray bands which pass upward, generally one present on each costal fold. As these bands pass upward they frequently anastomose to form reticulations. About one-third of them continue up and meet their fellows from the opposite side on the mid-line of the back. The pattern on the top of the head and the dorsal surface of the tail is essentially the same except that the narrow, gray bands do not follow costal folds. Ventrally, the pattern of the throat, belly, and under surfaces of the tail, and limbs, is composed of innumberable tiny white areas on a ground color of grayish-black, giving a salt and pepper appearance. The dorsal surfaces of the limbs have narrow, gray bands similar to those on the back.

Coloration in life: In life the ground color of the dorsum was a chocolate-black and the narrow dorsal bands were a brownish-gray. The lateral, lichen-like areas on the sides of the head and between the axilla and groin were pearl-gray; hence these lichen-like areas and the dorsal bands arising from them were appreciably different in coloration. The ventral ground color was black and the ventral light markings were a diffuse gray.

Measurements (in millimeters): Head width, 8; head length, 13; body length, 43.5; tail length, 46.5; axilla to groin, 30; fore limb, 12; hind limb, 13; total length, 103.

Variation: Fresh adult material of *A. c. bishopi* is rather uniform in coloration, but there is some variation in the dorsal pattern. The ground color of the dorsum is a chocolate-black and the lateral, lichen-like marks between the axilla and groin are gray, but the narrow bands which arise from this lateral, gray area, generally one on each costal fold, are a definite brownish-gray. Thus in life the dorsal bands seem to arise from, but not be continuations of, the lateral, gray areas whereas in *A. c. cingulatum* the dorsal bands seem to be mere continuations of the lateral, gray areas. In the majority of the adult specimens of fresh material the dorsal, light marks tend to divide and anastomose, giving a definitely reticulated appearance to the dorsal surface. Markings similar to those of the back are present on the top of the head and sides and top of the tail. In a specimen which I still have alive in a terrarium (plate 1, fig. 5) the brownish-gray bands arising from the lateral, gray areas and ascending on the costal folds show the minimum amount of branching or anastomosing, the great majority of them continuing uninterruptedly to the mid-line of the back where they meet their fellows from the opposite side, giving the individual an annulate rather than a reticulate appearance.

Ventrally, the ground color is black with numerous tiny, anastomosing, gray flecks giving the throat, venter, and under side of the tail, a salt and pepper appearance. In general, the dark pigment ventrally is more concentrated posteriorly so that there is an indefinite gradient in tone with the animal being lightest under the chin and throat, intermediate on the venter, and darkest on the ventral side of the tail.

As so much of the heretofore available material was old and in such poor condition that teeth and costal grooves could not be counted or accurate measurements made, I list in Table 1 tooth counts, costal groove counts, and measurements of eleven recently collected and well preserved specimens of *A. c. bishopi* that are 50 mm. or more in head and body length. From this table it can be seen that the costal grooves (all forks

counted) are constant at 15. The axilla to groin length seems to be on the average greater in relation to the head length and the limb length than it is in *A. c. cingulatum.* In this fresh, adult material of *bishopi* the number of costal folds between adpressed toes ranges from 2 to 4 with an average of 3.23. In axilla to groin length divided by head length, *bishopi* ranges from 2.23 to 2.77 with an average of 2.52.

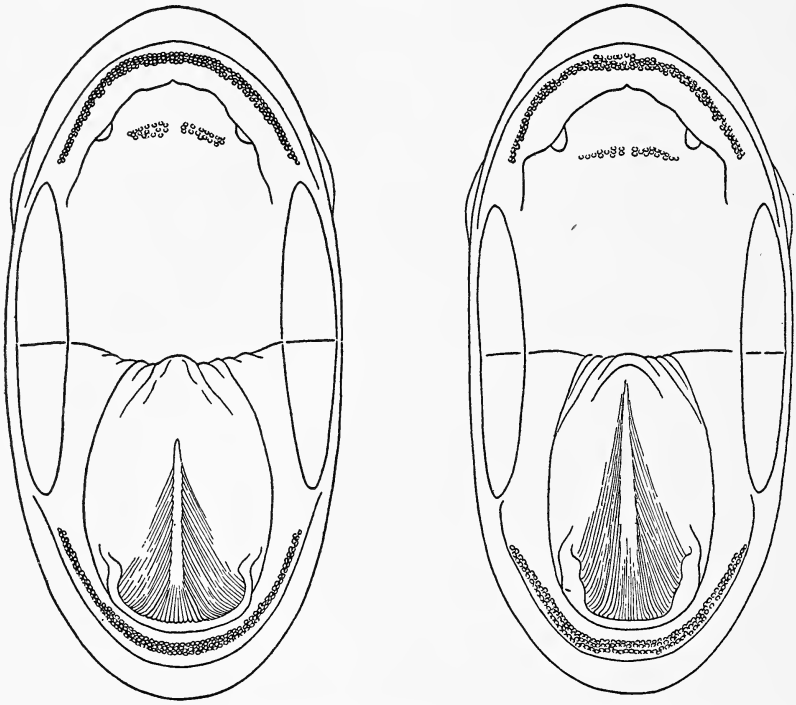

FIG. 1. Left, teeth of *Ambystoma c. cingulatum* from Emanuel Co., Georgia, CM 29,145. Right, teeth of *Ambystoma c. bishopi* from Escambia Co., Florida, CM 29,137 (type).

If all specimens in which I have been able to make accurate counts are considered, the number of rows of teeth on the premaxillary-maxillary occur in the following order of frequency: 3, seven times; 4, thirty-five times; 5, eight times; and 6, once. The numbers of rows of teeth on the mandibles occur as follows: 3, twenty-two times; 4, twenty-six times; and 5, twice. In all specimens in which accurate counts of vomerine teeth were possible, the number in each patch ranges from 5 to 20 with an average of 13.2. In general, the vomerine teeth in *A. c. bishopi* are arranged in

Museum	Number	Costal Grooves	Vomerine Teeth	Costal Folds between adpressed toes	Head and Body Length	Head Length	Head Width	Tail Length	Axilla to Groin	Total Length
JWC	293	15–15	13–17	4	62	13	7.8	32	36	94
SCB	1547	15–15	10–10	4	61	13	8.5	51	33	112
Tulane	11824	15–15	7–5	4	61	12.5	8.7	43	33	104[2]
ANSP	26274	15–15	18–19	3	59	13	9.6	49	33	108
ANSP	26275	15–15	7–8	3+	59	12	8.7	39	30	98
CM	29138	15–15	11–18	4	57	12	8.6	46	31	103[2]
CAS	15551	15–15	5–6	3½	55	11.5	8.4	37	31	92
CM	29137	15–15	14–11	2	55	13	8.0	46.5	30	103
CM	29139	15–15	5–9	3	55	12	8.0	57	31	112
UMMZ	100695	15–15	13–14	2	55	13	7.7	34	29	89
DBUF	344	15–15	– –	3	52	12	7.8	36	28	88[2]

TABLE 1. Costal groove counts, vomerine tooth counts, and measurements of eleven fresh specimens of *A. c. bishopi* 50 mm. or more in head and body length.

[2] Tip of tail broken.

two rows whereas in *A. c. cingulatum* they show a definite tendency to be arranged in three rows.

In general build, an adult specimen of *bishopi* usually lacks a definite constriction at the neck and has a broad, heavy tail. This is in contradistinction to *A. c. cingulatum*, a form which has a rather definite neck and generally a more slender tail.

Specimens from Calhoun County, Florida, approach *c. cingulatum* in three respects: ventral pattern, vomerine tooth number, and costal grooves. The thirty-two specimens in this series were unfortunately placed in a bottle containing preservative too strong, so that they are coiled and quite stiff, hence impossible to measure accurately. Therefore they are not included in the table. In ventral pattern, the ventral, light spots are slightly larger and more scattered than in topotypical *bishopi* although there is some variation within the series. In the vomerine tooth-count, the series ranges from 12-12 in the specimen having the lowest count to 21-21 in the specimen with the highest, and averages 14.5 in each patch, which is above Pensacola specimens which average 9.7 in each patch, but below *cingulatum* which averages 15.6 in each patch. Two of the thirty-two specimens have 16 costal grooves, a count commonly found in *cingulatum*. The specimens JWC 293 from Baker County, Georgia, and UMMZ 100,695 from Early County, Georgia, are like the Calhoun County specimens in having the ventral spots a little larger than they are in the Pensacola specimens. The vomerine tooth-counts are 13-17 and 13-14 respectively. Finally, it should be mentioned that several of the Calhoun County specimens tend to have the vomerine teeth alined in three rather than two rows and thus approach *c. cingulatum* in this respect.

The dorsal pattern seems to be the same as it is in the Pensacola specimens. Although not measurable, in general body form they are comparable to topotypical specimens of *bishopi* and I have therefore included them in the definition of this race.

This Calhoun County series exhibits a certain degree of abnormality in feet and hands. Three specimens have some modification of the normal digital complement. One of these has the middle toe on the left hind foot bifurcate, and the third toe on right foot amputated. In another specimen, the third digit on the right hand has two supernumerary digits growing out of the side of it, and another specimen has the fifth toe missing and the fourth very short on the right hind foot. Finally, one specimen has the left hand amputated.

Sexual dimorphism: In the series of thirty-two specimens from Scott's

Ferry, Calhoun County, there are fifteen males and seventeen females. Sexual dimorphism is not pronounced in this species. The males have the cloacal region slightly swollen but this character is by no means so obvious in this species as it is in the larger species of *Ambystoma*. The most convenient and accurate method of determining sex is by examination of the Müllerian duct, which is pigmented in the males and unpigmented in the females, as is the case in *Salamandra* (see Francis, *The Anatomy of the Salamander*, 1934: 284). The amount of pigmentation is apparently correlated to some extent with age, since the ducts in the larger males are more heavily pigmented than they are in the smaller individuals.

Ambystoma cingulatum cingulatum Cope

FROSTED SALAMANDER

(PLATE 1)

1867. *Amblystoma cingulatum* Cope, Proc. Acad. Nat. Sci. Phila., Vol. XVIII, p. 205.—Strauch, Mem. Imperiale des Sci., St. Petersbourg, Tome XVI, no. 4, 1870, p. 65.—Cope, Bull. U. S. Nat. Mus., no. 1, 1875, p. 26.—Boulenger, Cat. Bat. Grad., 1882, p. 50 (part).—Davis and Rice, Ill. State Lab. of Nat. Hist., Bull. no. 5, 1883, p. 11.—Yarrow, Bull. U. S. Nat. Mus., no. 24, 1883, pp. 21, 192.—Garman, Bull. Essex Inst., Vol. XVI, 1884, p. 38.

1886. *Amblystoma lepturum* Cope, Proc. Amer. Philos. Soc., Vol. XXIII, p. 524. —Cope, Amer. Nat., Vol. XXI, 1887, p. 88.

1889. *Chondrotus cingulatus* Cope, Bull. U. S. Nat. Mus., no. 34, p. 100.

1889. *Linguaelapsis lepturus* Cope, Bull. U. S. Nat. Mus., no. 34, p. 116.

1907. *Ambystoma cingulatus* Brimley, Jour. Elisha Mitchell Sci. Soc., Vol. XXIII, no. 4, p. 153.

1917. *Ambystoma cingulatum* Stejneger and Barbour, *A Check List of North American Amphibians and Reptiles*, 1st ed., p. 8 (part).—Stejneger and Barbour, *A Check List of North American Amphibians and Reptiles*, 2nd ed., 1923, p. 4 (part).—Brimley, Jour. Elisha Mitchell Sci. Soc., Vol. XLII, nos. 1 & 2, 1926, p. 77.—Wright, Ecology, Vol. VII, no. 1, 1926, p. 82.—Stejneger and Barbour, *A Check List of North American Amphibians and Reptiles*, 3rd ed., 1933, p. 4 (part).—Wright, Proc. Nat. Acad. Sci., Vol. XXI, no. 6, 1935, pp. 340, 341 (part).—Wright, Science, Vol. LXXXI, no. 2106, 1935, p. 463 (part).—Gee, South Carolina Vert. Fauna, 1936, p. 1.—Brimley, Carolina Tips, Vol. II, no. 4, 1939, pp. 14, 15.—Stejneger and Barbour, *A Check List of North American Amphibians and Reptiles*, 4th ed., 1939, p. 7 (part).—Carr, Univ. Fla., Biol. Sci. Ser., Vol. III, no. 1, 1940, pp. 30, 46 (part).—Bishop, *Handbook of Salamanders*, 1943, pp. 113, 123-126 (part).—Stejneger and Barbour, Bull. Mus. Comp. Zoöl., Vol. XCIII, no. 1, 1943, p. 9 (part).—Allen and Neill, A checklist of the amphibians and reptiles of Florida, 1949, p. 1 (part).—Neill, A checklist of the amphibians and reptiles of Georgia, 1949, p. 1.

1932. *Ambystoma angulatum* Wright, *Frogs of the Okefinokee Swamp*, p. 10.

Type locality: Grahamville, Jasper County, South Carolina.

Neotype (here selected): USNM 129,396, adult female collected at Robertsville, Jasper County, South Carolina, Nov. 17, 1947, by Wilfred T. Neill.

Diagnosis: An *Ambystoma* with multiple rows of knob-like teeth on both jaws and on the vomers, and with a dorsal pattern consisting of grayish-green, lichen-like marks which tend to form reticulations. From *Ambystoma cingulatum bishopi* it differs in its more slender, delicate build, in having the ventral pattern composed of discrete light spots on a dark background and the dorsal pattern more lichen-like or "frosted" in appearance, and in a tendency toward having the vomerine teeth arranged in three rows and more numerous (average 15.6 in each patch in *cingulatum*, 13.2 in each patch in *bishopi*).

Variation: The fresh material of *A. cingulatum cingulatum* which I have been able to examine is remarkably uniform in general appearance. The dorsal pattern has a ground color of black with extensive, gray, lichen-like markings concentrated along the side between the axilla and groin. On each costal fold these gray, lichen-like marks extend dorsally, generally forking near the mid-line of the back to meet their fellows from the opposite side. Similar diffuse lichen-like marks are present on the top of the head and top and sides of the tail. The general effect of these gray, somewhat indefinite bands on the black background is to give the salamander a lichenose or frosted appearance and Brimley's use of the common name "frosted salamander" seems to me to be appropriate for this subspecies. Ventrally the ground color is black with scattered pearl-gray light spots.

Since much of the material which has heretofore been available for study is old or poorly preserved, I give in Table 2 a list of counts and measurements made on recently collected specimens 50 mm. or more in head and body length. From this table it can be seen that *cingulatum* has a tendency to have sixteen costal grooves (all forks counted) whereas fifteen is the number in the great majority of *bishopi*. It likewise tends to be relatively shorter in axilla to groin length in relation to head and leg length than does *bishopi*. In this fresh, adult material of *cingulatum* the number of costal folds between adpressed toes ranges from 0 to 3 with an average of 1.69. In axilla to groin length, divided by head length, *cingulatum* ranges from 2.08 to 2.62 with an average of 2.33.

There is a pronounced tendency in *cingulatum* for the teeth to be arranged in rather compact groups. The teeth on both jaws are arranged

Museum	Number	Costal Grooves	Vomerine Teeth	Costal Folds between adpressed toes	Head and Body Length	Head Length	Head Width	Tail Length	Axilla to Groin	Total Length
DBUF	2628	16–16	23–19	3	60	13	9.5	49	34	109
DBUF	2629	15–15	14–16	2	56	13	7.9	30	30	86
CM	29145	15–15	17–16	1½	52.5	12.5	7.5	41.5	28	94
ERA-WTN	14005(a)	15–16	15–14	1	52	11	7.4	39	28	91
ANSP	26277	16–15	24–22	1	52	13	8.2	40	27	92
ANSP	26276	16–16	17–15	2	52	12.5	7.7	45.5	28	97.5
ERA-WTN	14005(b)	16–16	13–15	3	51.5	12	8.1	37.5	28	89
USNM	129396	15–15	19–19	0	50	12	7.8	38	27	88

TABLE 2. Costal groove counts, vomerine tooth counts, and measurements of eight fresh specimens of *A. c. cingulatum* 50 mm. or more in head and body length.

in more or less definite rows and in the specimens in which unquestionable counts can be made the rows on the premaxillary-maxillary vary from 3 to 6, occurring in the following frequencies: 3, twice; 4, eight times; 5, three times; and 6, once. On the mandible the number of rows ranges from 2 to 4, occurring in the following frequencies: 2, once; 3, three times; 4, nine times. In vomerine teeth there is a tendency for three rows to be formed on each patch and in fresh material there is definitely a greater number of teeth in each patch than in *bishopi*. Extreme caution should be used in counting vomerine teeth since, if a needle is used in the process, many peripheral teeth may be displaced without leaving a definite gap, thereby causing future workers to obtain a lower count. Thus, at the present time, I am able to count only 12 in each patch on USNM 49,432 from Jacksonville, Florida, a specimen which has been examined many times by many workers, and on USNM 14,583, the type of *A. lepturum* Cope, there are now 9 teeth in the left vomerine patch and 10 on the right. Since in this specimen, however, the vomerine teeth tend to be arranged in three rows, since a faint trace of a ventral pattern similar to that of *c. cingulatum* is still discernible, and since the general build is much more similar to *cingulatum* than it is to *bishopi*, I do not hesitate to consider it a synonym of *A. c. cingulatum*.

I have seen two specimens which are recorded in the literature as coming from Pensacola, Florida, which seem to me to be referable to *cingulatum* rather than to *bishopi*. These are MCZ 204. In both of these specimens the vomerine teeth are uncountable. The larger specimen has 16 costal grooves on the left and 15 on the right, and the smaller I could not count accurately. The smaller of the two specimens is certainly recently transformed and the adult pattern is not fully developed. In the larger, however, although it is somewhat faded dorsally, the ventral pattern is quite distinct and is similar to that seen in fresh material of *cingulatum* and unlike that of any of the fresh material of *bishopi* I have seen from Pensacola. When I queried Mr. Loveridge regarding the data of these two specimens, he told me that the entry in the catalogue of the Museum of Comparative Zoölogy reads as follows: "*Amblystoma jeffersonianum* Bd. var. 2 ex. Pensacola, Fla. Alcoholic. (Collected) 1853. Col. Deas. Prof. Agassiz. Sent to Prof. Baird Jan. 22nd 1859. (entered in register) Feb. 20, 1862." In view of the length of time that elapsed between collection of the specimens and their entry in the catalogue, the possibility of error cannot be ruled out.

LIFE HISTORY

Habitat: Both races of *A. cingulatum* seem to be essentially inhabitants of slash pine—wire grass flatwoods. Every specimen for which detailed ecological notes are available was taken in or near one of the small, shallow, cypress ponds so characteristic of these flatwoods or in a drainage area from such a pond.

Habits: Specimens of *A. c. cingulatum* can be found under logs around the margins of the above-mentioned ponds throughout the winter months. While they appear to be quite capable burrowers, Wilfred T. Neill informs me that they show a pronounced tendency to occupy crayfish burrows.

The recent specimens of *A. c. bishopi* from Escambia County, Florida, have all been taken near an old, abandoned air field which had been made in the flatwoods about five miles north of Pensacola. Most of the specimens were found around the margin of a cypress pond, that has become more or less a dump heap, near the edge of the air field. Specimens have been taken in April, May, June, September, and November by turning over the rubbish in contact with the moist ground. In one case, specimens were found under clods of earth that had been turned up by people digging fishing worms. The specimen from Baker County, Georgia, was taken under a cypress log eight to ten inches in diameter in the nearly dry basin of a similar cypress pond. A specimen of *Triturus v. louisianensis* was under the same log.

The individuals that I kept alive in a terrarium in my back yard from May 7, 1949, to February, 1950, were active burrowers and built extensive tunnels about equal in diameter to that of their bodies through the four inches or so of dirt in the bottom of the terrarium. Some days they would remain in the tunnels, while on others they would rest under a board kept in the terrarium. They generally tended to remain hidden either in the tunnels or under the board except on rainy nights when they would come out and wander about on the surface. During February and March, 1950, the specimen (CJG, 1,869), still alive in the terrarium, had a burrow which had its entrance at the exposed surface rather than under the board. While occupying this burrow it would remain hidden during the day but would often rest at night with just the tip of its head exposed. They made no attempt to climb the glass walls of the terrarium.

Eggs and Breeding Season: Specimens of both subspecies have been found with mature, pigmented eggs in the ovaries. A specimen of *cingulatum* from Jasper County, South Carolina, taken on November 7, 1947,

had twenty-one pigmented eggs in the left ovary and twelve in the right. Another specimen, from Emanuel County, Georgia, collected November 24, 1949, had forty pigmented eggs in the left ovary and thirty in the right.

Two specimens of *A. c. bishopi* with pigmented eggs seem to indicate a rather extensive breeding season. A specimen taken in Escambia County, Florida, in June, 1949, had sixty-three pigmented eggs on the left side of the body and sixty-four on the right, whereas the specimen taken by John Crenshaw in Baker County, Georgia, on January 13, 1950, when killed on January 25, had forty-seven eggs on the left side and fifty-five on the right.

The series of thirty-two specimens taken at Scott's Ferry, Calhoun County, on February 20, 1950, had presumably bred shortly prior to the time of collection. In none of the females were the ovaries full of pigmented eggs and six had obviously spent ovaries in which just a few pigmented eggs were retained. In these six specimens the following numbers of pigmented eggs were found (in each case the first figure is for the left side of the body, the second for the right): 7-2, 3-0, 0-2, 2-4, 0-1, 1-0.

Larvæ and Immatures: Orton (1942: 170) described and illustrated three larval specimens of *Ambystoma* which, on the basis of comparison with known larvæ, she assigned to *cingulatum*. Upon comparison of these larvæ with recently transformed specimens of both races of *cingulatum*, I feel confident that Dr. Orton's identification of them as belonging to this species is correct. In addition to the three larvæ from Jackson County mentioned above, I have seen three recently transformed specimens which retain the larval pattern: AMNH 36,479 (38 mm., head and body length; 65 mm., total length), from Lanier County, Georgia; CM 29,141 (36 mm., head and body length; 57 mm., total length) from Escambia County, Florida; and MCZ 204 B, purportedly from Escambia County, Florida. I have indicated earlier (p. 310) that the adult specimen numbered MCZ 204 seems to be more like *cingulatum* than *bishopi*. Examination of the recently transformed specimen confirms this opinion.

The specimen of *cingulatum* from Lanier County, Georgia, is brown in ground color with a tan stripe extending from axilla to groin and another tan stripe extending from above the arm posteriorly until it fades out on the distal third of the tail. There is a black stripe from the nostril which extends posteriorly through the eye to the vertical extension of the gular fold on the side of the neck. Above this is a slightly lightened area as though the uppermost lateral stripe in life continued on to the side of the head. A narrow mid-dorsal light line extends from the base of the head to

above the insertion of the fore limbs. There is a very narrow black margin along the sides of the upper lip. The venter is very pale brown. The same general coloration and pattern can be made out in MCZ 204 B except that the upper lateral stripe is more indistinct, the adult pattern is becoming discernible on the tail and the venter is becoming more heavily pigmented, leaving spots of unpigmented areas. The specimen of *bishopi* from Escambia County, Florida, although 2 mm. less in head and body length and 8 mm. less in total length than the specimen of *cingulatum*, has more of the adult pattern. Both of the lateral stripes are still present but the stripe between the axilla and groin is breaking up into patches and the superior lateral stripe is not nearly so sharply defined as it is in the specimen from Lanier County, Georgia. Furthermore, although the specimen from Lanier County has a definite dorsal fin on the tail extending from above the vent to the tip, the tail fin is completely obsolete in the Escambia County specimen of *bishopi*. The adult dorsal pattern is beginning to develop between the upper lateral stripes in the specimen of *bishopi;* there is no hint of it in the specimen of *cingulatum*. There is no trace of a mid-dorsal light line in the former.

If these specimens are at all typical as to the size at which the adult color pattern is developed, it would seem that *bishopi* transforms and attains the adult pattern at a smaller size than does *cingulatum*. While the specimen of *cingulatum*, 38 mm. in head and body length, retains the larval coloration and tail fin, the specimen of *bishopi*, 36 mm. in head and body length, is beginning to lose the larval coloration and attain the adult pattern and has completely lost the tail fin. Two other specimens of *bishopi*, collected at the same time and place as the recently transformed one described above, and measuring 36 and 38 mm. in head and body length and 56 and 62 mm. in total length respectively, show the typical sub-adult pattern and have lost all sign of a tail fin.

The sub-adult pattern of *A. c. bishopi* differs from the adult in that the dorsal reticulations are less sharply defined and the venter is paler in coloration. In immature specimens ranging from 36 to 43.4 mm. in head and body length, there is a definite light area on the ventral surface of the throat just anterior to the gular fold, and the chin, venter, and under surface of the tail are paler than in adult specimens. The lichen-like area between the axilla and the groin seems to be less well developed since in specimens of this size the light areas are not confluent but consist of ill-defined but separate light marks.

Growth Rate and Longevity: No information is available regarding *A. c.*

cingulatum but a specimen of *A. c. bishopi*, measuring 35 mm. in head and body length and 56 mm. in total length, was put in my terrarium on May 7, 1949. It fell into a pan of water in the terrarium and drowned, apparently on the night of June 23, since, when I returned from the meetings of the American Society of Ichthyologists and Herpetologists in Washington on June 24, I found it in the pan of water, dead but still in good, fresh condition. At this time, after a lapse of 47 days, it measured 44 mm. in head and body length, an increase of 9 mm., and 73 mm. in total length, an increase of 17 mm.

Two adult specimens of *A. c. bishopi* which were also placed in the terrarium on May 7 thrived until February 7, a period of 9 months, when my two-year old son released one of them in the leaf mold of my back yard. The other is still (July 18, 1950) alive.

Food: Apparently both subspecies feed on earthworms. Three specimens of *A. c. bishopi* taken in September, and one taken in February, had the undigested remains of earthworms in the digestive tract, and one specimen of *A. c. cingulatum* from Jasper County, South Carolina, taken in October, 1947, had no less than seven pieces of earthworm in its stomach. Since five of these pieces were terminal sections, it is evident that parts of at least three individual worms were in the stomach at one time. Many of the series of specimens of *bishopi* taken in February in Calhoun County regurgitated earthworms when they were placed in what was apparently a quite strong preserving fluid, and earthworms were found in eight of the specimens when their digestive tracts were examined after preservation. I have twice found tiny fragments of unidentifiable plant remains in stomachs of *bishopi*, and the majority of stomachs of both subspecies which I have examined have contained at least a few sand grains. This, of course, would be expected if earthworms are a staple in their diet.

The earthworms removed from the salamanders probably belong to the genus *Diplocardia* according to my colleague, Professor E. Ruffin Jones.

I have made no attempt to supply food to the adult specimens which I have kept alive, but the soil which I put into the terrarium came from my back yard, which supports a flourishing annelid population, and worms have frequently been seen in the terrarium. While I have never been able to observe one of the salamanders in the process of eating, they seemed to thrive and apparently there was no other food available.

RANGE

Ambystoma c. cingulatum ranges from Colleton County, South Carolina, and Jefferson County, Georgia, west and south to Lanier County, Georgia, and Duval County, Florida.

Ambystoma c. bishopi seems to be restricted to a region on the Gulf Coastal Plain from Baker County, Georgia, and Calhoun County, Florida, west to Mobile Bay, Alabama. Dr. E. R. Dunn informs me that he has

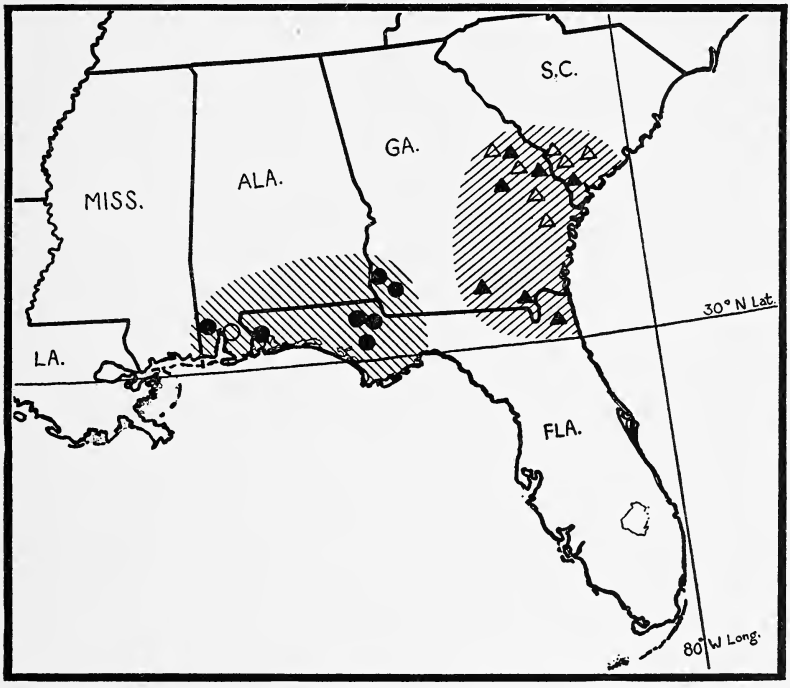

FIG. 2. Map showing the distribution of the subspecies of *Ambystoma cingulatum*. Triangles, *Ambystoma c. cingulatum;* circles, *Ambystoma c. bishopi*. Solid symbols, specimens examined; hollow symbols, literature records.

examined the specimen recorded by Boulenger (1882: 50) from New Orleans, that it is at present uniform black, and that his notes indicate that it is most likely a specimen of *texanum*. Since I have seen a number of fresh specimens of a small dark form of *texanum* from the same vicinity, and since no other specimens of *cingulatum* have ever been taken from there, it seems wisest to me to consider Louisiana beyond the range of *bishopi* unless and until fresh specimens of this subspecies are collected from there.

The accompanying map indicates the distribution of the two subspecies. The solid symbols represent localities from which specimens have been examined by me and the hollow symbols represent literature records. The records represented by hollow symbols from northern Georgia and South Carolina are from Wilfred T. Neill's unpublished manuscript, "The Amphibians of Georgia."

Specimens Examined

Ambystoma cingulatum cingulatum: Nineteen, as follows: South Carolina: Jasper Co., Ridgeland, ERA-WTN 14,007; Robertsville, USNM 129,396 (*neotype*). Georgia: Burke Co., Midville, ANSP 26,277; Charlton Co., 1 mi. E. Chesser School, CU 2,936; 2 mi. E. Chesser Island, CU 2,933; Emanuel Co., ½ mi. S. Midville, Burke Co., ANSP 26,276, CM 29,145, DBUF 2,628-29; McKinney's Pond in northern part of county, ERA-WTN 14,006; Lanier Co., Lakeland, AMNH 36,479, 37,388; Screvin Co., Bascom, ERA-WTN 14,005 (2). Florida: Duval Co., Jacksonville, USNM 49,431-32; ? MCZ 204 (2) (purportedly from Pensacola, Escambia Co.). ?? USNM 14,583, no data (*type of lepturum*).

Ambystoma cingulatum bishopi: In addition to the type and sixty-two paratypes listed, I have seen three additional specimens of *bishopi.* Two of these (MCZ 229) were sent several years ago to the University of Kansas for osteological studies by Mr. Loveridge. The other specimen (CJG 1,870), I kept alive for nine months before it escaped.

Acknowledgments

I am particularly indebted to Wilfred T. Neill and Harvard E. Nygren for the gift of many specimens. In addition, Mr. Neill has kindly made his unpublished manuscript on "The Amphibians of Georgia" available to me. I wish to thank Dr. E. R. Dunn and Dr. Sherman C. Bishop for their valuable suggestions and assistance. For the loan of material I wish to thank E. Ross Allen of Ross Allen's Reptile Institute, Charles M. Bogert of the American Museum of Natural History, Doris M. Cochran of the United States National Museum, Arthur Loveridge of the Museum of Comparative Zoölogy, M. Graham Netting and Grace Orton of the Carnegie Museum, Charles F. Walker of the Museum of Zoology, University of Michigan, A. H. Wright and Edward C. Raney of Cornell University, Fred R. Cagle of Tulane University, and John W. Crenshaw of Emory University Field Station, Newton, Georgia. The drawings are from the pen of Miss Esther Coogle. To her I owe my thanks.

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ADDENDA

After the above paper was submitted for publication, four students at the University of Florida collected a series of *A. c. bishopi* which provides data on abundance. On April 7, 1950, Messrs. David Beecher, Byrum W. Cooper, Robert Hellman, and Edwin H. McConkey collected forty-five specimens about three miles south of Mariana, Jackson County, Florida. These specimens were taken in low slash pine—wire grass flatwoods in an area approximately ⅛ by ¼ of a mile in extent. The region had been recently cut over for timber, and logs about six feet in length had been left lying by the stumps. The four students collected the entire series between four and six in the evening by looking under these logs. Some of them had two or three *bishopi* under them and one had five.

Manculus q. quadridigitatus, *Microhyla c. carolinensis*, and *Storeria d. wrightorum* were found under the same logs as the *Ambystoma*. Eight specimens of *Pseudotriton m. floridanus* were found under logs in damper places in the same general locality but were not taken under the same logs with *bishopi*.

EXPLANATION OF PLATE 1

MISS ESTHER COOGLE, del.

FIG. 1. Dorsolateral view of *Ambystoma c. cingulatum* from Emanuel Co., Georgia, in life. (CM 29,145)

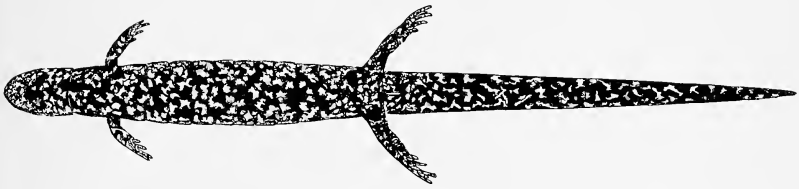
FIG. 2. Ventral view of same.

FIG. 3. Dorsolateral view of *Ambystoma c. bishopi* from Escambia Co., Florida, in life. (CM 29,137, type)

FIG. 4. Ventral view of same.

FIG. 5. Dorsolateral view of *Ambystoma c. bishopi* from Escambia Co., Florida showing maximum degree of annulation. (CJG 1,869).

1



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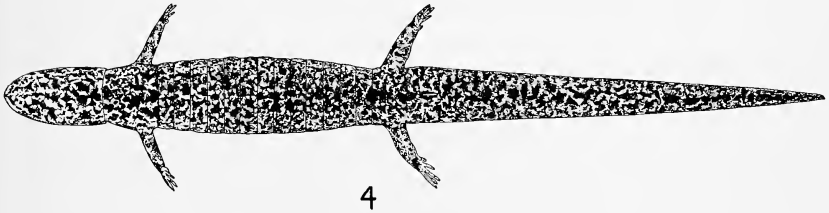

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ART 15. AN ANALYSIS OF COLOR AND PATTERN IN BUTTERFLIES OF THE ASIATIC GENUS *KARANASA*

By Andrey Avinoff
(A posthumous paper. Dr. Avinoff died July 16, 1949.)

Foreword

The major avocation of the late Dr. Andrey Avinoff, Director of the Carnegie Museum from 1926 to 1945, was the collection of butterflies and the study of their colors and patterns. To him the ultimate in rarity and interest was the group of little brown and orange Satyrids of the genus *Karanasa* from the high mountains of Turkestan, Afghanistan, and Kashmir. Over a period of forty years he studied all of the known specimens and gathered together everything that had been written concerning them. He accumulated two imposing collections, the first of which was nationalized by the Soviets and the second given to the Carnegie Museum. I worked with him in the study of these butterflies for eight years and the task of publishing the final report has been placed in my hands. Dr. Avinoff was constantly devising and revising schemes for recording and analyzing the color patterns of *Karanasa*. This one, evolved in 1945, is more or less of a digression from the main line of study of the genus. I present it separately with a minimum of editing.

Walter R. Sweadner,
Curator of Insects, Carnegie Museum

A standardization of properties in coloration and pattern of *Karanasa* lends itself to a graphic survey. A chart based on the characteristics of the front wings has been prepared (plate 1) in order to assist in analyzing the mutual relationship of coloration and pattern of the upperside. It occurs to me that the most convenient way of visualizing these characteristics, as exemplified by all possible variations in *Karanasa*, is to be obtained by a table with vertical and horizontal rows: the vertical columns stand for pattern, the horizontal for pigmentation, thus establishing a system of co-ordinates. By reducing the variety of patterns to as few types as possible it was found that the most practical subdivisions would represent the gradual intensification of the dark parts of the basal portion of the front wings. Thus, the sequence runs through the following gradations: (1) a completely light base, (2) a light base bounded by a dark band through the mesial part of the wing from the middle of the costa to the inner edge, corresponding in part to the branded portion on the wings of the males in some species, (3) a more or less uniform dark suffusion of the base, mixed with the ground color, and without a too contrasting transverse mesial

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band, or (4) a completely dark base approximating in intensity the fuscous marginal area with usually a still darker outline of the discal, light, transverse band. These four divisions would practically suffice if there would not be occasionally some forms displaying a general darkening not only of the basal part but also the outer portion of the wing; the light band in such instances is much darkened, especially exteriorly. Examples of this are few but they have to be accounted for in a diagrammatic scheme and it is questionable whether such a phenomenon should be classified under the terms of pattern or coloration. Since this is an extension and spread of the dark area, it was found more advisable to consider it as a matter of pattern—in the sense of distribution of the light and dark areas on the surface of the wings—and treated accordingly as the fifth step in the horizontal classification of patterns, under (5) general darkening of the wings including chiefly the exterior portions of the post-discal light band.

The vertical divisions of ground color, besides the dark fuscous pattern on portions of the wings, would naturally comprise two tints: different hues of russet, either of a bright brick tint or of an ochreous tone, and a basic whitish or ivory color, corresponding to *astorica* and *naryna* respectively. A pale ochreous tone, standing between these two types of coloration, called for a special subdivision which, however, does not comprise many forms. So the chromatic variation has been broken into three steps: russet, pale ochreous, and whitish, marked as A, B, and C. With the five possible variations of pattern, any form of *Karanasa* can be thus designated by these co-ordinates in a table covering fifteen fundamental types. It is to be noted that males and females of the same form do not fall on the same point of this table of color-pattern co-ordinates. To make the use of the table clearer, each intersection is illustrated by examples of typical males and females having such properties. That is how it happens that in the majority of cases the two sexes belong to different divisions in the table. The fifth group of "general darkening" does not lend itself with certainty to the attribution of russet, ochreous or whitish and in the case of "russet" could not be illustrated by any female. So there is no such insect which could be designated by the formula ♀ A5.

The advantages of this table lie not only in the simplicity of indicating the exterior aspect of a form by means of a symbol, expressed in a letter and a number; it helps also the appreciation of the range of variation, the component elements of variability, and also the deviation of a given type, in terms of color and pattern variations. Diagonal variations on the chart denote naturally the most extreme forms of instability involving a shift in

both respects. Also the most extreme point on diagonal lines constitutes the greatest polarity of types as illustrated, for instance, by *wilkinsi* A1 and *kazakstana* C4 (excluding the fifth step) and *lactea* C1 and *kafir* A4. For instance, the amplitude of variations of *latefasciata* may be made graphically clear by extending into the three horizontal-chromatic-division in the fourth step of patterns A4, B4 and C4, with a tendency to deviate occasionally into B3.

A critical approach to this chart should not minimize a weak side of it, namely the mixed phylogenetic significance of the horizontal row B. The ochreous step, introduced merely for practical reasons to show graded differentiations, contains on the same levels entities which are not wholly comparable. Some of the ochreous forms are merely insects of the russet section that have acquired a paler aspect (like *leechi* and *decolorata*), or a regular whitish species, which has gained more color (like *ershoffi* and some females of *conradti*). For purposes of denoting actual kinship, the level B should be split into a fluctuating line of demarkation segregating only two basic color groups: russet (sometimes pale ochreous) and whitish (sometimes with a yellowish tinge). Grum-Grshimailo with his "keen entomological eye" perceived that it was enough to consider only two chromatic divisions.

As has been stated above, the chart accompanying this paper is used both for supplying a precise notation and for stimulating an analytical appreciation of analogous, but not homologous, properties falling into one category in accordance with the use of suggested coordinates. A compromise in this case is an invitation for a more comprehensive study.

Finally, it is interesting to note the statistical distribution of forms. Of the males, 45 (3/5ths) belong to A1-A4. The horizonal B and the vertical 5 both contain the least number of forms. In the A group the males fall predominantly into the divisions with higher numbers and the females belong mostly to the lower numbers in successive designations. For instance, in the division 4 there are males of several forms and very few females; these females belong to the preceding division 3; males of the 2nd and 3rd divisions often have females of division 1. In B and C the sexes are more closely paired in the various degrees of matching both as to coloration and pattern. Whether it could be an indication that the ancestral prototype fitted closer into these latter groups, as does the American *Neominois*, or that one should not attach any phylogenetic importance to these relationships, is a matter that could not be argued one way or the other on the ground of such considerations. At any rate the sche-

matic table of patterns and colors simplifies and clarifies the revision of forms, and lends itself to interesting comparisons with other properties of the pattern on the underside of the hind wing.

In order to systematize the variations of the configuration of the marbled pattern on the underside, I propose the following method, based on the position and character of dented ante-marginal line e_3 of Schwanwitch, and the properties of the dark median band (plate 2). This ante-marginal toothed line is formed of outward pointed dentations or arrowheads between the veins. In some of the butterflies these points are sharp; in others they are blunted into crescents which tend to produce a scalloped effect. The position of this dented or scalloped line may vary; it occupies either the middle distance between the exterior margin of the darker median band and the edge of the wing, or else runs closer to the latter, approximately at one-third of the distance from the edge of the wing to the median band. These differences in position are respectively indicated by X and Y, and the acute or obtuse formation of the indentations are marked as a and o. A further notation of d and l for "dark" and "light" indicates the characteristics of inner portions of these arrowheads which might be darkened inwardly or traced on an even, light background. This element of the pattern is in close co-ordination with the character of the median band which may be either a shade darker than the general background, or else suffused with a marbled striation.

A further characteristic recorded in abbreviated notation is the prominence of the white veins: (1) for faintly seen veins (like *angrena*), (2) for a medium development (like *dissoluta*), and (3) for well accentuated white veins (like *aksuensis*). The notation of these traits of the underside is deemed sufficient, although one might also devise special notations for the variation of the pattern of the base which is either light or tends to merge in coloration and surface effect with the darker median band. It may be light as in *aksuensis* and, blending with the band into an even striation, spread throughout the whole basal half of the wing.

With these fundamental elements, a simple formula in letters and numbers can express the character of the underside and, together with the notation of the upperside in regard to color and pattern, may give an abbreviated, compressed description of the insect. For instance the *huebneri* male is ♂ A3 y d a v 2.

One could go further into the analysis of the underside of *Karanasa* in order to find a language of symbols for the most conspicuous traits—like the antemarginal portion of the front wings, the relative development

of the pattern in the discus, and the characteristics of the ocelli. It seems, however, that the features pointed out so far will be sufficient for a proposed method of "algebraic" recording. Such a procedure of using a formula of conventional letters and figures could be easily applied and is recommended for a designation and analysis of forms in any related group.

For comparative clarity a typical section of the hind wing is taken into consideration from vein Cu_2 to the middle of the next interspace and inwardly as far as the inner edge of the median band. This irregular section is reduced to a rectangular conventionalization so as to show the characteristics of the band and the position and aspect of the antemarginal zig-zag line. In such a fashion each form is reduced to an even and comparable rectangular band as shown on plate 2. It can enable one to see at a glance the elements that are recorded in the system of schematic notations and group similar forms together. Other important characters, the formation of the band and the aspect of the base, are too variable for a system of notation, which might tend to become unduly complex.

One of the pioneers of a study of patterns reduced to co-ordinates in a rectangular conventionalization was Riffart, who analyzed the pattern of *Heliconia* and prepared illustrations which look like a species of lepidopterological cubism. The illustrations in plate 2, where patterns are reduced to tags, is a less extreme adaptation of the same principle where the actual pattern remains sufficiently recognizable within moderate conventionalization. The Heliconids in the "pictograms" of Riffart, on the other hand, require a considerable stretch of the imagination to visualize the actual insects. It proves, perhaps, that the rule of geometry over lepidopterology should not be overly dictatorial where the interests of visual recognition have to be safeguarded.

While it is aside from any proposed system of marking, it is considered of interest to illustrate a comparison of a few typical bands in *Karanasa* with those of *Neominois*, *Satyrus* and even such a distantly related genus as *Neope*, as an example of the extreme complexities in the development of the band. Schwanevitch[1] made some extensive studies of significant and component elements of the pattern of the underside of the hind wings in Satyrids. His conclusions on the identity of different parts of the pattern undergoing fluctuations, dislocations, and fusion are highly instructive.

[1] Schwanwitsch, B. N. "Evolution of the Wing-Pattern in Palearctic Satyridæ" "I. Genera Satyrus and Oeneis." Zeit. Morph. Oekel. Tierre; Berlin, Vol. 13, pp. 559-654, 1929.

It suffices to state here in this conjunction that the median band traversing this discocellular is based on a phenomenon of certain symmetry in the pattern of the basal and external part of the wing. Thus for the Satyrids, as well as for the related group of Nymphalidæ, Brassolidæ, and Morphidæ, one may accept as typical a medium dark band edged symmetrically, inwardly and outwardly, by a lighter line and a darker outline, as is clearly seen in *Neope*. These elements may become partly broken up by veins and the double margin preserved for each open cell, or else they are undisturbed by the venation. A comparison of *Neope muirheadi* with three other species of the genus illustrates those two varieties of reaction of the pattern to the presence of veins (plate 2). It demonstrates the relative— not absolute— dependence of the pattern on anatomical properties of the surface of the wing, namely, the arrangement of veins, and it may show to a considerable degree what may be termed organic autonomy of the pattern. In *Karanasa* the band does not display such regularity of pattern structure and is of interest mainly by its outline obeying some standard fluctuations within cellular outlines. A comparison of *Karanasa* and *Neominois* in this respect is instructive. In *Neominois* the tooth in space M_2-M_3 is the most prominent, while in *Karanasa* it is the one above in space M_2-M_1. Furthermore, in space Cu_2-Cu_1 in *Neominois* the band is distinctly narrowed, but usually of the same width as the rest of the band in *Karanasa*. A constriction of the band in this point is typical for some forms of the *conradti-regeli* group, namely in *turugensis* and *arpensis* and in *korlana* to a lesser degree. This trait is also observed in *Satyrus geyeri* and it may be taken perhaps as a sign of some primitive character for a whole group of related Satyrids. It may be another indication that it is the *conradti-regeli* type which corresponds to the ancestral form related to the American *Neominois* and somewhat similar to another far more removed branch exemplified by *Satyrus geyeri*.

The upper part of the band calls for special considerations. The portion between the first and second subcostal in *Karanasa* tends to be outlined by a concave contour on either side with an extension outwardly along the 2nd subcostal. In *Neominois* the formation is reversed constituting a convex outline that produces an oval marking in this interspace. This divergence is demonstrated on plate 2 and has certain phylogenetic implications. The band formation of *Karanasa* is in closer correspondence to the predominantly even or parallel outlines in the pattern of Satyrids in general. The comparison with *Satyrus* and *Neope* is a confirmation of this effect. So, the formation of the band in *Karanasa* may be considered more

primitive than the alteration in *Neominois*, especially in certain extreme specimens of *N. dionysius*. The interpretation of the peculiarities in the relative formation of the upper portion of the band in *Karanasa* and *Neominois* requires a more thorough scrutiny. The extension into outward points between the veins in the whole exterior outline of the band is characteristic in both genera and is shared by *Satyrus geyeri* as well. In the interspace below the second subcostal, the outline of the band shows a vestige of this point in *Karanasa*, just below the extension along the vein. One may consider that the point situated in the middle of this interspace in *Neominois* has relatively moved upward and has produced a partial disappearance of this protrusion together with an extension alongside the vein. It corresponds to the general shift of the pattern upward toward the costa, thus effecting in *Karanasa* a constriction of the band, while in *Neominois* this part of the pattern shows central inflation, producing between the veins an isolated oval spot. A shift of pattern, independent of the anatomical properties of the wing, falls into the general category of the peculiar phenomenon designated as "pierellisation" by Schwanevitch. It was described as a particular dislocation of bands and ocelli in the South American Satyrid genus *Pierella*. Schwanevitch observed and singled out analogous phenomena in a number of cases. Something analogous occurred in the genus *Karanasa*, and it may be assumed that the conservative trends in the formations of the band were complicated and supplemented by an evolutionary process expressed by a slight shift of the pattern toward the costa.

The character of the surface treatment of the band in *Karanasa* may vary substantially from being almost as light and uniform as the rest of the background of the wing, as in *wilkinsi* and *intermedia*, to an even darkening as in the *decolorata* group, or to a marbled aspect as in *alpherakyi*. Such a reticulation is, in fact, of a dual nature. In part it is the remnants of the shuffled outlines of the inner portions of the band so clearly exemplified in *Neope;* and in part it is the ancestral vermiculation of large areas in the underside of Rhopalocera, of which the family Elymnidæ is the most typical. Such a pattern is evidence of the loss of the numerous transverse veinlets of the primitive Neuropteroid insects which preceded the development of Lepidoptera. Primitive forms of Lepidoptera show well these surviving scars of lost veins, in the pattern, as in the family Cossidæ, for instance. The preservation of such a transverse reticulation in the costal region of the front wings, not only of Nymphalids and Satyrids but even in Pierids, is symptomatic of this origin, as has been

frequently stated in entomological literature. The costal region is supposed to have preserved certain atavistic traits in terms of pattern. The strongly marbled base of the hind wings, including the band, in the *pamira* group and in other forms as shown on plate 2, is at least in part an atavistic character of this order and not merely a splitting and dislocation of identifiable linear bands. It is practically a double phenomenon of the same order as the case of *Caligo*, where the general over-all reticulation condenses itself to suggest the shading of typical, individual, ante-marginal bands in zig-zag formation. Analogously, through the maze of an irregular striation in the *pamira* group of *Karanasa*, one can easily discern the inner outlines of the median band and the accentuation of the usually obscured basal band.

In one more point the underside of the hind wing of *Karanasa* requires some study, namely in regard to vestigial ocellation. The primoridal type of the Nymphalo-Satyrids possessed presumably a complete row of ocelli between the median band and the ante-marginal arcuated line. Parenthetically it should be mentioned that these ocelli in their own turn were a modification and confluence of two bands, transformed into isolated links. In *Neominois* there are no traces of such ocelli, while in *Karanasa* they appear in rare instances (in *abramovi* and *talastauana* groups) on the upperside between the first and second radial. On the underside, vestiges of ocelli may be observed as faint white spots just within some of the ante-marginal arrow points as seen in diagrams in plate 2.

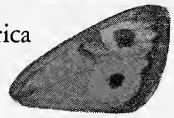
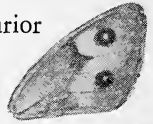
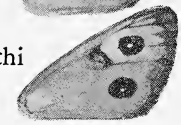
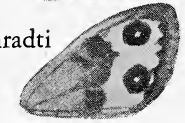
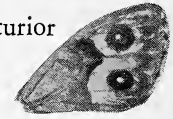
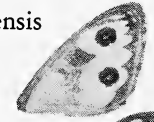
Probably the closest approach to an abortive ocellus is observable in *safeda* which shows a dark outline of this white center. So here we see in *Karanasa* an ancestral trait which has been lost in the American branch of the group. The presence of such vestigial pupils of lost ocelli in the most primitive *Karanasa* of the *regeli* group should not be overlooked from the phylogenetic angle. Altogether one might sum up the characters of the *Karanasa* underside as a typical Satyrid pattern somewhat impoverished, and with a slight upward dislocation of the hind wing pattern. The ut-most of simplification is reached in *intermedia*, which constitutes the ex-treme manifestation of a gradual loss of patern on the upperside, with a predominant russet hue always remaining as one of the two most typical chromatic possibilities in the family of Satyridæ. From these various grounds it would be justifiable to consider *intermedia* as the most progres-sive type in the evolution of the *Karanasa* group.

The fluctuations between the highly pigmented scales with a russet hue and the tendency toward a whitish color is to be seen in the whole

realm of Satyrids. It may be individual within certain species like *Satyrus anthe* and *briseis* where the white and ochreus-orange morphs appear as aberrations or mutations. It may be a sexual trait, as in *Lethe*. On the other hand, the color principle may be a matter of established stability such as the white background of *Melanargia* or the russet bands of *Epinephele*. In our group the coloration is in itself a trait of uneven phylogenetic value. The lighter background—less pigmented with ochreous and russet—acquires a more ancestral significance only in conjunction with more archaic pattern traits. It is only in this spirit that one should advance the arguments in favor of the antiquity of the whitish *conradti-regeli* group, recording at the same time the phenomenon of wide chromatic variation within the species *grumi* and the group *pamira-alpherakyi*, both of which groups may include either whitish or bright russet forms. It proves only that the pattern and color traits are not of equivalent value as factors of heredity; but both should be considered in their interplay of relative significance.

EXPLANATION OF PLATE 1

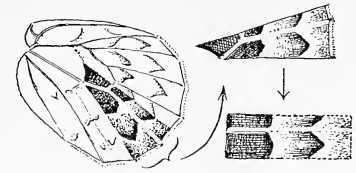
Table of standards for the classification of the colors and patterns in the genus *Karanasa*. Plate prepared by A. Avinoff.

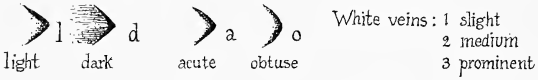
COLOR \ PATTERN		1. light base	2. discal band	3. suffused base	4. dark base	5. general darkening
A RUSSET	♂	wilkinsi 	darvasica 	balti 	modesta 	fumigata 
	♀	astorica 	josephi 	moorei 	kafir 	
B OCHREOUS	♂	leechi 	decolorata 	mihmana 	chitralica 	obscurior 
	♀	leechi 	ershoffi 	conradti 	chitralica 	obscurior 
C WHITISH	♂	conradti 	naryna 	arpensis 	kasakstana 	hoffmanni 
	♀	lactæa 	naryna 	eburnea 	püngeleri 	hoffmanni 

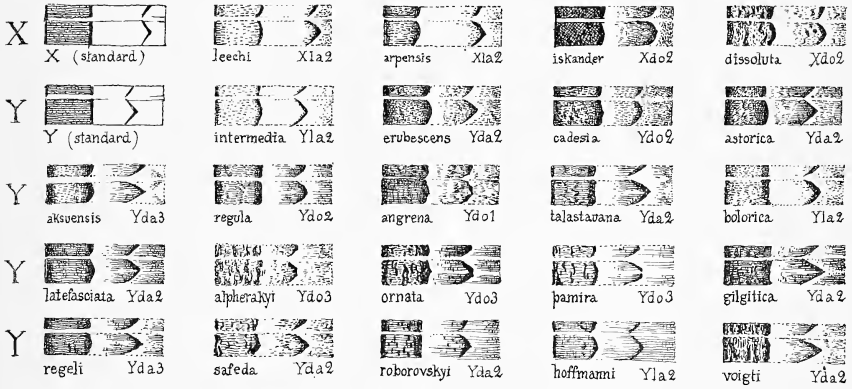
EXPLANATION OF PLATE 2

Schema for the analysis of the undersides of the wing in *Karanasa* and related genera. Plate prepared by A. Avinoff.

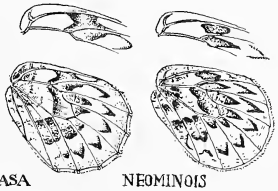
DIAGRAMMATIC NOTATIONS ON THE UNDERSIDE OF THE HIND WING OF KARANASA

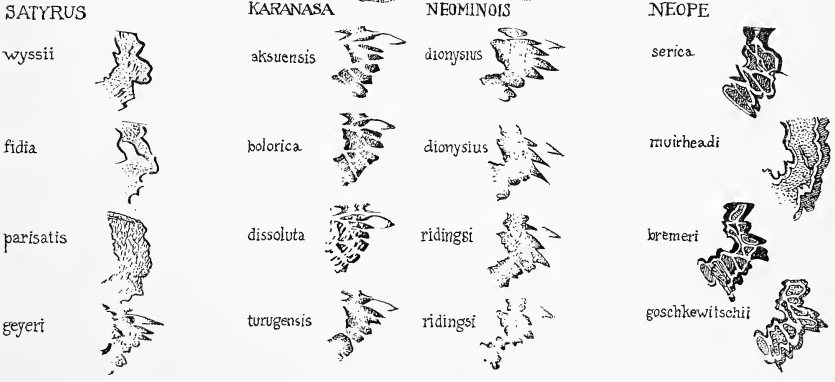






COMPARISON OF THE SHAPE OF DISCAL BANDS





ART. 16. A NEW RACE OF HUDSONIAN CHICKADEE

By W. E. Clyde Todd

Several years ago, with a fine series of 136 specimens of the Hudsonian Chickadee at my command, by far the larger part of which was collected expressly for the purpose of this investigation, I prepared an extensive manuscript on the taxonomy of this species for my projected report on the birds of the Labrador Peninsula. Presentation of these notes in their original form is necessarily deferred, but now that we are looking forward to the publication of a comprehensive study of this species by a competent Canadian ornithologist, it may be in order to put on record at least that part of them which deals with an apparently new race from the coast of Labrador. Since my earlier study, 35 specimens have been added to the Carnegie Museum series of this species, and I have also had the benefit of additional material lent for examination by the authorities of the United States National Museum, the Academy of Natural Sciences of Philadelphia, and the Royal Ontario Museum of Zoology, to the authorities of which institutions I desire to express my thanks. A brief resumé of the taxonomic history of this species is a necessary preliminary.

Parus hudsonicus was described by Forster (Philosophical Transactions, 62, 1772, pp. 383, 408, 430) from the mouth of the Severn River, on the west coast of Hudson Bay. Before any specimens from this point were available, I found that birds from Churchill to the north, and from James Bay and northern Ontario on the south, were comparable in every respect—a judgment that was fully confirmed by actual examination of a series from the type-locality. The range of this, the typical race, extends eastward into the Labrador Peninsula and northward to the limit of trees. Specimens from the north shore of the Gulf of St. Lawrence ("*nigricans*" of Townsend) are not satisfactorily distinguishable from others from Fort Chimo ("*ungava*" Rhoads) and Richmond Gulf. Recent authors (including Ridgway, 1904), however, recognize *littoralis* (Bryant, 1865) for the birds of Nova Scotia and New Brunswick. With specimens from the type-locality (Yarmouth, Nova Scotia), collected by myself in 1901, and with considerable borrowed material from other localities in these provinces, I must confess that I am very dubious about the validity of *littoralis*. In the specimens examined, there is much variation in exact shade of color, and the average smaller size seems to be inconsequential. A larger series of really good specimens, comparable for season, might suffice to establish its validity, but as matters stand I consider it doubtful.

Issued October 27, 1950.

With Rhoads' type-series of *columbianus* before me, I am quite unable to distinguish this supposed race, but again my present material is insufficient for a final conclusion. The northwestern race *evura* of Coues (1884) is easily recognizable by its larger size and somewhat different coloration. Leaving these western birds, and returning to the East, I find that the recently described *rabbittsi* of Burleigh (1948) is barely distinguishable in fresh plumage by the characters assigned in the original description, namely, the slight grayish cast of the underparts (as compared with typical *hudsonicus*), the duller and darker brown flanks (nearer snuff brown than sayal brown), and the slightly duller and darker brown upperparts, with less contrast between the pileum and back than in the typical bird. In breeding dress these distinctions are mostly obscured.

Specimens from the coast of Labrador, however, cannot be referred to any of the described races. They are certainly as worthy of subspecific status as are the Newfoundland birds. In naming them herewith I must explain that, following Ridgway, I continue to use *Penthestes* for the generic group instead of *Parus*.

Penthestes hudsonicus labradorius, subsp. nov.

Ten specimens: Nain, Mokkovik, and Rigolet, Labrador (August 29—September 25).

Type, No. 100,125, Collection Carnegie Museum, immature male; Rigolet, Labrador, September 24, 1926; W. E. Clyde Todd.

Subspecific characters.—Similar to *Penthestes hudsonicus hudsonicus* (Forster) of Hudson Bay, etc., but upperparts slightly duller brown; underparts more purely and more extensively white; and brown color of flanks paler, duller, and more restricted. Wing (type), 67; tail, 61; bill, 10; tarsus, 15.5.

Range.—Coast of Labrador.

Remarks.—As a series, these specimens may readily be separated from James Bay birds, as their characters stand out sufficiently well, but individual birds might be hard to distinguish. This is by far the whitest (below) of all the forms of *P. hudsonicus*. All of the series on which it is based happen to be birds of the year in fresh plumage, which show the characters to good advantage. Whether spring and summer specimens can be as readily discriminated remains to be seen. They are not so satisfactory for comparison as a rule—an observation which applies with equal force to all individuals of this species.

ART. 17. A NEW GEOMYID RODENT FROM THE MIOCENE OF MONTANA

By Albert E. Wood

Biology Laboratory, Amherst College, Amherst, Massachusetts

Recently, Dr. J. LeRoy Kay of the Carnegie Museum sent me a rodent jaw from the Miocene of Montana for identification. This specimen represents a member of the Entoptychinæ, the dominant Lower Miocene subfamily of the Geomyidæ or pocket gophers. The specimen indicates that this represents a member of the group which differs from all hitherto described specimens sufficiently to warrant its being established as a new species.

I wish to express my deep appreciation to Dr. Kay for permitting me to describe this specimen. This study was assisted by a grant from the Marsh Fund of the National Academy of Sciences.

Gregorymys kayi, sp. nov.

Holotype: Carnegie Museum No. 8,999, left lower jaw with incisor and P_4-M_3.

Horizon and Locality: Miocene, Six Mile Creek, 5 miles west of Toston, Montana, field no. $\frac{22}{48}$, collected by J. LeRoy Kay, 1948.

Diagnosis: Similar to *G. douglassi*, but apparently smaller; much greater development of cement around the roots, extending well up the sides of the crown, more than in *G. douglassi* or *G. montanensis;* enamel greatly thinned or even absent on anterior faces of molars; roots present.

This species differs from the other members of the genus* in the very extensive development of cement. This not only covers the roots, but extends up the sides of the crown to levels well above the bottom of the pattern. The enamel is thinned on the anterior side of the teeth much more than is the case in other species of the genus, though it does not appear

*Wood, Albert E. 1936. Geomyid rodents from the middle Tertiary. *American Museum Novitates*, no. 866, 31 pp., 33 figs.

Hibbard, Claude W., and Kendall A. Keenmon. 1950. New evidence of the Lower Miocene Age of the Blacktail Deer Creek Formation in Montana. *Contrib. Mus. Paleont., Univ. Michigan*, vol. 8, no. 7, pp. 193-204, 3 figs., 1 map. According to a letter from Dr. Hibbard, dated November 21, 1950, there is no cement on the sides of the crowns of *G. montanensis*, even well down in the alveoli.

Issued December 21, 1950.

to be interrupted at the stage of wear represented by the specimen. However it seems probable that at a somewhat more advanced stage of wear the enamel would be interrupted, thus coming within the definition of *Entoptychus* as given by Wood (1936). However, the fact that roots are clearly present, and that the crowns are not exceptionally high, justifies the inclusion of this form in *Gregorymys*. The cement extends as a thin layer along the anterior face of the molars, although interdental wear removes it very largely.

In all the molars, the central valley has been transformed into a crescentic lake, with its concave side directed anterad (fig. 1 b). No trace of separate cusps seems to be visible in the molars. M_1 is the largest of the molars, and M_3 is the smallest.

In the premolar, the central valley has the same shape as in the molars, but opens broadly along the lingual side. There is, however, a lingual dam some distance down the side of the crown, so that the valley would eventually be transformed into the same lake as is seen in the molars. In the talonid, there is no trace of details of the pattern. In the trigonid, however, there are faint irregularities in the enamel outline, suggesting the last traces of cusps. At the antero-lingual corner there is a marked valley, extending only a short distance below the wear surface, which appears to represent the last remnants of a valley behind the anteroconid. That is, as in other species of *Gregorymys*, the trigonid of P_4 must have had a well developed group of accessory cusps. The premolar is the largest of the teeth.

The incisor has a broad, flat anterior face, with the enamel only just reaching the median and lateral surfaces (fig. 1 a). The tooth is a broad and very efficient cutting tool. A peculiarity, presumably of this individual, is the narrowing of the incisor from both ends, so that it is distinctly more slender at a point just inside the alveolus than it is either nearer the tip of the tooth or nearer the root (see measurements). The extra-alveolar enamel is orange-brown in color.

The jaw is not exceptionally heavy for a geomyid. The ventral border of the masseteric crest extends nearly straight laterad, below the cheek teeth, and runs nearly horizontally (fig. 1 c). The ascending ramus rises steeply by the middle of M_2. The diastema is short and deeply notched. The mental foramen lies beneath the deepest point of this notch, just ventrad of the anterior end of the masseteric fossa. The symphysis is at a sharp angle with the horizontal ramus, so that, viewed from above, the two jaws must have diverged markedly. It is also heavily pitted and cor-

rugated, showing that there was no motion between the mandibles, a fact in accord with the structure of the incisor. Just below the main part of the symphysis is a deep pit. The angle is reduced but is markedly inverted, being of the general entoptychine type, in contradistinction to *Thomomys* and *Geomys* where the angle is non-existent.

This form is obviously similar to *Gregormys curtus*, *G. montanensis*, and *G. douglassi*, the last two also coming from Montana. Although *G.*

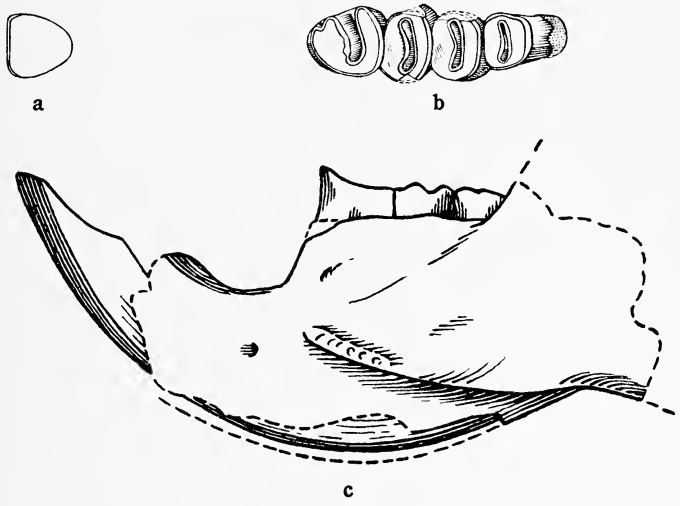


FIG. 1. *Gregorymys kayi*, Carnegie Museum No. 8,999.
All figures, × 4.

a. $Incisor_1$ left, view of anterior face.
b. P_4—M_3 left.
c. Lateral view of lower jaw.

douglassi is known only from a skull, the present form is clearly too large to belong with that skull. A more important difference lies in the great expanse of the cement in *G. kayi*, which would seem to be a progressive character. The sequence *G. curtus*—*G. douglassi*—*G. kayi* seems to represent a structural line of rather uniform morphology but with gradually increasing amounts of cement and with a gradual approach toward the condition found in *Entoptychus*. *G. montanensis* would represent a related side-branch in which the amount of cement had been secondarily reduced, but which otherwise was very close to *G. kayi*.

G. kayi seems to represent a culmination of the *Gregorymys* evolutionary

line, being somewhat the most specialized member of the genus. In its specializations, it shows a number of features characteristic of the related genus *Entoptychus*. These, however, certainly represent parallelisms within the *Gregorymys* line to the trends within the contemporary *Entoptychus*, where *Entoptychus*, at any given period, is structurally more advanced than the members of *Gregorymys*, just as the entoptychines as a whole parallel but are more advanced than the contemporary heteromyids.

Measurements of *Gregorymys kayi*

(Carnegie Museum No. 8,999)

P_4—M_3,	alveolar distance	7.80 mm.
	crown surface	6.90
P_4	antero-posterior	2.37
	width trigonid	1.80
	width talonid	2.24
M_1	antero-posterior	1.53
	width trigonid	2.26
	width talonid	ca. 2.30
M_2	antero-posterior	1.60
	width trigonid	over 2.05
	width talonid	over 2.00
M_3	antero-posterior	1.58 (crown)
	width trigonid	1.83
	width talonid	1.67
I_1	antero-posterior	2.06
	transverse, at tip	2.04
	transverse, just inside alveolus	1.96
	transverse, beneath cheek teeth	2.05

ART. 18. THE MAMMALS OF THE MAZINAW LAKE REGION OF ONTARIO; THEIR REPRODUCTION AND POPULATION DYNAMICS*

By John J. Christian
The Wyeth Institute of Applied Biochemistry
Philadelphia, 30, Pennsylvania

I. Introduction

The mammals of the Mazinaw Lake region of southern Ontario were investigated during the first two weeks of July, 1949, and July, 1950. The following is a report on these investigations.

The region lies in the Canadian Precambrian shield section of Lennox and Addington Counties, Ontario. The particular area covered in this account is a north and south strip about twenty-five miles long following highway 41. The west shore of Mazinaw Lake forms the middle of this strip. The lake itself is seven miles long and from one-half to three miles wide, and is one of the larger lakes in the region. All trap locations were within a mile and a quarter from the highway.

The general elevation varies from 850 to 1,250 feet, rising continuously to the northwest to the Algonquin Park area about sixty miles away. The region falls away to the south to meet the great lakes plains, and to the north to meet the Ottawa River valley. The whole region is rolling and rocky with numerous extensive outcrops and bare spots resulting from extensive glaciation. Lakes are numerous, and the general altitude of the low areas is so nearly the same that the drainage from lake to lake flows down only a slight gradient, resulting in slow-flowing, sluggish streams. These traverse numerous boggy areas, and recent lake or pond fills are numerous. The poorly drained, low areas possess a rich acid soil, while the hillsides and uplands are relatively dry and rocky with a thin, sandy, subacid soil. The hillsides are drained by numerous, small, rocky streams which rapidly go dry under drought conditions. Springs are scarce.

Along the eastern shore of Mazinaw Lake, and extending considerably north and south, is a relatively recent fault reaching a height of 1,450 feet from the lake bottom to its highest point. This is responsible for a series of north and south lakes and bogs, and for forming the main drainage of the Mazinaw region.

Halliday (1937) puts this area in the Algonquin-Laurentides section of

*The mammal specimens upon which this paper is based are deposited in Carnegie Museum.

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the Great Lakes-St. Lawrence forest region, which he characterizes as follows: ". . . the bed-rock is part of the great Precambrian Shield of Canada, and consists largely of crystalline limestones (Grenville series), schists, and gneisses of the altered sedimentaries and granite intrusives. The topography is rough and irregular, and glacial deposits of varied character, chiefly of somewhat light texture, cover the greater part. In addition there are some lacustrine deposits from the Nipissing-Great Lakes and Algonquin periods. A podsol type of soil is to be expected, but areas of gray-brown and brown forest soils may be present.

"In this section, white pine probably reached its maximum development in Canada, but extensive lumbering and fire have removed the greater part. Red pine has also been a prominent species, especially on the Algonquin Highlands. In spite of the previous dominance of these species and the presence of intrusive conifers from the boreal forest region, the general character is that of a mixed forest, and the dominant or competitive association is one of sugar maple, yellow birch, hemlock, and white pine. In addition there are varying amounts of basswood, white spruce, balsam fir, beech, (Northern) red oak, elm, white ash, red maple, ironwood, white birch and large-toothed aspen. The composition of this association changes somewhat to the north, as hemlock, (Northern) red oak, and beech decrease numerically and finally drop out before the limits of the Section are reached and the proportion of yellow birch, white spruce, balsam fir, and white birch increases. . . . Throughout the Section, areas of hardwood occur on the ridge tops and on heavier soil deposits, and black spruce, tamarack, and some cedar are found in swampy depressions."

The Mazinaw region fits into Halliday's description for the more northern limits of the Algonquin-Laurentides Section, probably as a result of its altitude. Beech and hemlock are scarce, and the northern red oak is confined to the drier areas. The uplands support a hardwood forest with sugar maple dominant. Cut-over areas have grown up to aspen (both large-toothed and trembling), white birch, red maple, red oak, and some white spruce and fir. Pure conifer stands of white spruce and fir occupy the lower dry areas, while extensive black spruce and tamarack bogs abound. These latter, when cut over, come up in alder and willow. Black ash-white cedar bogs are abundant. About seven miles to the west of Mazinaw Lake there is still a large stand of virgin white pine surrounding Weslemkoon Lake. This stand, in which pines four feet d.b.h. are reportedly common, is being lumbered around its edges at the present time, but only in winter when the logs can be skidded out. Besides these forest

types, there are numerous high "balds" of bare rock alternating with extensive areas of blueberries.

Extensive timbering occurred sixty years ago and the area has been burned over two or three times since, the last fire having taken place about twenty years ago. It is evident at present that white pine will again be the climax forest type, as even now they are beginning to crowd out the aspens and birches on the hillside areas. Pine seedlings of all sizes abound.

A small area of each general forest type was selected for trapping, and as far as possible these areas were chosen so that they were in a continuous habitat of the same type. The following habitats were trapped in, and further discussions of the vegetation will appear under the heading describing the specific area.

I. Dry, rocky, mixed deciduous-conifer woods: deciduous vegetation dominant.

II. Low, wet, deciduous woods with a few patches of conifers, and boggy areas.

III. Black ash-northern white cedar bog.

IV. Dry old field. *Danthonia* dominant.

V. Open Vaccinium-sphagnum bog surrounded by spruce and tamarack.

VI. Dominantly deciduous woods with alder bogs and small open sedge bogs.

VII. Small sphagnum-spruce-fir bog in a more extensive mixed woods.

VIII. Open, sedge marsh.

IX. High blueberry bog.

X. Pure, dense, black spruce bog; white spruce and fir on surrounding drier areas.

The climate of the area is classified by Halliday (1937) as temperate and humid plus, with moisture abundant at all seasons. Thirty inches of snow is seldom exceeded at any time. The lowest temperature so far recorded at Mazinaw Lake is 52° below zero F., but ordinarily winter temperatures do not go below −20°F. In 1949, however, drought conditions prevailed for two months from the end of April until the end of the first week in July, with the final forty days without any rain whatsoever. Bogs were for the most part without standing water, and most streams were either totally dry or with only a slight trickle. More normal conditions of precipitation prevailed in 1950, and during the first two weeks of July there was from a foot to eighteen inches of water standing in the bogs which had been dry the previous year.

In 1950 a much colder spring and a later summer prevailed than in 1949. This difference was reflected in the plants. In 1949 the hot, dry spring was from two to three weeks ahead of the colder, wet spring of 1950. Blueberries and Aralia berries were ripe by July 1, 1949, but were just beginning to ripen by July 14, 1950, and this difference was true of many other blooms and fruits.

The small mammals were trapped with regular snap-back traps. The bait used was either pure ham-fat rubbed on the trap, or a mixture of ham-fat, peanut butter, and almond extract. Smears of the testis and epididymis were made of each male and were stained with haematoxylin-eosin (Christian, 1950a). The reproductive tracts of the females were preserved entire.

The fur-bearers and large animals were not trapped, although a few in good condition were picked up from the highway. Information regarding these mammals was, for the most part, obtained by questioning local trappers, and residents, and others who were familiar with the local mammals. Most of this information was obtained from Albert Spencer and Irving Brown, both reliable and experienced trappers in the area, and from Fred Garbutt, an interested and observant local resident.

The following account has been divided into four sections: the habitats trapped in, accounts by species, discussion of populations, and information on reproduction and its relation to population dynamics.

II. Discussion of Specific Habitats

Ten habitats were chosen for trapping as being representative of the region, and these are discussed in detail below. All references to habitats following the discussion of a mammal refer to the designating numeral of the specific habitat area.

I. *The dry, rocky, steep hillside of the west shore of Mazinaw Lake, seven miles north of Cloyne, Ontario. Elevation 900 feet. Trapped in 1949 and 1950.*

This area is the dry hillside comprising the west shore of Mazinaw Lake, which is completely wooded except for a few old cleared areas. The forest is primarily deciduous and is composed of sugar maple, aspen, white birch, and some white and red pines. Numerous bare boulders and outcrops of quartzite are scattered through the area providing many cracks and crevices in which small mammals may take refuge. The hillside is well drained. The sandy, thin, and subacid soil has been formed by the breakdown of metamorphosed sandstones. Wild sarsaparilla, wintergreen, bush

honeysuckle, and low sweet blueberry form the principal ground cover. The area was burned and lumbered in the past and now represents a maturing second growth.

The difference in seasons between similar dates in 1949 and 1950 is plainly shown by the various flowering plants. Bunchberry was in berry in 1949, while at the same time in 1950 it was only in full bloom, even in warm, open spots. Aralia berries were ripe in 1949, but the plant was just past blooming in 1950. The bush honeysuckle was well past blooming in in 1949, but was in full bloom in 1950. Blueberries were ripe the first of July in 1949, but were only beginning to ripen at the end of the second week of July in 1950.

The following is a list of the principal plants of the area. The more dominant forms are preceded by an asterisk in this and all following lists of flora. More than one asterisk indicates that the form is dominant almost to the exclusion of others.

White pine (*Pinus strobus*)
Red pine (*Pinus resinosa*)
Balsam fir (*Abies balsamea*)
Hemlock (*Tsuga canadensis*)
*Trembling aspen (*Populus tremuloides*)
*Large-toothed aspen (*Populus grandidentata*)
*White birch (*Betula papyrifera*)
Red oak (*Quercus borealis*)
*Sugar maple (*Acer saccharum*)
Red maple (*Acer rubrum*)
*Smooth-leaved shadbush (*Amelanchier laevis*)
Moosewood (*Acer pensylvanicum*)
*Bunchberry (*Cornus canadensis*)—berry, 1949; bloom, 1950.
*Low sweet blueberries (*Vaccinium pennsylvanicum*)—berry, 1949.
*Bush honeysuckle (*Diervilla lonicera*)—Bloom, 1950.
*Wintergreen (*Gaultheria procumbens*)
Running ground pine (*Lycopodium complanatum*)
Running clubmoss (*Lycopodium clavatum*)
Rock polypody (*Polypodium virginianum*)
Bracken (*Pteridium latiusculum*)
*Heartleaf lily (*Maianthemum canadense*)—just past bloom, 1950.
*Fireweed (*Epilobium augustifolium*)—in bloom, 1949 and 1950.
**Wild sarsaparilla (*Aralia nudicaulis*)—berries ripe, 1949.
Green pipsissewa (*Chimaphila umbellata*)

A list of the birds found in the area follows. Both the yellow-bellied sapsucker and the least flycatcher were known to be nesting in the immediate area, while the others, if not nesting in the immediate area, were nesting in the vicinity.

Spotted sandpiper (*Actitis macularia*)
Ring-billed gull (*Larus delawarensis*)
Whip-poor-will (*Antrostomus vociferus*)
Kingfisher (*Megaceryle alcyon*)
Ruby-throated hummingbird (*Archilochus colubris*)
Flicker (*Colaptes auratus*)
*Yellow-bellied sapsucker (*Sphyrapicus varius*)
Crested flycatcher (*Myiarchus crinitus*)—abundant 1949, scarce 1950.
*Least flycatcher (*Empidonax minimus*)
Robin (*Turdus migratorius*)—abundant 1949, less so 1950.
Veery (*Hylocichla fuscescens*)
*Cedar waxwing (*Bombycilla cedrorum*)
**Red-eyed vireo (*Vireo olivaceous*)
Magnolia warbler (*Dendroica magnolia*)—1950 only; immature.
Myrtle warbler (*Dendroica coronata*)
Pine warbler (*Dendroica pinus*)—1949 only.
Oven-bird (*Seiurus aurocapillus*)
Purple finch (*Carpodacus purpureus*)
Goldfinch (*Spinus tristis*)
*Chipping sparrow (*Spizella passerina*)
Song sparrow (*Melospiza melodia*)

One blue-tailed skink (*Eumeces fasciatus*) was collected from among the rocks at the lake-edge in this habitat.

Mammals: Since the area is relatively dry, there is a large chipmunk population in and around the rocks. Skunks are common, probably attracted by the garbage from the few cottages in the area. One half-grown and one very emaciated adult female were collected. Another young *Mephitis*, a litter mate of the one collected, was also known to be in the area, and possibly others were present. Red squirrels were at one time abundant, but have been completely "shot out." At least one mink is known to have been in the area. Porcupines have wandered in and out, but are shot on sight. One young racoon was found dead, apparently a highway casualty, as the animal was entire, including its pelt.

In 1949, eighteen traps were set in the area in places looking suitable for small mammals, such as rock crevices, along fallen logs, and at the

bases of rocks. These remained for three nights, during which time one *Peromyscus maniculatus gracilis*, three *Peromyscus leucopus noveboracensis*, and two *Blarina brevicauda talpoides* were captured, making nine trap-nights, per catch.

In 1950, no mouse traps were set, but five rat traps were placed in likely spots for chipmunks. None was caught, but one *Blarina* fell victim. Later the traps were moved and baited with bacon rind for flying squirrels. These traps caught one juvenile *Peromyscus maniculatus gracilis* the first night and two nights later took a half-grown *Mephitis*.

TRAPPING SUMMARY—1949

Date: **July**	3	4	5	Total
Peromyscus m. gracilis	0	0	1	1
Peromyscus l. noveboracensis	1	1	1	3
Blarina b. talpoides	1	1	0	2
Total	2	2	2	6

6 catches in 54 trap-nights, or 1/9 trap-nights.
Summary 1950: 50 trap-nights (rat traps)—3 catches or 1/17 trap-nights.

II. *A damp, second-growth, deciduous woods along Bon Echo Creek, five and one-half miles north of Cloyne, Ontario. Elevation 900 feet. Trapped in only in 1949.*

Bon Echo Creek flows from Bon Echo Lake to Mazinaw Lake, where it empties on the west shore. The gradient from Bon Echo to Mazinaw is slight, resulting in the creek being a slow-flowing stream traversing a poorly drained area with many bogs. The soil is rich, black, and acid, and the creek is stained dark from this acid bog soil through which it flows. The surrounding forest is composed primarily of second-growth deciduous trees with some firs, and patches of white and black spruces in the drier and wetter areas respectively. An occasional white pine still stands. Most of the growth has developed since the area was burned over about twenty years ago. A road passes through the area, and ends at an abandoned lumber camp at the east end of Bon Echo Lake. The undercover is very dense with a large percentage of alder, aspen, and white birch saplings.

A list of the dominant vegetation follows.

White pine (*Pinus strobus*)
White spruce (*Picea glauca*)
*Black spruce (*Picea mariana*)
*Balsam fir (*Abies balsamea*)
*Large-toothed aspen (*Populus grandidentata*)
*Trembling aspen (*Populus tremuloides*)

Yellow birch (*Betula lutea*)
*White birch (*Betula papyrifera*)
*Speckled alder (*Alnus incana*)
White elm (*Ulmus americana*)
Moosewood (*Acer pennsylvanicum*)
*Sugar maple (*Acer saccharum*)
*Red maple (*Acer rubrum*)
Sensitive fern (*Onoclea sensibilis*)
Thin-leafed pyrola (*Pyrola elliptica*)

This habitat is of a more southern type than any of the others trapped, and approaches the transition (upper austral) zone in character.

The birds noted in the area are:

Ruffed grouse (*Bonasa umbellus*)—covey of 6 young.
Woodcock (*Philohela minor*)
Hummingbird (*Archilochus colubris*)
Crested flycatcher (*Myiarchus crinitus*)
Phoebe (*Sayornis phoebe*)
Robins (*Turdus migratorius*)

Mammals: Deer tracks were seen along the old dirt road. Every time the area was visited a *Lepus americanus*, apparently the same one, was seen alongside the road in approximately the same spot. On every occasion I was able to approach within a few feet of this animal without unduly alarming it.

Forty-nine traps were set in the area with thirty-three through the moist woodland and along the stream in likely looking spots. An especially promising site for voles was a rocky portion of a grass-grown, abandoned road. Seven traps were set in a small, bog area with black spruce saplings and alders growing in a wet black soil, and nine in a dry patch of white spruces. These traps were left set for only two nights.

Two *Peromyscus maniculatus gracilis*, one *Peromyscus leucopus noveboracensis*, and four *Blarina* were caught in this area. One *Microtus pennsylvanicus* was caught in the grassy spot mentioned above, but was eaten, apparently by a shrew, and could not be saved as a specimen. A total of eight mammals caught meant 1 catch per 12.25 trap-nights.

TRAPPING SUMMARY—1949

Date: **July**	**3**	**4**	Total
Peromyscus m. gracilis	2	0	2
Peromyscus l. noveboracensis	1	0	1
Blarina b. talpoides	2	2	4
Microtus p. pennsylvanicus	1	0	1
Total	6	2	8

III. *A dense, cool, black ash-northern white cedar bog, five and one-half miles south of Denbigh, Ontario. Elevation 950 feet. Trapped in 1949 and 1950.*

A typical, dense, cool, northern white cedar-black ash bog, which has apparently been by-passed by recent-past fires or lumbering operations. The actual bog area is approximately fifty yards wide and extends north and south about a half-mile, draining into a small mill pond at the south. The bog is criss-crossed with fallen white cedar logs, subdividing the area into a series of small, disconnected "boglets." These vary from a few feet in each dimension up to about twenty by fifty feet. The black, acid, mucky soil supports a dense growth of sphagnum which continues on, with other mosses, over fallen logs, stumps, and hummocks. Liverworts and *Seliginella* were also included with the mosses. In 1949, there was no standing water in the bog except in the center of one very large boglet, where there were a few inches. The area remained wet, however, in spite of the lack of standing water. In 1950, there were between twelve and eighteen inches of water throughout the bog, and this was added to in the first week of July by the almost daily rains. The hills forming the east and west boundaries of the bog were covered chiefly with white and black spruces and firs. Black spruces and firs also occurred in the bog, but were not among the dominant forms. The full grown, standing, white cedars, and the great majority of the cedars were of this type, averaged a foot *d.b.h.*, while the fallen trunks of these trees were of this size or larger. The relatively uniform size of the standing cedars probably indicates the growth since some past lumbering operations or fires. The surrounding spruces were mature trees in the neighborhood of fifty or sixty feet tall.

The bog abutted abruptly against a low, fault scarp on the east. This scarp varied from a few to over thirty feet in height. Under the sphagnum-covered talus at its base was a continuous "tunnel-run" which produced the usual high catches of an "edge" habitat. This scarp appears to be a northward continuation of that forming the eastern shore of Mazinaw Lake, and is at the northern end of a continuous valley containing a series of bogs and small and large lakes. It is also the center of drainage for the immediately surrounding area.

A list of the major plant forms follows:

*White spruce (*Picea glauca*)—adjoining dry areas.
*Black spruce (*Picea mariana*)
*Balsam fir (*Abies balsamea*)
**Northern white cedar (*Thuja occidentalis*)

Trembling aspen (*Populus tremuloides*)
White birch (*Betula papyrifera*)
Speckled alder (*Alnus incana*)
White elm (*Ulmus americana*)
Moosewood (*Acer pennsylvanicum*)
Black alder (*Ilex bronxensis*)
Alder-leaved buckthorn (*Rhamnus alnifolia*)
Red baneberry (*Actaea rubra*)—in berry 1949.
White baneberry (*Actaea alba*)—in berry 1949.
Squashberry (*Viburnum pauciflorum*)—in berry 1949.
Labrador tea (*Ledum groenlandicum*)
**Various mosses and sphagnum.
Thallus liverworts
Bunchberry (*Cornus canadensis*)—in berry 1949; in bloom 1950.
*Small cranberry (*Vaccinium oxycoccos*)
*Wood sorrel (*Oxalis montana*)—in bloom 1950.
*Barren strawberry (*Waldsteinia fragaroides*)—in bloom 1950.
Arctic bramble (*Rubus borealis*)—in bloom and berry 1950.
Yellow bead lily (*Clintonia borealis*)—in bloom 1950.
Wild sarsaparilla (*Aralia nudicaulis*)—in berry 1949; just past bloom 1950.
Cinnamon fern (*Osmunda cinnamomea*)
Shining club moss (*Lycopodium lucidulum* v. *occidentale*)
Running club moss (*Lycopodium clavatum*)—adjoining dry areas.
Round-branch ground pine (*Lycopodium obscurum* v. *dendroideum*)—dry areas.

From the comments in this list it again becomes evident how much later the 1950 season was than the same period in 1949.

The birds noted in the area follow:
Horned grebe (*Colymbus auritus*)
Broad-winged hawk (*Buteo platypterus*)
Flicker (*Colaptes auratus*)
Pileated woodpecker (*Ceophloeus pileatus*)—only in 1949; one seen.
Yellow-bellied sapsucker (*Sphyrapicus varius*)
Hairy woodpecker (*Dryobates villosus*)
Downy woodpecker (*Dryobates pubescens*)
Least flycatcher (*Empidonax minimus*)
Eastern wood pewee (*Myiochanes virens*)
Bluejay (*Cyanocitta cristata*)

Black-capped chickadee (*Penthestes atricapillus*)
Tufted titmouse (*Bacolophus bicolor*)—1949 only.
White-breasted nuthatch (*Sitta carolinensis*)—1949 only.
Red-breasted nuthatch (*Sitta canadensis*)
Brown creeper (*Certhia familiaris*)
Blue-headed vireo (*Vireo solitarius*)
Black and white warbler (*Mniotilta varia*)
Ovenbird (*Seiurus aurocapillus*)
Canada warblers (*Wilsonia canadensis*)
Bronzed grackles (*Quiscalus quiscula*)
Rose-breasted grosbeak (*Hedymeles ludovicianus*)
Junco (*Junco hyemalis*)

The drought conditions prevailing during 1949 may account for the birds (especially the titmice) observed in this area in that year, which were not seen in 1950. In 1950, however, the breeding bird population was noticeably higher than in the previous year; for example, there were at least two pairs of rose-breasted grosbeaks in 1950 in this relatively small, trapping area. The warblers were conspicuously abundant in the latter year.

Mammals: In 1949, *Tamiasciuris* and *Marmota* were seen in this habitat. The former were abundant, although efforts to trap them failed. The red-squirrels were conspicuous by their absence in 1950, nor were any *Marmota* seen. Chipmunks were abundant in the dry areas surrounding the bog in both years.

In 1949 the area was trapped for six nights. Traps were placed along fallen logs, at openings of runs in the centers of boglets, under overhanging hummocks, and in runs along the scarp base. The traps were concentrated and the area was trapped in two sub-areas at two separate times. In the first area, for the first night, there were eighty-seven traps which were reduced to fifty-three for the following two nights by removing one or more from each station. Sixty-six traps were used for the last three nights in a part of the bog north of the first area, making a total for the area of 391 trap-nights. The trapping summary appears below.

One *Condylura* and one *Synaptomys* were trapped at the fault base run. Four *Clethrionomys* were taken in and around the western edges of the bog where it adjoined the white spruce-fir covered hillside. *Blarina* was found on the dry hillside next to the bog, while the long-tailed shrews (*Soricidae*) were all taken in the boglets throughout the swamp. *Peromyscus leucopus novaboracensis* was taken mainly in drier areas, while the one *Peromyscus*

maniculatus gracilis was taken in the wet area. A total of sixteen mammals caught meant 1 catch per 24 trap-nights.

TRAPPING SUMMARY—1949

Date: July	5 (87)	6 (53)	7	11 (66)	12	13	Total
Condylura c. cristata	1	0	0	0	0	0	1
Sorex c. cinereus	0	0	1	1	0	0	2
Sorex f. fumeus	0	0	0	0	1	0	1
Sorex p. albibarbus	1	0	0	0	0	0	1
Blarina b. talpoides	0	0	1	0	1	0	2
Peromyscus m. gracilis	0	0	0	0	0	1	1
Peromyscus l. noveboracensis	1	0	0	0	1	0	3
Synaptomys c. cooperi	1	0	0	0	0	0	1
Clethrionomys g. gapperi	0	1	0	3	0	0	4
Total	4	1	2	5	3	1	16

In 1950 this area was re-trapped intensively for several reasons: (1) to compare the population with last year, (2) to obtain more shrews, and (3) because of the large number of species obtained in 1949 in such a limited area and habitat. Much the same trap concentration was used as in 1949, but a somewhat wider area was covered, with more traps. Due to the standing water this year, no traps were placed in the boglet bottoms, being necessarily placed in dry spots around the edges. Traps, 101 in number, were placed across the bog, along the cliff base, and back across the bog again for two nights. For the next three nights the same number of traps were in the bog, but sixty-one of them were removed from the original sets and re-set in other areas, with about half of these being along the scarp base. For the following three nights seventy-two of the scarp and last-set bog traps (in an area similar to the conditions of last year with no standing water) were left in place, the remaining twenty-nine in the bog center having been picked up, since no mammals were caught in that area. This constituted a total of 721 trap-nights under trap concentrations and movements similar to those of 1949.

No rodents were caught in this area in 1950, and no mammals were caught in the center of the bog in areas with or without standing water. One specimen of *Microsorex*, two of *Sorex cinereus*, and one of *Sorex fumeus* were caught in the scarp-base run. One *Blarina* was caught in a dry spot at the western edge. Four of these five mammals were caught the first two nights, and the fifth (*Sorex cinereus*) three nights later. This strongly suggests that the four represented the total small mammal population of the bog, and that the fifth was an outside wanderer that came in. It seems reasonable that the water level made the difference in the loca-

tion of the shrews within the habitat in the two years. In 1949, with a wet, black muck and no standing water, the shrews were scattered over the bog, but in 1950, with abundant water, no shrews were in the center of the bog, all having been taken at the bog's eastern margin in the scarp-base run. The total catch of five mammals was the equivalent of 1 catch per 144 trap-nights.

TRAPPING SUMMARY—1950

Date: July	3 (101)	4	5 (61 reset)	6	7	8 (72)	9	10	Total
Microsorex h. intervectus	1	0	0	0	0	0	0	0	1
Blarina b. talpoides	1	0	0	0	0	0	0	0	1
Sorex c. cinereus	0	1	0	0	1	0	0	0	2
Sorex f. fumeus	0	1	0	0	0	0	0	0	1
Totals	2	2	0	0	1	0	0	0	5

IV. *A dry, old field, seven miles south of Denbigh, Ontario. Elevation 1,000 feet. Trapped in only in 1949.*

A dry, grassy, old field with many rocks and piles of old fence-rails surrounding a field of un-mown rye. A stone fence topped by a broken-down rail fence separates the two fields. *Polytrichum*, dry grasses (*Danthonia*), sweet fern (*Myrica asplenifolia*), and bracken (*Pteridium latiusculum*) were the dominant plants. An extensive, pure stand of white spruce surrounds the area. A pair of ravens were once seen in this area, as well as purple finches, and song and vesper sparrows.

Mammals: Hares (*Lepus americanus*) were frequently seen along the highway in this area, and deer (*Odocoileus*) were seen just south of the area. The rye field probably was attractive to many mammals.

Only six traps were placed in the area, for three nights. These were placed along the old stone and rail fence. Three specimens of *Peromyscus leucopus noveboracensis*, one *Microtus pennsylvanicus*, and one *Tamias striatus lysteri* were caught. One of the *Peromyscus* was captured, by the front foot only, and it remains alive and well at the present writing. This was the most productive area trapped relative to trap-nights per catch, with 1 catch per 3.6 trap-nights.

TRAPPING SUMMARY—1949

Date: July	5	6	7	Totals
Peromyscus l. noveboracensis	3	0	0	3
Microtus p. pennsylvanicus	0	1	0	1
Tamias s. lysteri	0	1	0	1
Totals	3	2	0	5

V. *An open, sphagnum-Vaccinium bog, five miles south of Cloyne. Elevation 850 feet. Trapped in only in 1949.*

This area was once a black spruce-tamarack bog but, having been cleared for a high-power line, it is now primarily an open bog with a dense mat of sphagnum supporting a heavy growth of *Vaccinium* and *Kalmia*. There are a few black spruce and tamarack seedlings in the cleared area. On either side of the clearing are stands of mature black spruces and tamaracks, while on the drier surrounding land are white spruces and firs. In 1949 this was thoroughly dried out and few spots of standing water remained; one in particular was formed by a stone and log cradle for a power-line pole. Ordinarily the entire area would be quite wet. The principal vegetation follows:

**Sphagnum
*Pale laurel (*Kalmia polifolia*)
*Sheep laurel (*Kalmia augustifolia*)
*Bog bilberry (*Vaccinium uliginosum*)
*Small cranberry (*Vaccinium oxycoccos*)
*Canada blueberry (*Vaccinium canadense*)
Cattails (*Typha* sp.)
Tamarack (*Larix laricina*)
Black spruce (*Picea mariana*)
Pitcher plant (*Sarracenia purpurea*)

The birds noted, principally in the black spruce-tamarack, mature stand, follow:

Kingbird (*Tyranus tyrannus*)
Wood pewee (*Myiochanes vireus*)
Barn swallow (*Hirundo erythrogaster*)
Bluebird (*Sialia sialis*)
Bronzed grackles (*Quiscalus quiscula*)
Myrtle warbler (*Dendroica coronata*)
Vesper sparrow (*Pooecetes gramineus*)

This type of habitat is common in low areas south of Cloyne and north of the lake-plain region.

Mammals: In the dried-out portion of the sphagnum bog, there were abundant old runs containing old, dried (winter or early spring) *Synaptomys* droppings and cuttungs. The spruce edge sphagnum floor had similar runs with black droppings. *Lepus* runs (and forms) were abundant, criss-crossing the area, and one hare was jumped from its form in the vicinity of the cradle every time the area was visited. The wet areas con-

tained numerous runs in the sphagnum containing bright green, vole feces and fresh cuttings of grasses and mosses (*Polytrichum*). Apparently these voles had migrated to the wetter spots as the bog dried.

Fifty-three traps were set across the area so that the spruce edge, a few of the dry spots, and a large portion of the wetter areas with fresh signs, were trapped. The traps averaged about ten feet distant from each other. *Synaptomys*, and possibly *Zapus* and *Sorex*, were considered likely catches. The traps remained set out for two nights.

Two specimens of *Synaptomys cooperi cooperi* and one *Peromyscus leucopus noveboracensis* were caught the first night, comprising the entire catch, or 1 catch per 35 trap-nights.

TRAPPING SUMMARY—1949

Date: **July**	**6**	**7**	Totals
Peromyscus l. noveboracensis	1	0	1
Synaptomys c. cooperi	2	0	2
Totals	3	0	3

VI. *A small creek and a high, alder bog in the dry hills, seven miles north of Cloyne, Ontario. Elevation 1,050 feet. Trapped in part in 1949, further in 1950.*

This area includes more than the specific area trapped, and consists really of more than one type of habitat. The hill on either side of the area trapped is included in the following discussion. The hillside itself is a dry, deciduous, second growth woods with a few remaining white and red pines and some white spruces. White pines, however, comprise the great majority of the seedlings in the area, almost to the exclusion of all other types. Large-toothed and trembling aspens, white birch, and sugar maple are the dominant mature trees. The middle of the hill is traversed by a small rock-lined stream with a black mud bottom. This stream successively drains an alder marsh, a cattail-sedge marsh, another alder bog, and alternating bogs of these two types above this. These extensive bog areas lie in a flat, shallow valley between the hills. An abandoned road crosses the stream about half-way up the hill, and below the road the stream becomes much rockier and flows more rapidly. Sugar maples and herbaceous plants are much heavier along the stream than on the rest of the hill.

The plants in the general area include:

White pine (*Pinus strobus*)

Red pine (*Pinus resinosa*)

White spruce (*Picea glauca*)
Black spruce (*Picea mariana*)
Balsam fir (*Abies balsamea*)
Hemlock (*Tsuga canadensis*)
*Trembling aspen (*Populus tremuloides*)
*Large-toothed aspen (*Populus grandidentata*)
*Speckled alder (*Alnus incana*)
Black willow (*Salix nigra*)
Basswood (*Tilia americana*)
Red osier dogwood (*Cornus stolonifera*)
Beaked hazelnut (*Corlylus rostrata*)
Long-beaked willow (*Salix rostrata*)
*Sugar maple (*Acer saccharum*)
Red maple (*Acer rubrum*)
Moosewood (*Acer pennsylvanicum*)
Red oak (*Quercus borealis*)
Sycamore (*Plantanus occidentalis*)
Black cherry (*Prunus serotina*)
Smooth-leaved shadbush (*Amelanchier laevis*)
Bush honeysuckle (*Diervilla lonicera*)
White ash (*Fraxinus americana*)
Toothed woodfern (*Dryopteris spinulosa*)
Cinnamon fern (*Osmunda cinnamomea*)
Interrupted fern (*Osmunda claytonia*)
Sensitive fern (*Onoclea sensibilis*)
*Sphagnum—in the bogs.
Yellow bead lily (*Clintonia borealis*)
*Wool grass (*Scirpus cyperinus*)—bogs.

The birds in this area were observed rather closely, and those on the following list are all breeding birds, noted in both 1949 and 1950. At the time of the observations of 1950, fledglings and young of all varieties were abundant. The second growth, the slashings, the bare grassy areas, the low brush, and the variety of habitats apparently provided ideal breeding locations for most varieties, especially the brush-loving warblers. This area had a higher bird population than any other habitat discussed in regard to both species and individuals.

Ruffed grouse (*Bonasa umbellus*)Female and covey of young.
Woodcock (*Philohela minor*)
Whip-poor-will (*Antrostomus vociferus*)

Hummingbird (*Archilochus colubris*)—feeding on sap of white-birch from sapsucker holes.

Northern flicker (*Colaptes auratus*)

Yellow-bellied sapsucker (*Sphyrapicus varius*)

Least flycatcher (*Empidonax minimus*)

Wood pewee (*Myiochanes virens*)

Bluejays (*Cyanocitta cristata*)

Black-capped chickadee (*Penthestes atricapillus*)

Winter wren (*Nannus hiemalis*)

Robins (*Turdus migratorius*)—abundant 1949, scarcer 1950.

Hermit thrush (*Hylocichla guttata*)

Veery (*Hylocichla fuscescens*)

Cedar waxwing (*Bombycilla cedrorum*)

Red-eyed vireo (*Vireo olivaceous*)

Black-throated blue warbler (*Dendroica coerulescens*)

Black-throated green warbler (*Dendroica virens*)

Chestnut-sided warbler (*Dendroica pensylvanica*)

Ovenbird (*Seiurus aurocapillus*)

Redstart (*Setophaga ruticilla*)

Magnolia warbler (*Dendroica magnolia*)

Nashville warbler (*Vermivora ruficapilla*)

Rose-breasted grosbeak (*Hedymeles ludovicianus*)

Indigo buntings (*Passerina cyanea*)

Purple finch (*Carpodacus purpureus*)

Goldfinch (*Spinus tristis*)

Chipping sparrow (*Spizella passerina*)

Mammals: Bears (*Euarctos americanus*) have been shot frequently in this area, and a barren field on the hill crest contained numerous overturned stones where a bear had been looking for ants. Tracks of minks, racoons, deer, and foxes were seen in a muddy rut between two parts of an alder bog. The abandoned road in this area apparently provided a well-travelled animal highway. A skunk was seen walking up this road in mid-afternoon.

In 1949, fifty-five traps were set; sixteen along the creek and through an alder bog, eight through a sedge meadow in underground muddy runs, twenty-two in a dense, alder and deciduous thicket, and nine in a cattail-sedge marsh. These traps were set for two nights and yielded one *Sorex fumeus*, one *Blarina b. talpoides*, one *Peromyscus maniculatus gracilis*, and six examples of *Microtus pennsylvanicus*. The latter were

caught in both the sedge meadow and the dense, alder bog. The average catch was 1 per 12.2 trap-nights.

TRAPPING SUMMARY—1949

Date: **July**	9	10	Totals
Sorex f. fumeus	0	1	1
Blarina b. talpoides	1	0	1
Peromyscus m. gracilis	1	0	1
Microtus p. pennsylvanicus	5	1	6
Totals	7	2	9

In 1950 twenty-nine traps were set along the same stream starting just across the abandoned road from the beginning of the line of 1949 and working downstream for about two-hundred feet. This portion of the stream had steep banks and was rockier than above. There were numerous, large boulders with many runs, crevices, and other likely places for small mammals. These traps were set for three nights and produced one *Sorex fumeus*, one *Condylura cristata*, and two of *Blarina brevicauda talpoides*, for an average of 1 catch per 22 trap-nights.

TRAPPING SUMMARY—1950

Date: **July**	8	9	10	Totals
Condylura c. cristata	1	0	0	1
Sorex f. fumeus	0	0	1	1
Blarina b. talpoides	1	0	1	2
Totals	2	0	2	4

VII. *A small, sphagnum bog in a patch of spruces, 0.6 miles west of route 41 and 1.25 miles southeast of Massanoga, Ontario. Elevation 950 feet. Trapped in in 1949 only.*

This is a small sphagnum bog in a patch of black spruce and firs in the center of a larger and more extensive forest of second-growth hardwoods. In many respects it is much like trapline III except that it is not as extensive or dense, and in general is an area not as cool. It was at one time burned over, as many charred stumps and logs cover the ground. The bog is divided into boglets by fallen logs, and these are covered with mosses, primarily sphagnum. Standing water persisted in some of the boglets in 1949. The outstanding feature of this habitat is its present discontinuity with the surrounding drier forest, and it is consequently an island situation.

The principal vegetation is as follows:

*Black spruce (*Picea mariana*)

Balsam fir (*Abies balsamea*)

*Black ash (*Fraxinus nigra*)
Red baneberry (*Actaea rubra*)
*Sphagnum, and other mosses and liverworts.
*Yellow bead lily (*Clintonia borealis*)
Star violet (*Dalibarda repens*)

Mammals: Twenty-one traps were set in this area in locations very similar to those in trapline III: in suitable runs, along fallen logs, around stump bases, and other such spots. One *Condylura cristata* and one *Microtus pennsylvanicus* were taken in two nights of trapping. This seemed like an ideal spot for *Clethrionomys* and for *Sorex*, but since none were caught, the conclusion was reached that the area was too small to support a typical bog or bog-edge fauna in an extensive dry habitat. There was one catch for each 21 trap-nights.

TRAPPING SUMMARY—1949

Date: **July**	**10**	**11**	Totals
Condylura c. cristata	0	1	1
Microtus p. pennsylvanicus	0	1	1
Totals	0	2	2

VIII. *A sedge meadow and a marsh area in an old lake fill, 1.2 miles southeast of Massanoga and 1.2 miles west of route 41, on the old road to Mica. Elevation 950 feet. Trapped in only in 1949.*

This is a completely open "beaver meadow" of grasses and sedges (wool grass, locally called "beaver hay"), about three-quarters of a mile long and varying from one-quarter to one-half mile wide. A small lake still remains unfilled at the western end of the area. A small, muddy, slow-flowing creek traverses the center of the area after leaving the lake. The stream is dark and very acid, as are all of the streams in this area. The wool grass is about three feet tall and forms a dense cover under which is a thick blanket of sphagnum, broken dead sedges, and other litter. Surrounding the meadow is a dense zone of speckled alders which, along with small willows, are now reaching out into the meadow area, and are thinly scattered throughout, as well as lining the central creek. These alder thickets seem to be a favorite breeding place for chestnut-sided warblers. Surrounding the alders, and on slightly higher ground, are tamaracks, white spruces, black spruces, white pines, and beyond these are mixed hardwoods in which the white birch is dominant. The vegetation of the area is listed below:

White spruce (*Picea glauca*)—edges.
Black spruce (*Picea mariana*)—edges.
Tamaracks (*Larix laricina*)—edges.
White pine (*Pinus strobus*)—edges.
*Speckled alder (*Alnus incana*)
*Black willow (*Salix nigra*)
White birch (*Betula papyrifera*)—edges.
**Sphagnum.
**Wool grass (*Scirpus cyperinus*)—"Beaver hay."
Cattails (*Typha* sp.)

Chestnut-sided warblers (*Dendroica pennsylvanica*) were breeding in large numbers in the low willow and alder bushes in the area, especially along the northern margin, where there was an extensive area of second-growth white birch and large alders and willows.

Mammals: Beavers were at one time plentiful in the lake at the west end of the meadow, but are now reduced by trapping to just a few. According to the report of the trapper for this area (Albert Spencer, Cloyne), they are building up again (1950) as a result of the present Ontario trapping laws. *Tamiasciurus* was plentiful in 1949, see the account under the species discussion.

Twenty-eight traps were put out at twenty-one stations about twelve feet from each other, extending in a straight line across the meadow with a few scattered on the opposite side in a patch of spruces and alders. Two of *Blarina b. talpoides*, one *Peromyscus maniculatus gracilis*, one *Peromyscus l. noveboracensis*, and one *Microtus pennsylvanicus* were caught in two nights of trapping, or 1 catch per 11.2 trap-nights.

TRAPPING SUMMARY—1949

Date: **July**	**10**	**11**	Totals
Blarina b. talpoides	1	1	2
Peromyscus m. gracilis	0	1	1
Peromyscus l. noveboracensis	1	0	1
Microtus p. pennsylvanicus	1	0	1
Totals	3	2	5

IX. *A high, dry, barren rocky hill, 8.5 miles south of Denbigh, Ontario. Elevation 1,000 to 1,150 feet. Trapped in only in 1950.*

This area represents one of the habitat types missed in 1949. The hill is a solid eminence of quartzite, and is one of the typical glaciated granitoid hills of the region. It is very steep-sided to the east, north, and south, but slopes more gradually to the west. At one time this now barren

hill may have been forested, as a few burned logs bear mute evidence to a previous fire. At present, however, large areas of bare rock lie exposed, especially where the slope is steep. A few aspens have gained a foothold along with patches of poverty grass, blueberries, brackens, and a sweet fern. A few other plants are found in the area, as the following list shows. The dominant form, however, is the blueberry, and this site is more or less typical of the many so-called blueberry balds or barrens in this region. Many of the hilltops and higher elevations are of this type of habitat. The soil, where it has been gathered in the more level spots, is a breakdown of the altered sandstones which form the hill itself. It is in these relatively level areas, in cracks, and in such soil-gathering spots that the plant life is found. The area is very dry and exposed. Blueberries were ripe at the time of trapping (July 4, 5, and 6), in contrast to the other areas in this region.

The following plants were noted.

*Lichens.
*Bracken (*Pteridium latiusculum*)
*Hair moss (*Polytrichum* sp.)
White pine (*Pinus strobus*)—very few.
White spruce (*Picea glauca*)—very few.
Trembling aspen (*Populus tremuloides*)
Large-toothed aspen (*Populus grandidentata*)
White birch (*Betula papyrifera*)
*Sweet fern (*Myrica asplenifolia*)
*Poverty grass (*Danthonia* sp.)
Smooth sumac (*Rhus glabra*)
**Low sweet blueberry (*Vaccinium pennsylvanicum* v. *augustifolium*)
Ground bean (*Strophostyles helvola*)
Pink fume root (*Corydalis sempervirens*)
Hairy rock cress (*Arabis hirsuta*)
Whorled loosestrife (*Lysimachia quadrifolia*)
Barren strawberry (*Waldsteinia fragaroides*)

Not many birds were noted in the area. Those seen follow:

Bluejays (*Cyanocitta cristata*)
Black-throated green warbler (*Dendroica virens*)
Ovenbird (*Seiurus aurocapillus*)
White-throated sparrow (*Zonotricha albicollis*)

Mammals: This area was picked as typical of the high blueberry barrens of the region, in the belief that the faunal inhabitants would be

representative of this type of habitat. Some runways, old signs, and grass cuttings were found around the grasses and blueberries. The cuttings and runs were old. One *Tamias* was seen feeding on blueberries, otherwise no mammals were seen.

Forty-seven traps were put out, starting in a blueberry patch at the base of a steep, rock face about 150 feet below the summit, and extending on up to the crest with traps placed in all suitable patches of blueberries, grasses, or brackens, and along the bases of cliffs, and around the few logs and stumps. A few were put in relatively barren spots. The average trap interval was ten feet. The traps were baited with a mixture of peanut butter, ham-fat, and almond extract, and oatmeal was scattered over each trap. No small mammals were trapped in the three nights the traps were left set, although a few were sprung by a heavy rain during the first night.

It seems probable that this type of habitat is marginal in this region and that during a year of excessively low population, as in 1950, it remains practically uninhabited. The evidence of runs, signs, and cuttings shows the area to have been occupied by small mammals in the past, probably the preceding fall and early winter.

X. *A dense, black spruce bog, 4.5 miles south of Denbigh, Ontario. Elevation approximately 1,000 feet. Trapped in in 1950 only.*

In 1949, no traps were placed in the climax black spruce bog, so this area was trapped in during 1950 to fill this gap. This is a typical, boreal, black spruce bog. The upper story was almost a pure stand of mature black spruce with a few tamaracks. The understory was a solid carpet of sphagnum with Labrador tea growing from it. The spruce habitat was extensive, and has apparently been totally by-passed by fire and timbering except for a small area at the south end which now consists of an overstory of speckled alder. Water was standing beneath the sphagnum. The soil is acid, black muck. Small cranberries are common. The alder portion had less sphagnum with more of the black muck being exposed. Also, there was little standing water in this portion of the bog.

The higher ground surrounding the bog was covered almost entirely with white spruce and fir. Cinnamon ferns and yellow bead-lillies formed a dense cover around the periphery of the bog.

Floral list of the area:

**Black spruce (*Picea mariana*)

*Tamarack (*Larix laricina*)

*Speckled alder (*Alnus incana*)
**Sphagnum.
**Labrador tea (*Ledum groenlandicum*)
*Small cranberry (*Vaccinium oxycoccos*)
Heart-leaf lily (*Maianthemum canadense*)
Bunchberry (*Cornus canadensis*)
*Deer vine (*Linnaea americana*)—in bloom.
Barren strawberry (*Waldsteinia fragaroides*)
Arctic bramble (*Rubus arcticus*)—in berry.

The following birds were noted in the area, although no concentrated effort was made to obtain a complete list due to the density of the growth with its attendant poor visibility. All are probably nesters in or near the area.

Pair of Broad-winged hawks (*Buteo platypterus*)
Ruffed grouse (*Bonasa umbellus*)
Red-breasted nuthatch (*Sitta canadensis*)
Nashville warbler (*Vermivora ruficapilla*)
Redstart (*Setophaga ruticilla*)
Purple finch (*Carpodacus purpureus*)

Mammals: The area was laced with runs of the snowshoe hare and fresh scats were abundant, although no hares were seen.

Forty-seven traps were set in the area at intervals of approximately twenty feet. The first fifteen traps were in the alder portion of the bog, and the remaining thirty-two were in the stand of black spruce. All traps were set in likely-looking spots with the spacing a secondary consideration; so that some were grouped more closely than others. These traps remained set and unmoved for four nights for a total of 188 trap-nights.

One *Sorex cinereus* was caught on the second night in the alder portion of the bog. One *Sorex cinereus* and one juvenile *Peromyscus maniculatus gracilis* were caught in the spruce portion of the bog on the fourth night. Two very hot, dry days preceded the final night, making one wonder if the two catches on that night hadn't wandered into the cool, moist, bog area from surrounding drier territory. The lack of catches in this portion of the bog for the three preceding nights tends to support the idea that these animals were transients from outside of the area. Three catches in 188 trap-nights equals 1 catch per 63 trap-nights.

TRAPPING SUMMARY—1950

Date: July	7	8	9	10	Totals
Sorex c. cinereus	0	1	0	1	2
Peromyscus m. gracilis	0	0	0	1	1
Totals	0	1	0	2	3

In addition to the specific trapping areas described above, highway 41 was a collecting locality. In 1949, three *Tamias*, one *Tamiasciurus*, and one *Lepus* were picked up and saved as specimens. In 1950 two *Tamias* were found in a condition good enough for specimens. Others were picked up which could not be saved. Among the latter were a weasel (*M. frenata*), several porcupines, several red squirrels in 1949 and another red squirrel in 1950. Many sight records were obtained along the highway for *Marmota*, *Mephitis*, *Mustela vison*, *Erethizon*, *Lepus*, *Odocoileus*, *Tamias*, and others, as well as for many of the birds. Most of the animals seen or picked up from the highway came from the hardwoods and brush along the roadside. *Lepus* and deer were seen especially about six miles south of Denbigh in a small grove of spruces below the farm of trap-site IV. In 1950 minks were twice seen crossing the highway in daytime. Road construction on portions of the highway reduced the number of animals seen in 1950 from that which otherwise might have been present. Hares were conspicuous by their absence from the road in 1950, only one record having been obtained, but that this was a result of the road-work was shown by their abundance along other roads. The discontinuance of road treatment with calcium chloride further reduced the numbers seen in 1950, since this salt attracted many mammals, especially hares, even though it resulted in their death from calcium poisoning.

III. ACCOUNTS BY SPECIES

Condylura cristata cristata. This was the only mole captured in the area. Three specimens were captured, two in 1949 and one in 1950, in wet, muddy habitats. One was taken in the tunnel-run at the base of the scarp in area III, one along a fallen log in the area VII bog, and one at a run opening at the base of a rock wall in area VI (1950). It may be noted that all three of these moles were taken in runs at the bases of natural barriers.

A female captured on July 5, 1949 contained one extremely small embryo in each horn of the uterus, corresponding to a six day pregnancy (early implantation) in the rat. The female trapped on July 8, 1950 was not lactating, was not pregnant, and no implantation scars were found. A male trapped July 11, 1949 was immature with small abdominal testes. No smear of the testis was made. These data suggest that these moles may have two litters a year in this region.

Sorex cinereus cinereus. Six of these shrews were captured, two in 1949 and four in 1950. The two specimens taken in 1949 and the two in

1950 were trapped in the black ash-white cedar bog (III). The bog had no standing water in 1949, and the shrews were caught in boglets in the center of the bog—one at a hole emerging from the black muck bottom, and the other at the base of an overhanging hummock. In 1950, when the boglets were under water, these shrews were caught in a tunnel-run at the base of a scarp at the bog edge, while none were caught in the central area. The remaining two specimens of *Sorex cinereus*, taken in 1950, were trapped in the black spruce-sphagnum bog (X): one in the black spruce portion, and the other in the alder portion of the bog. Both were in clumps of sphagnum.

Sorex cinereus in this region has the tricolor pattern with a distinct lateral band, described by Jackson (1928) as occasionally occurring. This pattern was much more conspicuous in dead specimens than in prepared skins. Another feature quite striking in specimens "in the flesh" is the much denser, softer, and silkier pelage found on *cinereus* than on *fumeus* when caught in the same place at the same time. The coarser pelage of *fumeus* is less pronounced in the dried skins, but it is nevertheless evident. This suggests that *cinereus* may have more fossorial habits than *fumeus*. All of the *cinereus* caught in both years had long tail pencils regardless of obvious age differences.

Both of the *cinereus* trapped in 1949 were pregnant females, one with six 9 mm. embryos caught on July 11, and the other with four minute embryos captured July 7. The distribution of the embryos in the uterine horns was equal in both shrews. One immature, non-pregnant female was caught in 1950. No implantation scars were found, the uterus was very small and juvenile, and the mammæ were obviously small and undeveloped. The three males of 1950 were all adult with scrotal testes and abundant sperm in the epididymes. The testicular smears, however, showed advanced degenerative changes, with few or no spermatozoa, chromolytic changes in the nuclei of the spermatids, and numerous giant cells containing up to twenty spermatid or secondary spermatocyte nuclei. Occasionally primary spermatocytes were found involved. The fact that all three males showed these changes is strong evidence that the adult males cease their reproductive activity at this time of the year.

If combining two years' findings is a valid procedure, the capture of a sexually immature female and two pregnant females at the same time of the year indicates that two litters may be raised. The fact that pregnant females were caught so late in the season is suggestive of this without any further evidence, as the young of the year probably have not reached

maturity by this time. The possibility still remains until disproven. The degenerative condition of the testes of the male shrews taken in 1950 indicates that the end of the spring breeding season occurs about the first of July.

With the adult males undergoing testicular degeneration in early July, the problem arises of determining the ages of shrews caught later in the summer. It has been noted in *Blarina* that the degenerate, late fall testes of adults have a flaccidity which is quite distinct from the small, firm testes of juvenile animals, and this may be a useful criterion for *Sorex cinereus*. Tooth-wear should also be a distinct aid at this point.

The evidence at hand, then, suggests that *Sorex cinereus* has a limited breeding season in the spring and early summer and that either (1), two or more litters may be raised per adult female, or (2), the young of the year reach maturity soon enough to become pregnant before the adult males undergo testicular regression early in July.

Sorex fumeus fumeus. Four smoky shrews were captured: two in 1949, and two in 1950. One was caught each year in habitats III and VI. In 1949 one was caught beneath some alder roots along the streams of VI, while in 1950 another was caught farther down along the rocky bank of the same stream. The specimen taken in 1949 in the black ash-white cedar bog was caught at the base of a boglet hummock in the center of the area, while in 1950 this shrew was caught in the tunnel-run at the fault base. None was caught in the boreal, black spruce bog. The implication is that *Sorex fumeus* is more closely associated with deciduous growth than *cinereus* is in this region.

Of the four specimens of *Sorex fumeus*, three were females, one with an undetermined reproductive status, but not pregnant, and the other two obviously immature shrews with small, undeveloped uteri with no implantation scars. The one male, captured in 1950, was also immature with abdominal testes containing mainly spermatogonia with a very few primary spermatocytes. The interstitial cells were small. In contrast to *Sorex cinereus*, it appears from the collected evidence that *Sorex fumeus* in this region may have an early spring breeding season with probably only one litter raised. This is admittedly limited evidence, and Hamilton (1943) states that these shrews have two spring litters, and less often a third litter in the fall. The possibility of the young of the year being responsible for these later litters, however, is not precluded. It does seem, if there were adult, reproductively active individuals of *fumeus* about during the 1949

and 1950 trapping periods, that at least one would have been captured. Also, *Sorex fumeus* may have but one litter in the spring in this region, whereas it has two farther south and at a lower altitude. That the relative population levels of these animals may reflect changes in reproductive potentials must also be taken into consideration.

Sorex palustris albibarbis. One male water shrew was captured in 1949 in the black ash-white cedar bog (III). Judging from its cross-wise and attenuated position in the trap, the animal apparently had been running along the mud at the base of an overhanging sphagnum hummock in the center of the bog. The habitats and trap locations were almost identical with those in which one of these shrews was caught in Monroe Co., Pa., in May 1949.

This animal was an immature male with abdominal testes measuring 1.0 x 1.5 mm. The testicular smear showed abundant spermatogonia, very few primary spermatocytes, and no spermatogenesis beyond this stage. There were no sperm in the epididymis.

None of these shrews was caught in 1950, when most of the bog was covered with standing water, even though the area was trapped much more heavily and for a longer period.

Microsorex hoyi intervectus. One pregnant female was caught in the run at the base of the fault-face of the black ash-white cedar bog (III) on July 3, 1950. She had three very small embryos, two in the right and one in the left uterine horns. The mammæ were enlarged.

This shrew was captured in the same tunnel-run in which *Sorex cinereus* and *Sorex fumeus* were taken in 1950, and *Condylura* and *Synaptomys* in 1949, as well as the same bog in which these two shrews and *Sorex palustris* were taken in 1949. Thus four species of long-tailed shrews and *Blarina* were inhabiting the same bog. The obvious aquatic adaptations of *Sorex palustris* probably serve equally as well on the wet, black muck of the "1949 bog floor." That *Sorex cinereus* may lead a more fossorial existance than *Sorex fumeus* with slightly different habitat preferences has already been suggested, but where *Microsorex* fits in the ecological picture with these other shrews is difficult to say. That *Sorex palustris albiborbis* and *Microsorex hoyi intervectus* are much less common than the other two shrews is evident.

The thymus in all of these shrews was found to be extremely large, compared with most other mammals. It is a flat, leaf-like organ spreading over the entire ventral surface of the thorax, from its apex in the superior

mediastinum. The interscapular, hibernating gland mass, is likewise large and extends as a continuous mass over the back in the scapular region, passing posteriorly around the shoulder and into the axilla. In other mammals the hibernating gland exists as more or less discreet masses in these various regions.

Blarina brevicauda talpoides. Twelve short-tailed shrews were captured in 1949, and five in 1950. As elsewhere in their range, these shrews are probably the commonest mammals in the region. In 1949 they were caught in all habitats except the dry, old field (IV), the vaccinium-sphagnum bog (V), and the small, relatively warm, spruce bog, while in 1950 they were not caught on the high, dry bald (IX), or in the black spruce bog (X). The inference is that they do not occur in extensive, wet sphagnum bogs or excessively dry spots, but are otherwise ubiquitous. However, the low population of 1950 must be kept in mind. In years of peak populations they may possibly occur in these places.

Testicular smears were made of five males in 1949. Three of these showed all stages of spermatogenesis in the testes, and spermatozoa in the epididymes. All three had early degenerative changes with numerous, large giant cells of spermatids and secondary spermatocytes, chromolytic changes of the spermatid nuclei, and vacuolar degenerative changes of the spermatogonial series. The other two were immature with no spermatogenesis beyond a few primary spermatocytes and no sperm in the epididymes. Of the four males in 1950, two were immature with smear pictures similar to the above juvenile shrews. Two were adult with scrotal testes, sperm in the epididymes, and active spermatogenesis. One of these, however, showed marked degenerative changes of the testes, involving particularly the secondary spermatocytes and spermatids. Giant cells, composed primarily of spermatids, were abundant with up to ten nuclei. Most mature *Blarina*, then, probably undergo testicular regression at the end of the spring breeding season in this region, while a few may remain in a functional reproductive state, although they, too, may undergo degeneration at a later date than is covered in this account.

Four females were examined in 1949. None was pregnant; one had visible placental scars and was lactating, two others were lactating, and the fourth was obviously immature. The one "1950 female" was a nulliparous juvenile with remarkably prominent lateral scent glands. Since no pregnant females were trapped, it is probable that the peak of the breeding season had been passed by the first part of July.

Chiroptera. No bats were seen in the 1949 period, and sight records reported by various people all turned out to be chimney swifts. Definite knowledge of a few was obtained in the report of some which had been hanging behind the shutters of a lakeside cottage earlier in the summer.

In 1950, one was seen flying with a cicada in its mouth. It was flying across a clearing above Marble lake at dusk and the species could not be determined, but it appeared small—not much larger than the cicada. No others were seen.

Euarctos americanus. The black bear is common in the region. At this time of the year they are reported to be back in the bush feeding on blueberries. In 1950, many large stones turned over by a bear searching for ants were found in a barren field above area VI. The bear had apparently left shortly before my arrival, as the ants were still running around carrying their eggs to safety. There were others on the east shore of Mazinaw Lake during the 1949 period. In the early fall of 1947 three were trapped above the west shore of Mazinaw in area VI. The unanimous local opinion is that they are a nuisance.

Procyon lotor. Local trappers and residents report that raccoons are very abundant, but the present low value of their fur keeps them from being trapped. One dead juvenile, apparently a highway casualty, was picked up in area I on the west shore of Mazinaw Lake.

Martes americana. Two trappers (Al Spencer and Irving Brown) and the Lands and Forests District warden, all report that martens have been unknown in the region during their lives—about forty years. Martens were undoubtedly present at one time, but their trap stupidity has probably long since exterminated them throughout the district.

Martes pennanti. Reports on the fisher are conflicting, but it seems likely that some still exist about seven miles northwest of Mazinaw Lake in the enormous, virgin white pine forest surrounding Weslemkoon Lake. A few are known to be in Algonquin Park, and some could have wandered down from there through the continuous intervening forest. However, the area west of Mazinaw is wild and inaccessible enough to have maintained a small permanent population, especially in the white pine forest. Albert Spencer, who traps an area of about seventy square miles between Mazinaw and the pines of Weslemkoon, has never taken or seen a fisher in his area, although he thinks they may be present in the pines. Irving Brown states definitely that fishers are still present "about seven to eight

miles west of here in the virgin white pine wilderness around Weslemkoon Lake." The forest warden said that Brown was the best trapper hereabouts and knew more than anyone else about the mammals. The warden himself recalls having seen the last fisher taken in the Plevna region about forty years ago.

It is unfortunately true that the edges of the virgin pine forest are already being timbered during the winter, and it is only a matter of time before the forest will no longer exist. With its passing, the fisher will undoubtedly disappear also.

Mustela erminea cicognanii
Mustela frenata noveboracensis } Both of these weasels are present, and are distinguished from each other on the basis of size by all trappers with whom I talked. A large white *frenata* from this region commands a good price on the fur market ($3.75 top in 1949; $2–$3, depending on size, in 1950), hence they are conscientiously trapped. One example of *frenata*, too badly damaged to keep, was killed on the highway in 1949.

Mustela rixosa. According to Anderson (1946), the least weasel has not been taken in this part of Ontario. Evidence from local trappers is contradictory. Brown stated that weasels of all sizes had been accidentally trapped, but brought a good price "except for the very small one with a tail about an inch long, which was worthless." The forest warden stated that weasels were very abundant last year (1949-50) in the Plevna district with "very large, small, and little short-tailed ones." Albert Spencer, however, after hearing a careful description of the least weasel, said that he was totally unfamiliar with the animal, and that perhaps it did not occur around Mazinaw. The comments of these three reliable people are difficult to reconcile. Although in the face of the above statements it seems very unlikely, it is possible that Brown and the warden were referring to small females of *Mustela erminea cicognanii*.

Mustela vision vision. Minks, along with beavers, are the staples of the fur business in this region. They are quite common, and I noted mink tracks along most of the muddy streams or bogs investigated in 1949 or 1950, especially along the creek and alder bogs of area VI. One mink was seen in mid-afternoon crossing the highway towards the shore of Mazinaw Lake in 1950. With both mice and muskrats at very low levels, the mink must have to work hard and travel far for sufficient sustinence. Irving Brown (1950) says that the mink is getting scarce in the trapping area to the east and north of Mazinaw Lake. The forest warden reported them

plentiful in the Plevna district, and trapped a few in 1949 and 1950. The fur value of a large mink is now from eighteen to twenty-five dollars.

One mink is known to have been living on the west shore of Mazinaw in Area I several years ago when it attempted to carry off a kitten from an old trailer. It was driven off by the mother cat after a vicious fight.

Lutra canadensis canadensis. Otters reportedly have been uncommon in the past, but are now increasing. Albert Spencer trapped two in this area in the 1949-1950 season, but complained that they brought only fifteen dollars apiece. Irving Brown reports "loads of otter" and he recently has been trapping more otters than minks in his area, which includes the river and marshes north of Mazinaw Lake, as well as the east side of the lake.

It is evident that otters are quite abundant in the area, as one might expect from the numerous waterways, lakes, and ponds.

***Mephitis mephitis nigra.** Skunks are very common and are a pest on the highway and around cabins, where they visit every night looking for tidbits. Skunks were feeding largely on ripe blueberries in 1949. Several were killed on the highway, and more were seen alongside the road at night. Two half-grown young ones dwelt beneath our cabin in 1950 (area I), and one of these was trapped. An adult female was collected at Garbutt's camp in the same area. This skunk was found alive, but dying, on the edge of the lake with its head partially in the water. Its left, rear ankle joint was rigid, forcing it to walk on the tips of its toes. This identified it as the same animal which had been seen abroad on the hill above the lake (area VI), at noon two days previously. Autopsy revealed this animal to be extremely emaciated with atrophic muscles and no fat deposits whatsoever. No gross pathological changes were noted in any of the internal organs. Five porcupine quills, however were removed: three from beneath the skin, one from in the mandibular joint, and one from the fibrosed ankle. The ankle fibrosis, however, appeared to be from a much older lesion than the quill could account for, as old callouses on the foot testify. The animal had been lactating recently, and had three recent and three old right, and two recent and three old, left, uterine implantation scars. External parasites, mostly lice with a few ticks and fleas, were too numerous to count, and were estimated at at least a hundred for each square inch of skin over the entire body. The probable history of this skunk would be that she had raised at least one litter this spring, and some-

*Additional information concerning this species is included in the addendum *after* the bibliography, page 385.

time, probably after the birth of her young, encountered a porcupine. The quill in the jaw, after it had worked into the muscles and joint, probably prevented feeding. The hind-foot lesion was an old injury, and probably did not interfere much with her activities. The parasites most likely became so abundant as a result of her weakened condition. To the severe stresses of pregnancy, nursing, and inanition, was added the burden of parasites. Sinus worms were also present. All of these severe stressors resulted in the animal's death. In spite of all these alarming stimuli, the adrenal glands were found to have a quite high ascorbic acid content. This seems most paradoxical and cannot be explained, as exhaustion of her defense mechanisms, sufficient to cause death, most certainly would be expected to cause complete depletion of the adrenal ascorbic acid.

Vulpes fulva
Urocyon cinereoargenteus Red foxes are present in abundance, and many sight records are in my possession. I neglected to inquire if gray foxes were also present while listening to the general complaints about foxes. The region is outside of the normal range of gray foxes, although Anderson (*loc. cit.*) reports that a gray fox had been taken six miles west of Kaladar, which would be in this general region. The foxes present, however, are probably red foxes with possibly a few grays.

Canis lupus lycaon. Wolves are relatively common in the Mazinaw district, although their known presence causes considerable local comment. In the spring of 1949, a pack appeared on the east shore of Mazinaw Lake, and were heard nightly. The number of animals in the pack is not known. The forest warden saw a wolf about five and a half miles below Denbigh on highway 41 during late May, 1950. He stated that these wolves are much darker than the dog-like wolves around Tweed, and claims they are "true timber wolves" and distinct from the others. The so-called wolves of Tweed, that he refers to, may be *Canis latrans*, or even wild dogs. This same warden has snared wolves in the Plevna district.

Two or three times each winter, wolves put in an appearance along the shores of Mazinaw Lake. The local opinion, given for what it may be worth, is that the wolves in the area come down from Algonquin Park. They are known to be common in the park, but this area probably supports its own wolves.

Lynx canadensis. The lynx is probably unknown in the territory, or at least extremely rare, judging from reports.

Lynx rufus. The bobcat is reportedly common, being frequently shot or trapped, contrary to Anderson's (1946) statement that they are extremely rare. No further information was obtained.

Marmota monax rufescens. Woodchucks are common and were frequently seen along the west shore of Mazinaw Lake above Cloyne. None was found dead on the highway in good enough condition for a specimen, although several had been run over. They all appeared small and quite red, although one picked up below Kaladar, Ontario, was very large. The density and length of the guard hairs on this animal were noticeably greater than on more southern animals.

One was seen along the edge of a pond in the center of a black spruce bog, and others were noted in the woods, although the roadside areas seemed to be a choice habitat and supported a large population. This may be apparent rather than real, since they are so much more easily seen.

Woodchucks were reportedly very abundant in 1950, more so than in 1949, and created havoc with the few truck gardens in the region.

Tamias striatus lysteri. Chipmunks are abundant throughout the second-growth, dry, rocky, deciduous woods, and many are killed daily on the highway. The only mammal recorded on top of the rocky bald (area IX) was a chipmunk feeding on blueberries. None was seen or captured in any of the cold habitats visited, but they were abundant around the shores of the lake. Of the four chipmunks obtained in 1949, two females and one male were immature. The third female was adult, but, having been run over, the reproductive status could not be determined other than that it was lactating.

Two chipmunks were picked up from the highway in good condition in 1950. Both of these were mature males with scrotal testes. The epididymes of both contained abundant spermatozoa. The testis of one contained all stages of spermatogenesis and showed no evidence of degenerative changes. The other had a reduced number of spermatids and secondary spermatocytes with giant cells composed of four or five secondary spermatocytes. These findings are most likely indicative of very early degenerative changes, and indicate the beginning of the cessation of breeding activity in at least the one male.

The population of chipmunks appeared to be about the same in 1950 as in 1949, as they were abundant in both years.

Tamiasciurus hudsonicus loquax. Anderson (1946) states that *loquax* and *hudsonicus* intergrade in the Algonquin Park region of southern Ontario, and consequently probably do so in the Mazinaw region also.

The red squirrel is one of the common mammals of the region, and was abundant in 1949. Not a habitat was visited which did not have red squirrels chattering from the trees, and many were seen crossing the highway or lying dead on it. They were especially abundant in mixed spruce-deciduous woods, and seemed to stay fairly close to the spruces. They evidently feed primarily on spruce seeds, as abundant cone cuttings testify. In one grove of black spruce (VIII) the daytime nest of a red squirrel was found. It was situated in a crotch, formed by a limb and the trunk, about twelve feet from the ground. Its outside diameter was about twelve inches, and in the center was a hollowed out, uncovered cavity four or five inches in diameter. The whole nest was composed of sticks, thickly lined with sphagnum and other soft mosses and plant fibers. In general it appeared like a finely constructed, large, bird nest. A rat trap was set in this nest after the squirrel was seen in it, but to no avail. A few feet away, and about twenty feet from the ground in the top of a small spruce, was its permanent, fully roofed-over nest, composed primarily of *deciduous* leaves.

In 1949 one lactating female was picked up from the highway.

In 1950, red squirrels in general were conspicuous by their absence. Not one was seen in any of the habitats visited or trapped in, and none was heard chattering. Several were seen either crossing the highway or lying dead on it, but few compared with 1949. Although no actual census was made, it was very evident that the "1950 population" of red squirrels was way down from 1949.

Red squirrels are shot on sight by the local residents, since there is no closed season on squirrels, but their numbers appear to be unaffected by the shooting, probably due to the enormous reserve range in which they are completely unmolested.

Sciurus carolinensis leucotis. Both "black" and "gray" squirrels are found in the district, although I did not see or collect any. Their fur brings a fair market price, and they are trapped or shot for this reason. They are reportedly "abundant."

Glaucomys sabrinus macrotis. Flying squirrels are known to be abundant even though none was collected. One nest was located in an old sapsucker hole about eight feet from the ground, in an aspen along the

shore of Mazinaw Lake. At Northbrook a pair of young ones had been captured about two weeks prior to our arrival in 1949, and were kept as pets. Their mother had been shot.

Castor canadensis. Beavers are one of the mainstays of the Mazinaw fur business, and were rapidly approaching extinction until a few years ago when the present Ontario trapping laws were put into effect. These have given the trapper an incentive not to "trap out" a locality by allowing only him to trap in his registered area. Beavers are now increasing throughout the territory. Mr. I. Brown has been taking many during the past two years (1949, 1950). Mr. A. Spencer had one beaver house on his area in 1947, but now (1950) has fifteen, and they are still increasing rapidly. He limits his catch to one beaver to each house in order to increase the population. He permits no destruction of dams or houses which benefits both the beavers and the muskrats. One of his colonies is in Essen's Lake, slightly west of area VI.

One beaver skull was collected from a trapper's "carcass dump."

Peromyscus maniculatus gracilis. Three males and three females were collected in 1949, and two juvenile females in 1950. One of the males had completely gray pelage, but was sexually mature with sperm in the epididymes and all stages of spermatogenesis in the testes. The other five "1949 mice" were adult with respect to both pelage and reproductive functions. One female had six 23 mm. embryos, and the mammary glands were post-lactationally enlarged and pigmented. These embryos would then represent at least her second litter of the year. The same is true for another which had seven recent and five old implantation scars, and was lactating. The third had ten uterine scars, and was lactating.

Of the three "1949 males," the testes of the two with adult pelage showed marked degenerative changes with very numerous giant cells of secondary spermatocytes and spermatids. Spermatids with vacuolar and chromolytic changes were abundant. These two animals were obviously regressing from full reproductive functioning. The male with juvenile pelage showed no degenerative changes, but the number of mature sperm was low.

Peromyscus m. gracilis was captured in such diverse areas as the middle of a sedge marsh (VIII), an alder bog (VI), a patch of spruces (II), a black spruce bog (X), a black ash-white cedar bog (III), and dry mixed woods (I). The common ecological denominator here is elusive, except that all habitats are either forested or wet, with a dense cover. The dry

open habitats produced none of these mice, nor did the sphagnum-Vaccininium bog (V). They were not as abundant as *leucopus* was in 1949, but two were caught in 1950 when no *leucopus* were caught.

Peromyscus leucopus noveboracensis. This is probably the commonest mouse in the region. Twelve were taken in 1949, in every type of habitat trapped, but none was caught in 1950. Of the four females trapped, only one was adult with a perforate vagina, and this one was not pregnant, or lactating, or with implantation scars.

Of the eight males, two had abundant sperm in the epididymes. One of these possibly showed very early degenerative changes of the testes, while the other had a completely normal smear. One adult had a few sperm in the epididymes, and the testes showed marked degeneration with chromolysis of the spermatids and secondary spermatocytes. Two others, apparently recently matured, had few sperm in the epididymes, but showed no degenerative changes. The remaining three were juvenile with normal testicular smears and no spermatozoa in the epididymes. The testis of one of these contained a few small giant cells.

With only one of the five adult specimens of *Peromyscus l. novenboracensis* showing any marked degenerative changes in the testes, it appears that these mice either do not follow the same reproductive pattern as *Peromyscus m. gracilis*, or that the changes are slower in developing. The latter seems the likely answer, since at least some of the animals did show mild degeneration.

One of these mice was captured alive and fed blueberries and other foods so that it had a choice. At first only blueberries were placed in the cage and these were eaten. Then blueberries were put in the cage along with wintergreen berries, and were selected and eaten prior to the wintergreen berries. Berries of *Aralia* were left untouched, when put in alone or with other berries. A fly, a beetle, and a bumblebee were quickly seized and eaten in preference to any kind of berries, or bread, or prepared dog-food, or a cracker. The berries and an apple were selected in preference to any kind of prepared food. Black cherries were left untouched! Peanuts were nibbled, as were various grass seeds. A few stomach examinations revealed insects primarily, with spruce and pine seeds, and some undetermined vegetable remains. This mouse thrives well on a diet of dried dog-food and lettuce fourteen months after its capture.

Peromyscus l. noveboracensis has taken the place of the house mouse, and invades cottages extensively. Soap seems to be a dietary delicacy.

Neotoma sp. (?). Although this region is well out of the known range of the wood rat, it is possible that they are present. Mr. Fred Garbutt and his wife described two rats which their cat had brought in several years ago as being very distinct from *Rattus*, but about that size. The exceptional appearance was immediately noticed, and the animal was described as a rat with large deer-like ears resembling in general a deermouse, only larger. This information was entirely voluntary. Mr. Garbutt also saw a pair of these rats in a gravel pit about six years ago. Three rat traps placed in this pit for two nights caught nothing. The greater amount of fur on the tail of these rats was also mentioned. The fact that this information was wholly unsolicited lends validity to the description.

Synaptomys cooperi cooperi. Three of these animals were trapped in 1949; two in a sphagnum-Vaccinium bog (V), and the other in a run at the base of the rock face in a white cedar-black ash bog (III). They apparently were much more common prior to the extremely dry weather in the sphagnum-Vaccinium bog, as old droppings were found over the entire bog, and runs filled with old cuttings literally undermined the sphagnum of the whole area, most of which was quite dry at the time of trapping. Fresh feces and cuttings were found only in the remaining moist areas. One area in particular was littered with fresh green signs and cuttings, but no specimens of *Synaptomys* were captured here. The feces of the animal in the black ash-white cedar bog were black instead of the usual bright green, like those found in the open sphagnum bog. Due to the numerous and extensive spruce and sphagnum bogs in the area, *Synaptomys* is probably one of the more abundant mammals in the region. The period of rainless weather preceding the trapping period in 1949 may have reduced their numbers to some extent. None were caught in 1950.

The only female trapped had five minute embryos, as well as eight old implantation scars; so that the young *in utero* represented at least her second pregnancy of the year. The mammæ were enlarged and postlactational.

Both males had abundant epididymal sperm. One of these had a few, very small degenerative giant cells in an otherwise normal smear. The testes of the other had numerous giant cells with up to fifteen nuclei of primary secondary spermatocytes, or spermatids. Late and early spermatids were markedly degenerate, and secondary spermatocytes were undergoing chromolysis. These findings are indicative that *Synaptomys* may undergo testicular regression in this region at this time of year.

Clethrionomys gapperi gapperi. Four of these voles, of which all were taken in 1949, came from around the edges of a white cedar-black ash bog under fallen logs and hummocks. They are probably restricted to such habitats, and on this basis this vole could not be considered a very abundant mammal in the region. A higher, less extensive, and less boggy spruce bog, although containing many fallen moss-grown logs and apparently similar microhabitats, did not yield any of these voles. None was caught in 1950.

One female was immature; the other was mature, lactating, and contained five right and no left implantation scars or corpora lutea. No transmigration of ova from one uterine horn to the other had taken place.

Both males were reproductively mature with abundant sperm in the epididymes. The testes of both of these red-backed mice showed marked degenerative changes with giant cells of up to thirty secondary spermatocytes or spermatids. Some giant cells involved primary spermatocytes. All individual spermatids had obvious degenerative changes. The picture was one of extremely rapid degeneration in early July at the height of reproductive activity.

Microtus pennsylvanicus pennsylvanicus. Ten specimens were captured in 1949; one in a small spruce bog, one in moist hardwoods, one in a dry, old field, one in a sedge marsh, and six in an alder bog and sedge marsh. All but one of these were taken in moist habitats, all but two of which were wooded. This seems somewhat contrary to the usual type of habitat associated with *Microtus pennsylvanicus*. In this region, where cultivated or fallow fields are scarce, *Microtus* apparently inhabits sites, represented by the wet alder and hardwood bogs and sedge marshes, which are the type they originally occupied prior to the invasion of agriculture. *Microtus* appears to occupy the wetter spots with deciduous cover, *Clethrionomys* the coniferous edges of bogs, and *Synaptomys* the extensive sphagnum bogs and their edges. No specimens of *Microtus* were trapped in 1950.

Three of these voles were very small, apparently fresh from a nest beneath a snarl of alder and white pine roots, as I surprised them while out wandering in the afternoon. They were caught while running frantically for cover. Possibly many small mammals are frightened into crossing traps. One of these was sexually mature (Christian, 1950b).

One fully grown male contained abundant sperm in the epididymis, the other was immature with no epididymal sperm, although the testes

were scrotal, but small. The adult mammal showed advanced degenerative changes similar to the *Clethrionomys* above with extremely abundant giant cells and vacuolar changes. It may be that adult males of *Microtus*, functionally active in the spring, undergo testicular regression at this time.

Ondatra zibethica. Muskrats are one of the principal furbearers in this region, but not as much so as farther south where there are more extensive habitats. Extensive cattail bogs are not numerous in this area; so the population of muskrats is scattered over numerous, small, suitable areas, such as marshy areas, shallow lakesides, small ponds, and the larger, slow-flowing streams. There was apparently a high population in 1949, but a severe drop had occurred by 1950, at the time of the spring trapping period. Albert Spencer had expected a catch of 500 muskrats, but caught only 150, or a little better than twenty-five percent of the expected catch. Irving Brown likewise stated that his catch was only twenty-five percent of the usual number, and further that the catch for the entire Lake Ontario region was down to a quarter of the usual catch. Apparently there was a general decrease of three quarters in the expected muskrat catch throughout the entire area. Muskrats are prime in late March or early April in this territory.

Mus musculus. The house mouse apparently has not invaded this area, partly due to the abandoning of most of the houses and cabins for a good part of the year, especially the winter.

Rattus norvegicus. According to reports, rats are found in Cloyne and about its dumps. By their destruction of foods stored in the cellars, they constitute a serious economic pest, and a real threat locally during the winter, when they move indoors.

Zapus hudsonius
Napaeozapus insignis The "jumping mice" are apparently not common in the area, as none was caught or seen. The "kangaroo" mouse was described very accurately by Mr. Fred Garbutt from one his dog had caught on the rocky, west shore of Mazinaw Lake two years ago. The animal was most likely *Zapus*, since Mr. Garbutt was certain there was no white tip on the tail, and the rest of his description was so accurate that it does not seem likely that he would have missed it. This is the only one he has seen in sixteen years of residence in this area.

Erethizon dorsatum dorsatum. Porcupines are very common in the area, and they were frequently killed on the highway. Due to their destructive habits and the danger to dogs, they are shot on sight. They are not, apparently, destructive to the pine or other timber trees in the area, as several people evinced surprise when told that porcupines are known to "bark" pines and other trees.

Lepus americanus americanus. The snowshoe hare is the common "rabbit" of the region, and was very common both in 1949 and 1950. Reportedly they were much more abundant in the latter year than in 1949. This abundance is impressive when all reports indicate that there were none to be seen in 1947, and very few in 1948. They were seen nightly along the highway in 1949, to which they were drawn by the calcium chloride. In 1950 the practice of spreading this chemical had been discontinued and work was progressing on the road, so not so many were seen. Numerous hare signs, forms, and runs were noted in all of the marshy areas trapped in both years, and the hares were flushed in habitats II and V in 1949. One lactating female hare was collected.

The ruffed grouse population in this area has exactly paralleled the hare population for at least the last four years, and they were abundant and accompanied by large coveys of young in both 1949 and 1950.

Odocoileus virginianus borealis. Deer are relatively abundant, though much less common than in irruptive areas of the United States, such as Pennsylvania. The deer average larger than those further south, and 250-pound bucks are not at all uncommon. At present there is much local agitation to have no closed season on deer due to crop damage. Should this come to pass, I doubt if the deer would suffer very much, as most of the country is relatively inaccessible and extremely difficult to hunt. Even now most deer hunting is done with dogs, which would probably be disastrous elsewhere.

Alces americanus. Moose are uncommon in the summer, but are frequently seen in the other three seasons. Several were seen along Mazinaw Lake in 1949, and the fire rangers see them from time to time back in the bush. Moose tracks were seen about two miles west of Mazinaw Lake about two weeks before the trapping period of 1950. They are most frequently seen in the spring.

IV. Discussion of Populations

From the foregoing account it is evident that the small mammal population in the Mazinaw region decreased considerably in 1950 from the previous year. Examination of the trapping summaries in the section on habitats reveals the marked decrease in trap line productivity in 1950 as compared to 1949. It is true that trap-night figures will not give a quantitative picture of an area, but they will give a fairly accurate picture of relative changes under the conditions of this study. These conditions are that one person did all of the trapping, reducing the subjective variables of trap setting to a minimum; the same period of time is involved in both years; only three of the ten habitats were trapped in both years, but in both the same general area was involved; an effort was made to set the traps in as nearly the same concentration and manner in 1950 as in the preceding year; traps were moved often enough to avoid catching more than a minimum of stragglers; and the same bait was used each year. For the sake of uniformity, the figures for 1950 for area I have been omitted from the succeeding discussion, as the rat traps used there may have altered the situation. I believe that the following figures represent a valid picture of the relative population changes from 1949 to 1950.

In 1949, 54 small mammals of all species were trapped in 870 trap-nights, or one catch per 16 trap-nights. In 1950, only 12 mammals were caught in 1,127 trap-nights, or 1 catch in 94 trap-nights. This means that the small mammal population for the Mazinaw region in 1950 was only 17% of the 1949 level. The following figures give the breakdown into species using trap-night figures. The long-tailed shrews are lumped in one group, as are the mice and voles. The *Soricidæ* were 108% of the 1949 level which, considering the number of shrews involved, represents an unchanged population. *Blarina* was down 75% from its 1949 figure, and the mice and voles, represented by one *Peromyscus m. gracilis*, were down 98%. The population drop, then, was due to *Blarina*, *Peromyscus m. gracilis*, *Peromyscus l. noveboracensis*, *Synaptomys*, *Clethrionomys*, and *Microtus*. A similar, but not so marked, drop in population was experienced in census lines from the spring of 1949 to the spring of 1950 at Philadelphia, Pa. In this instance, *Blarina* dropped 71%, *Microtus* 86%, and *Peromyscus l. noveboracensis* increased 67% of the 1949 levels, to make an overall decrease of 48%. The principal difference seems to be in *Peromyscus*, which decreased in Ontario and increased in Pennsylvania. *Peromyscus* was in phase with the other small mammals (other than

shrews and moles) in Ontario, while it was out of phase with the others in Pennsylvania. The principal reason for bringing these figures in at this point is to show how much more severe the drop was in Ontario than it was 400 miles further south, and at 1,000 feet lower altitude, although the drop was experienced simultaneously in both places.

It is interesting that the small mammal decline coincided with the decline of muskrats throughout southern Ontario, where the spring catch was 25% of the expected level. However, snowshoe hares, ruffed grouse, woodchucks, and the predatory fur bearers of the region, were all abundant and reportedly increased over 1949 levels. Red squirrels were obviously way down from the 1949 level in this region, but no estimate can be made of the degree of the decline. This probably is a local change, as they have reportedly remained abundant in Algonquin Park (Fowle, 1950), although the other declines were also noted there. Based on sight observations, chipmunks were apparently at the same high level in 1950 as in 1949. Due to present Ontario trapping laws, beavers are increasing rapidly, and should reach high levels in the near future.

The Ontario laws license each trapper to trap in a specified area. No one else may trap in this area, and the trapper may keep it as long as he traps in it. This has added a powerful incentive for the trappers to be conservationally minded. The number of animals which may be removed without endangering the next year's catch is checked by each trapper, so that complete removal of all muskrats and beavers has ceased. In most instances, the trappers have been planting wild rice and cattails to increase muskrat forage. Also, wardens are assisted in the apprehension of poachers by the trappers concerned. All in all, these trapping practices have produced healthy results in the region, and have won the support of the trappers, but it remains to be seen what the final results will be in terms of population dynamics. In spite of this care, the muskrats declined, and it is conceivable that beavers, if allowed to increase excessively, will become cyclic and experience severe declines (Christian, 1950c).

V. Discussion of Data on Reproduction in Relation to Population Dynamics

As a preamble to the discussion of the Canadian data it is necessary to discuss briefly some findings from the Philadelphia area in April, 1949, and April, 1950. In the spring of 1949, as already mentioned, the population of small mammals in the Philadelphia region was high, while in the same period of 1950 the population of small mammals, except *Peromyscus*,

was at a low ebb. Smears of the testes were made of twelve adult male mammals (*Microtus*, *Blarina*, *Peromyscus*) trapped in this area in 1949. The testes of nine of these animals showed advanced degenerative changes with very numerous giant cells of up to thirty degenerate spermatids, secondary spermatocytes, or occasionally primary spermatocytes. Chromolytic changes were noted in a large portion of the spermatids and secondary spermatocytes. In some there was a marked reduction of spermatozoa and spermatids. The testes of all of these mammals were scrotal, and some or many spermatozoa were found in the epididymes. Two animals had mild degenerative changes with fewer and smaller giant cells, while one had a normal smear. In the spring of 1950, however, only one testicular smear in eight showed any marked degenerative changes, although the time of the year and the climatic conditions were about the same.

In a previous paper (Christian, 1950c), I discussed the possible effect of high population stresses on the reproductive potential of the species involved. It seems likely that the severe stresses attending the spring breeding season of a high population level seen in 1949 account for the degenerative changes found in the testicular smears. By contrast the normal smears of 1950 reflect a low population with a minimum of stressors. That various environmental, psychological, or traumatic stresses may produce these testicular changes, of which giant cell formation is characteristic, now seems well established (Selye, 1950). This degeneration is apparently caused by the withdrawal of pituitary gonadotrophin (hypophystectomy is the most potent producer of these changes) to favor the production of adrenocorticotrophin. The census taken in the fall in the same area revealed the population to be at the same level as in the early spring, instead of being increased. This would be predictable from the appearance of the spring testes, since the degenerative changes were indicative of a lower reproductive potential. Whether these changes would result in a complete cessation of breeding in each animal, or only in a reduction in the number of sperm produced, would probably depend on the severity of the stress in the animal. Even though sperm were produced, a lower count could be too low for successful fertilization. The effects of these factors on the female in the wild is not known, but experimental stress causes the ovaries of white rats to atrophy and the animal to go into permanent anestrus (Selye, 1939).

In contrast with the testes of mammals taken at Philadelphia in early spring of 1949 and 1950, adult males of *Sorex cinereus*, *Blarina*, *Tamias*,

Peromyscus m. gracilis, *Synaptomys*, *Clethrionomys*, and *Microtus* taken in Ontario, all showed marked degenerative changes of the testes during the first two weeks of July in both years. *Peromyscus l. noveboracensis* was an exception in that only two of five with sperm in the epididymes, and one of three juvenile males showed any degenerative changes. Degeneration was especially severe in the microtines and soricids. Five adult males of *Blarina* were examined in the two years, and four of these showed degenerative changes. Adults of the other mammals were examined in one year or the other; *Sorex* and *Tamias* in 1950, and the others in 1949. All of the adults of *Sorex cinereus*, *Peromyscus m. gracilis*, *Synaptomys*, *Clethrionomys*, and *Microtus* examined showed degenerative changes.

It would seem, since the testicular changes were found in both years of peak and low populations in the Ontario mammals, that something is working on all species other than the stress effects of a high population, as has been suggested for the "1949" Philadelphia animals. Since all species are involved, and the degenerative changes range from none (in *Peromyscus l. noveboracensis*) to advanced stages, it would seem that the causative agent had probably not been operative for very long. Logically, the passing of the summer solstice with the resultant decreasing day-lengths would appear to be the causative factor. The relation of light and other exteroceptive factors to reproduction has been previously referred to (Christian, 1950c), and the subject has been well summarized by Burrows (1949). It is clear that the daily added light increment is the important element in bringing an animal to full reproductive activity and to maintaining it, while decreasing light resulted in testicular regression in every case investigated. Since stress probably can be ruled out as a result of similar findings in years of divergent populations, light must the the factor involved in this early-summer male reproductive regression found following the summer solstice in all of the species of small mammals considered. The timing certainly seems more than coincidental.

The possibility of this being an artifact resulting from autolytic changes while the animal was in the trap has been ruled out by experiments in which one testis of a normal mouse was "smeared" immediately after death and the other at various intervals after standing at from 70° to 80°F. No differences between the smears of the two testes were observed at any time interval up to eight hours. Technical artifacts have been eliminated by frequent smears of laboratory mice, which were normal in every instance, as well as by comparison with normal smears in the wild-trapped mammals.

It is well known that the spring breeding season reaches a peak, and is followed by a sharp fall in reproductive activity, best expressed as the per cent of females which are pregnant. Coventry (1937) reviews this situation in connection with his own material from Ontario, and explains the fall in the per cent of pregnant females captured, by postulating a decrease in activity as a result of almost one hundred per cent of pregnancies earlier in the season. The present testicular findings indicate, however, that the testes in the males which were adult during the spring breeding season undergo regression following the solstice. This time would be extended three weeks for pregnant females; also, female reproductive activity may be similarly affected. The gradually increasing but low level of pregnancies during the balance of the summer could well be accounted for by young of the year reaching maturity, or by a few adults which did not regress markedly. C. D. Fowle (1950) reports that few, if any, pregnant individuals of *Sorex cinereus* or *Blarina* are taken after the middle of July in Algonquin Park, Ontario. Coventry's (1937) peaks of per cent pregnancies for *Peromyscus m. gracilis* and *Clethrionomys g. gapperi* from Temagami, Ontario, correspond exactly with the present findings, if conception is dated at an average of two weeks prior to his peak (pregnancy first being grossly detectable at six days with a twenty-one day gestation period).

The present material indicates, then, that the spring breeding season is terminated by the decreasing day-lengths following the summer solstice in *Sorex cinereus*, *Blarina brevicauda talpoides*, *Tamias striatus lysteri*, *Peromyscus maniculatus gracilis*, *Peromyscus leucopus noveboracensis* (at least to some extent), *Synaptomys cooperi*, *Clethrionomys gapperi*, and *Microtus pennsylvanicus* from the Mazinaw Lake region of Ontario.

In view of the above discussion it is evident that an actual die-off is not essential for a marked population decline. All that would be required to seriously curtail the population would be sufficient stress to markedly reduce reproductive activity of adults from the start of the spring breeding season until the summer solstice. With this occurring, along with a normal or increased death rate, the number of animals produced would be markedly reduced, and consequently the number surviving the succeeding winter to breed in the following spring would be correspondingly reduced. A population decline of this type would be more likely to occur in more temperate regions, while the actual marked die-off would be expected in the more northern regions which have severer stresses. This would certainly be true for the limited species-food ecology of the sub-

arctic. A greater reproductive potential farther north (Christian, 1950c) might still be expected, with a much more intense activity during the spring breeding season. Some evidence of this has been noted, but it is, as yet, inconclusive.

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ADDENDUM

The normal skunk (*Mephitis mephitis nigra*) adrenal is a rounded, unlobulated, somewhat biconcave disc. The zonation is similar to that found in other mammals. The glomerulosa, however, is distinctly divided from the outer fasciculata by a thin connective tissue septum which is clearly defined in ordinary preparations, and is richly invested with vascular channels. The glomerulosa of the normal animal is about a fifth the width of the entire cortex. Dividing the reticularis from the medulla is a thick, well-defined hyaline connective tissue septum containing numerous veins and small blood sinuses. This connective tissue boundary is denser and much more pronounced than has been seen by the writer in any other species of mammal. The medulla contains the usual granule-filled chromaffine cells. The microscopic appearance of the cortical cells is similar to that seen in other normal, healthy animals.

In the dying female skunk from Mazinaw Lake, Ontario, the cells of the glomerulosa are shrunken and the nuclei pyknotic. In some areas the glomerulosa is replaced by small foci of hyaline necrosis. The thin band of connective tissue between the glomerulosa and fasciculata is not seen. The changes in the fasciculata are very marked. The outer half of this zone is necrotic, having formed a coalesced mass of granular cytoplasm containing pyknotic and karyorhetic nuclei. In a few places this zone of necrosis is interrupted by a few cords of relatively normal appearing fasciculata cells. Central to this band of necrosis the cells of the inner half of the fasciculata and the entire reticularis are shrunken, and the sinusoids are widely dilated. The cytoplasm of approximately half of these cells have the characteristic foamy appearance of fine vacuolation. In several places, involving about one sixth of the entire gland area, wedge-shaped zones of hyaline necrosis extend from the medulla to the outer fasciculata. There has been extensive hemorrhage into these zones of necrosis, and all zones are heavily congested.

The connective tissue separating the medulla from the cortex is enormously widened, almost the entire width of the cortex in one gland and ten to thirty-fold in the other. This band and all of the thinner connective tissue septa are hyalinized, and scattered through them are large phagocytes filled with ingested red blood cells. Arteries, other than a few in the areas of hyalinosis, appear to be normal.

The medullary chromaffine cells are small, deeply staining, and have relatively little cytoplasm, which is free of the characteristic baso-

philic granules. The nuclei appear normal with distinct nucleoli. Throughout the medulla, however, there are islands of cortical cells replacing over half of the chromaffine tissue. A few of these islands are glomerulosa cells, but the majority are fasciculata cells containing abundant small cytoplasmic vacuoles. None of these misplaced cortical cells are necrotic, and appear to be normally functional.

Both of the adrenals of this skunk present the same appearance, both exhibiting the same marked degree of destruction and cortical metaplasia. The degree of damage is suggestive of the amount seen in cases of clinical Addison's disease; and, although there were limited numbers of normal appearing cortical cells, the destruction of both the cortex and the medulla must have been severe enough to seriously reduce the functional capacity of the glands, as well as impair the circulatory supply. I have already indicated that a semi-quantitative test showed these adrenals contained a moderate amount of ascorbic acid. This can only be accounted for by hyperactivity of the remaining normal cells.

The marked degree of hyalinosis, along with hyperplasia and metaplasia, which has occurred in these glands supports the previous assumption of long-standing stress with the more acute necrosis resulting from the final exhausting demands on the gland. The microscopic appearance of the adrenals of this skunk is a striking demonstration of the effect of excessive stress in a wild mammal.

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