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THE AMERICAN

MIDLAND NATURALIST

DEVOTED TO NATURAL HISTORY, PRIMARILY
THAT OF THE PRAIRIE STATES

JULIUS A. NIEUWLAND, C. S. C., PH. D., Sc. D.
EDITOR

VOLUME VI. 1919-1920

UNIVERSITY OF NOTRE DAME
NOTRE DAME, INDIANA

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Vol. VI. JANUARY, 1919 No. 1

THE AMERICAN MIDLAND NATURALIST

Devoted to Natural History, Primarily that of the Prairie States

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J. A. NIEUWLAND, C. S. C., Ph. D., Sc. D., Editor

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THE EDITOR, Notre Dame, Indiana

The American Midland Naturalist

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VOL. VI. JANUARY, 1919. NO. 1.

Birds of a Washington City Dooryard.

BY HARRY C. OBERHOLSER.

Attention has on a number of occasions been called to the fact that even in the midst of a large city numerous opportunities for out-of-door bird study exist. Many more birds than one might think venture into the closely built-up portions of the city, particularly wherever any trees or shrubbery are to be found. The writer has for a long time been interested in this phase of ornithology, especially to see what species come into our city of Washington, D. C., and at what seasons of the year.

From May 5 1911, to May 1, 1918, we lived at No. 1444 Fairmont Street, N. W., and there, with a number of interruptions, but, as opportunity permitted, more or less continuously, especially during the past four years, made observations on birds. These notes were taken of necessity incidentally, chiefly in the mornings before 8 o'clock and in the evenings after 6, except on Sundays and holidays, when, of course, more hours were available.

The house in which we lived stands between 14th Street and University Place, in a solid row; and the entire street on both sides east to the next corner at 14th Street is entirely occupied by dwellings. In front of the house there were two rows of small trees, one along each side of the street. At the western end of the block are two or three large silver poplar trees, inside a yard. The back yard of our house, together with those of several adjoining dwellings on the same street, and the large double yard of the house just back of ours, which faces on Euclid Street (the first street south), form a considerable open space divided only by low fences. In this area there is considerable shrubbery, a few small trees, and several large silver poplars, one of the latter being in our own yard. This place is, consequently, a decided attraction for birds, as the number of species which frequent it indicates.

The total number of different kinds of birds observed during the seven years amounts to 100, including those observed flying over but not actually alighting. On some occasions during spring and autumn many birds were identified from their notes as they passed low over the city on their migration at night. Our list, while not so large as some lists from other cities, includes, nevertheless, not a few rare or unexpected birds, though it is almost as remarkable for species that it does not contain. There is, of course, more or less of chance in desultory observations of this character, and the missing birds may well have occurred during the period of observation, but accidentally escaped being seen. Some species have, apparently, their regular times for coming into the city, not necessarily coextensive with their period of occurrence in this general region, and this applies even to transients. Naturally spring and autumn are in general the best seasons, but it seems that the latter is even better in some respects than spring, for we have observed more species during a single day here in fall than ever in spring. The very best time, at least for a variety of birds, is the last week in September, especially if the weather is fine. As an indication of what may be seen at this time, the two following lists from observations made about an hour before 8 a. m. and during the evening after 6 o'clock may be found of interest:

September 26, 1916.—American Sparrow Hawk, Northern Flicker, Brown Thrasher, Bluebird, Southern Robin, Gray-cheeked Thrush, Olive-backed Thrush, Red-breasted Nuthatch, Blue Jay, Fish Crow, Cedar Waxwing, American Redstart, Cape May Warbler, Black and White Warbler, Purple Grackle, Cardinal, English Sparrow, Purple Finch. Total, 18 species.

September 21, 1917.—Sora Rail, Northern Flicker, Chimney Swift, Bluebird, Southern Robin, Hermit Thrush, Gray-cheeked Thrush, Olive-backed Thrush, Blue Jay, Cedar Waxwing, American Redstart, Black-poll Warbler, Magnolia Warbler, Bobolink Purple Grackle, Cardinal, English Sparrow, American Goldfinch. Total, 18 species.

A complete catalogue of all the species observed during our period of observation, with brief notes on their occurrence, will be found in the succeeding pages. We are indebted to Miss May T. Cooke of 1450 Fairmont St. N. W., for several records additional to our own.

1. *Nycticorax nycticorax naevius.* Black-crowned Night Heron. This species was observed on three occasions flying over—May 18, 1914; September 1, 1917; and January 17, 1918.

2. *Butorides virescens virescens.* Green Heron.
Noted on four occasions—May 13, 1912; May 18, 1917; August 21, 1916; and August 24, 1914.

3. *Cathartes aura septentrionalis.* Turkey Vulture.
Although the Turkey Buzzard is of common occurrence about Washington, we have actually seen it at this place in the city only three times—February 28, 1915; September 24, 1916; and September 23, 1917; on each occasion sailing over high in the air.

4. *Tinnunculus columbarius columbarius.* Pigeon Hawk.
One seen flying over on February 20, 1916.

5. *Cerchneis sparveria sparveria.* American Sparrow Hawk.
This bird breeds in the cornices of buildings in our section of the city, and we have frequently seen it at our place, either flying over or perching on the very top of the large silver poplar tree in the yard. It has been noticed most often in April, May, September, and October, the earliest date being April 11, 1915, and the latest, November 9, 1915.

6. *Colinus virginianus virginianus.* Bob-white.
This was one of our most interesting and most unexpected visitors. Once a single bird, on a date not recorded, came into the back yard and perched on one of the fences for a considerable time. On September 21, 1913, two birds were heard calling from the trees in the street in front of the house; and on May 6, 1914, one was heard in the area back of the house. There seems to be little attraction for a Bob-white in the city, a place so very different from its native heath.

7. *Porzana carolina.* Sora Rail.
One individual heard calling in flight over the house on the night of September 21, 1917.

8. *Tringa solitaria solitaria.* Solitary Sandpiper.
Noted on two occasions flying over—May 13, 1912, and May 21, 1917. It is of interest to mention that the latter date equals the latest previous spring record for the species in the vicinity of Washington.

9. *Bartramia longicauda.* Upland Plover.
The Upland Plover is now one of the rare birds about Wash-

ington. Its mellow, characteristic note was several times heard on the night of August 21, 1916, coming from two birds flying over our place, evidently on their migration.

10. *Actitis macularia.* Spotted Sandpiper.

Heard on three occasions, flying over at night—April 28, 1915; and May 13 and 14, 1914.

11. *Oxyechus vociferus vociferus.* Killdeer.

Heard flying over at night on three dates—May 15, 1918; May 13, 1912; and September 10, 1915.

12. *Zenaidura macroura carolinensis.* Mourning Dove.

Seen on only one occasion—July 4, 1915.

13. *Coccyzus americanus americanus.* Yellow-billed Cuckoo.

Observed only in June, July and August, and not since 1915. The earliest date is June 23, 1914, the latest, August 23, 1914.

14. *Coccyzus erythropthalmus.* Black-billed Cuckoo.

Noted only once—on September 19, 1915.

15. *Colaptes auratus luteus.* Northern Flicker.

One of the commonest birds from March to September, and up to October 3 (1916). We observed it also on January 17 and 23, 1916. In the spring of 1915 and of 1916 a pair had a nest in the dead portion of the trunk of one of the high silver poplar trees in the large yard back of ours. We could watch the birds from the windows of the house and found their behavior of great interest. The birds could be heard calling at almost any time of the day during the early spring.

16. *Melanerpes erythrocephalus.* Red-headed Woodpecker.

Of nothing like as common occurrence as the Flicker, and very irregular. Seen from May 25 to 30, 1916; on June 2, 1916; June 29, 1914; August 18, 1914; September 8, 1915; and September 24, 1916.

17. *Dryobates pubescens medianus.* Downy Woodpecker.

A more or less frequent visitor during August, September, and October, but strange to say, not observed in any other month of the year. Its earliest date is August 14, 1915, and its latest, October 14, 1917.

18. *Dryobates villosus villosus.* Hairy Woodpecker.

Once observed, but the date was not recorded.

19. *Sphyrapicus varius varius.* Yellow-bellied Sapsucker.

One seen by Miss May T. Cooke, among the trees in the yard at the west end of our block, but we have no other record.

20. *Otus asio naevius.* Screech Owl.

Heard calling on the evenings of September 25, 1917, and October 4, 1914.

21. *Chordeiles minor minor.* Night Hawk.

Seen on only one occasion, and then flying over. This was on May 21, 1914.

22. *Archilochus colubris.* Ruby-throated Hummingbird.

This species occasionally came to the flowers in the yards during August and September. Our latest record is September 21, 1916. It was only once noted at any other time of the year—this on May 10, 1917.

23. *Chaetura pelagica.* Chimney Swift.

Of frequent occurrence, of course on the wing, from May 9 (1915) to September 22 (1917).

24. *Horizopus virens.* Wood Pewee.

For this species we have only two records: May 24, 1914, and September 3, 1914.

25. *Myiarchus crinitus crinitus.* Crested Flycatcher.

Observed, May 13, 1912; May 30, 1916; September 19, 1917; and on one other occasion.

26. *Tyrannus tyrannus tyrannus.* Kingbird.

Three records: April 27, 1915; May 21, 1915; and August 18, 1914.

27. *Sturnus vulgaris vulgaris.* European Starling.

The dead top of the tall silver poplar tree in our back yard seemed to form the special attraction for this species. One was seen perched on the summit, December 24, 1916; two others on January 6, 1918; and a flock of six on January 28, 1917. We have no other records.

28. *Toxostoma rufum rufum.* Brown Thrasher.

Not of regular occurrence, but it occasionally wandered into the yards during September and October, though we did not see it at any other time; in fact, the only records are two individuals on September 26, 1916; and one each on September 23, 1914, and October 1 and 3, 1916.

29. *Mimus polyglottos polyglottos.* Mockingbird.

Occasionally visited the area back of our house, but we have no definite dates.

30. *Lucar carolinensis.* Catbird.

Seen only during April and May, and very irregular during even these months. It was earliest noted on April 24, 1917, and latest, May 31, 1914.

31. *Sialia sialis sialis.* Bluebird.

Of occasional occurrence from September to May, but most frequently seen during the months of September, October, and March. Our only other records are for May 13, 1912, and February 27, 1917.

32. *Planesticus migratorius achrusterus.* Southern Robin.

Common from March to October, and perhaps once in a while nested within the area. Observed on February 14, 1915, and as late as October 27, 1917, but never in November, December, or January. Some of the autumn records probably refer to the Northern Robin, *Planesticus migratorius migratorius.*

33. *Hylocichla fuscescens fuscescens.* Wilson Thrush.

One seen in the tall tree in our yard, May 13, 1912, but on no other occasion.

34. *Hylocichla guttata pallasii.* Hermit Thrush.

Our only record is one individual seen on September 21, 1917. This, however, is an unusually early date for the species in the vicinity of Washington, as its average arrival here is October 17, and the very earliest previously recorded date is September 18, 1900.

35. *Hylocichla aliciae aliciae.* Gray-cheeked Thrush.

This species was seen on September 18, 1917; September 21, 1917; and October 4, 1917. Five individuals, also, were noted in our large silver poplar tree on September 26, 1916. The records for September 18 and 21 are unusually early for the vicinity of Washington, as the average autumn arrival of this species is September 25, and its earliest date, September 15, 1897.

36. *Hylocichla ustulata swainsoni.* Olive-backed Thrush.

This species is of much more frequent occurrence than the Gray-cheeked Thrush. It has been noted from May 13 (1912) to May 25 (1916); and from September 15 (1915) to October 4 (1917). It was heard on May 21, 1915, singing almost as well as in summer.

37. *Hylocichla mustelina.* Wood Thrush.
Rather strangely of not at all frequent occurrence. There are only three positive records—May 17 and 20, 1917, and one other for which we have no definite date.

38. *Polioptila caerulea caerulea.* Blue-gray Gnatcatcher.
Once observed, but date not recorded.

39. *Regulus calendula calendula.* Ruby-crowned Kinglet.
Seen, October 11, 1917, and November 4, 1916.

40. *Orchilus regulus satrapa.* Golden-crowned Kinglet.
Of much more frequent occurrence than the Ruby-crowned Kinglet, but still not very common. Noted on only the following dates: October 5 and 15, 1913; October 7 and 8, 1916; October 31, 1915; and November 7, 1915. For the vicinity of Washington, the average arrival at this season is October 6.

41. *Nannus troglodytes hiemalis.* Winter Wren.
One was reported in autumn by Miss May T. Cooke, but date not recorded.

42. *Troglodytes aedon aedon.* House Wren.
Strange to say, of very infrequent occurrence, and observed only in May. Our records are May 2, 1915, May 4, 1914, and May 21, 1917.

43. *Thryothorus ludovicianus ludovicianus.* Carolina Wren.
Also of very infrequent occurrence. The only dates are May 8, 1914; August 22, 1915; and October 26, 1916.

44. *Certhia familiaris americana.* Brown Creeper.
Observed on but one occasion, of which the date was not noted.

45. *Sitta canadensis.* Red-breasted Nuthatch.
Observed occasionally in September and October, but in no other month of the year. Our records are: September 18, 1914; September 26 and 27, 1916; October 3, 6, 7, 8, and 15, 1916; and October 5, 1913.

46. *Sitta carolinensis cookei.* White-breasted Nuthatch.
This bird seems to be much less frequent than the Red-breasted Nuthatch, for we have only two definite records—October 5 and 23, 1913, and one other without date.

47. *Penthestes carolinensis carolinensis.* Carolina Chickadee.
Once noted, but date unknown.

48. *Baeolophus bicolor.* Tufted Titmouse.

Two records—May 18, 1914, and May 26, 1916. This seems to be, in a way, rather remarkable, because one would expect the species in such a place during the winter rather than during the breeding season.

49. *Cyanocitta cristata cristata.* Blue Jay.

Tolerably common from September to early May, but most frequently observed in September. We have not noted it in the fall earlier than September 5 (1915), nor in spring later than May 2 (1915).

50. *Corvus ossifragus.* Fish Crow.

Another very common species, of regular occurrence from August to May, but not noted in June or July.

51. *Corvus brachyrhynchos paulus.* Southern Crow.

One of the most frequent birds from October to May, but not noticed in summer. Doubtless some of the individuals seen during the winter months belong to the common American Crow, *Corvus brachyrhynchos brachyrhynchos*, but as no specimens were taken it is, of course, impossible to verify this probability.

52. *Lanivireo flavifrons.* Yellow-throated Vireo.

A tolerably common summer resident, noted from May 1 (1914) to September 2 (1917). It was heard singing on August 23, 1914.

53. *Vireosylva gilva gilva.* Warbling Vireo.

For this uncommon species in the city of Washington we have but a single record—May 19, 1914.

54. *Vireosylva olivacea.* Red-eyed Vireo.

For so common a bird we have surprisingly few dates. They are: May 11 and 21, 1916; May 23, 1915; May 28, 1914; and September 24, 1914. It was also heard singing on August 23, 1914.

55. *Bombycilla cedrorum.* Cedar Waxwing.

Noticed occasionally from March 18 (1916) to June 2 (1916), and from August 19 (1917) to September 26 (1917). Rather strangely not seen at any other time of the year.

56. *Iridoprocne bicolor.* Tree Swallow.

A flock of 10 was seen flying over high in the air on August 23, 1916, but no others have been observed.

57. *Hirundo rustica erythrogastris.* Barn Swallow.

Seen once—on May 10, 1917.

58. *Stelgidopteryx serripennis serripennis.* Rough-winged Swallow.

For this swallow, also, we have but a single date—May 10, 1917.

59. *Progne subis subis.* Purple Martin.

Occasionally seen from May to September. Our earliest date is May 13, 1915, and the latest, September 3, 1917. It is of most frequent occurrence during the period of roosting; that is, during August and early September.

60. *Setophaga ruticilla.* American Redstart.

Rather frequent from May 3 (1914) to September 26 (1916), and apparently the commonest warbler. September 26, it is of interest to state, is an unusually late date for this species in the vicinity of Washington, since the average date of autumn departure is September 19, and the latest date is September 30, 1906.

61. *Wilsonia canadensis.* Canadian Warbler.

Observed on May 20 and 21, 1916, and May 27, 1917, but on no other occasions.

62. *Wilsonia citrina.* Hooded Warbler.

For this beautiful species we have but a single record—May 24, 1914.

63. *Geothlypis trichas trichas.* Maryland Yellowthroat.

One seen on April 24, 1917; and another, in spring, date unknown, was reported by Miss May T. Cooke.

64. *Seiurus aurocapillus aurocapillus.* Ovenbird.

We have no exact date for this species, but once in spring Miss May T. Cooke observed an individual that remained for two days about her yard.

65. *Seiurus motacilla.* Louisiana Water-Thrush.

We noted a single individual on September 20, 1914, a date considerably later than the latest previously known for the species anywhere in the vicinity of Washington, which is September 12, 1895.

66. *Dendroica striata.* Black-poll Warbler.

Sometimes common in May, and noted occasionally in September and October. The earliest spring date is May 14, 1916; the latest, May 31, 1917. Our autumn records are, rather remarkably, only September 21, 1917; October 4, 1914; and October 8, 1916.

67. *Dendroica castanea.* Bay-breasted Warbler.

There is but a single record for this species, and that on May 30, 1917, which, with a single exception, June 5, 1917, is the latest for the vicinity of Washington.

68. *Dendroica pensylvanica.* Chestnut-sided Warbler.

Of this warbler we saw but one, on an unknown date.

69. *Dendroica fusca.* Blackburnian Warbler.

Our single record is October 6, 1916, which is uncommonly late for the species in the region about Washington, since its latest date is October 7, 1889.

70. *Dendroica virens.* Black-throated Green Warbler.

For this pretty little warbler we have only a few records, which are as follows: April 30, 1914; September 17, 21, and 26, 1916.

71. *Dendroica coronata coronata.* Myrtle Warbler.

For so common a species we have surprisingly few notes, as follows: May 1 and 2, 1915; May 25, 1917; and October 4, 1914. That for May 25 is later than any published date for the species about Washington, the previous latest being May 23, 1903, although there is an unpublished record for May 30, 1917.

72. *Dendroica caerulescens caerulescens.* Black-throated Blue Warbler.

Three instances: May 25 and 27, 1915, and another without specific date.

73. *Dendroica tigrina.* Cape May Warbler.

This is one of the warblers that has recently much increased in numbers in the vicinity of Washington. It was not noted in our yard until September 21, 1916, and was more or less common until October 9 of that year; as many as five sometimes being seen within a few minutes. We have only two subsequent records, May 24, 1917, and October 8, 1917. It frequented both the trees along the street and those in the back yards.

74. *Dendroica magnolia.* Magnolia Warbler.

Identified on only three occasions: September 21, 1916; September 21, 1917; and October 8, 1916.

75. *Dendroica aestiva aestiva.* Yellow Warbler.

For so common a bird it was rather remarkably seldom seen; but it apparently does not come into the city so numerous as some other warblers. Our only records are: May 16 and 21, 1915; May 24, 1914; and June 11, 1916.

76. *Compsothlypis americana americana.* Parula Warbler.

We have but a single note on this species—a bird seen in the trees just in front of the house on October 3, 1916.

77. *Compsothlypis americana pusilla.* Northern Parula Warbler.

We have likewise but one record for this bird—a single fully plumaged, typical adult male seen on October 11, 1914.

78. *Vermivora ruficapilla ruficapilla.* Nashville Warbler.

One seen in our back yard on May 6, 1915.

79. *Vermivora peregrina.* Tennessee Warbler.

In 1916 the Tennessee Warbler was unusually numerous in spring about Washington, and on May 21 of this year we saw one in the large silver poplar tree in our back yard. We noted the species also on October 6, 1916, which is rather late, since the average time of its departure from this region is October 4.

80. *Mniotilta varia.* Black and White Warbler.

Only twice observed—on September 26, 1916, and on another occasion for which we have no definite date. The former record was unusually late for this species, since its average fall departure about Washington is September 15.

81. *Dolichonyx oryzivorus.* Bobolink.

Of common occurrence during both spring and fall, but most frequently heard migrating at night. We have records from May 13 (1912) to May 23 (1915); and from August 22 (1916) to September 21 (1917).

82. *Agelaius phoeniceus predatorius.* Red-winged Blackbird

A flock of nine seen flying over on October 11, 1917. Noted also, on one or two other occasions for which no date is available.

83. *Icterus galbula.* Baltimore Oriole

One seen on May 18, 1915, but on no other day.

84. *Icterus spurius.* Orchard Oriole.

Seen once, but no record was made of the date.

85. *Quiscalus quiscula quiscula.* Purple Grackle.

This is, with the exception of the English Sparrow, the most numerous and frequent visitor to our city yards. Apparently, however, it does not breed in this area. It was noted from February 25 (1918) to November 5 (1916).

86. *Piranga erythromelas.* Scarlet Tanager.

Noted on May 17, 1915, and on one other occasion.

87. *Cardinalis cardinalis cardinalis.* Cardinal.

With the exception of the English Sparrow and the Purple Grackle, our most regular and frequent visitor, and seen in every month of the year except July. It seems to be most numerous during February, March, April, May, September, and October. It is one of the most persistent singers of the city yards.

88. *Hedymeles ludovicianus.* Rose-breasted Grosbeak.

We have only two records—one for September 13, 1913, and another for which no date was noted.

89. *Linaria cyanea.* Indigo Bunting.

One seen on May 14, 1916, and another on May 18, 1917.

90. *Pipilo erythrophthalmus erythrophthalmus.* Chewink; Towhee.

Two records: May 13, 1912, and another without date.

91. *Melospiza melodia melodia.* Song Sparrow.

This bird was remarkably infrequent for a species so common in this vicinity. We have but three definite instances—March 31, 1917; May 30, 1916; and October 21, 1917.

92. *Zonotrichia albicollis.* White-throated Sparrow.

Our few dates are as follows: April 21, 1916; October 11 and 19, 1916; and November 15, 1916.

93. *Spizella pusilla pusilla.* Field Sparrow.

One heard singing on April 28, 1917.

94. *Spizella passerina passerina.* Chipping Sparrow.

Noted on April 15, 1915, and on another occasion.

95. *Spizella monticola monticola.* Tree Sparrow.

For this species we have three definite records: March 20 and 24, 1914, and April 13, 1914. The last is a remarkably late date for the District of Columbia; in fact, with the single exception of two other records, April 14, 1917, and May 11, 1917, it is the very latest.

96. *Junco hyemalis hyemalis.* Slate-colored Junco.

Occasionally seen during the winter months. We have records from October 7 (1916) to March 30 (1916).

97. *Passer domesticus hostilis.* English Sparrow.

This bird is, of course, the commonest and most permanent inhabitant of our yards, and breeds both in the trees and about the cornices of the buildings. It has been noted during every month of the year.

98. *Carpodacus purpureus purpureus.* Purple Finch.

This bird is more or less common during the autumn, winter, and spring, though of rather irregular occurrence. We have records from September 9 (1917) to May 20 (1917). Rather often heard singing in spring.

99. *Astragalinus tristis tristis.* American Goldfinch.

Occasionally observed, but only in April, May, September, and October.

100. *Loxia curvirostra minor.* American Crossbill.

One noted on January 14, 1917.

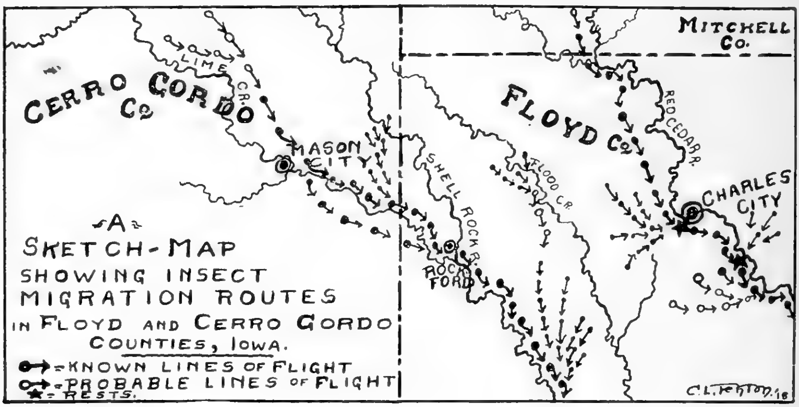
Insect Migration in Floyd and Adjoining Counties of Iowa.

BY CARROLL LANE FENTON.

On September 17, 1915, I noted a flock of Monarch butterflies (*Anosia plexippus*) resting in an oak grove west of Charles City, Iowa. The flock contained many thousands of individuals, and practically covered the trees for a considerable area. From time to time small numbers of the insects arrived from the north, and occasionally fifty to one hundred would rise into the air and fly to the southeast. In general, though, there was no movement of the flock between the hours of one and five-thirty P. M. In order to form an estimate of the density with which the insects were crowded together I swept my net along a twig, and thirty-seven Monarchs made up the capture.

Two days afterward I again visited the same locality, and found considerable numbers of Monarchs flying about over a near-by creek or resting on some willows or the lower branches of the oaks. Above the trees were large numbers of these butterflies, steadily flying to the southeast. With the Monarchs were a number of Clover Sulphurs (*Colias philodice*), these latter being particularly in evidence about the water. While I failed to make detailed observations each day, this migration apparently lasted until about the twenty-third of September. At no other time did I observe such large numbers of butterflies as I had noted on the first day, and after the twenty-third there was no noticeable evidence of migration, though Monarchs were not uncommon.

In 1916 I saw large numbers of Monarchs on September 5, but the true migration did not start until the eleventh, and two days later I found thousands of the butterflies at the oak grove, with constant flights to the southeast. I at once went to a little, sunny valley some three and one-half miles to the southeast and there I found conditions comparable to those at the oak grove on September 17 of the year before. The flock was almost entirely composed of Monarchs, and from a short distance many of the trees had the



appearance of being in autumn colors, the butterflies were so thickly gathered. On and by the road over which I went to the valley I had seen large flocks of *Colias philodice*, with considerable numbers of Monarchs, but I was unable to determine whether or not the former were in actual migration. On September 16, I saw a large flock of Monarchs and Clover Sulphurs flying east and south, and with it were numerous individuals of the European Cabbage Butterfly (*Pieris rapae*). I first saw this flock some two miles from the oak grove, and I was curious to know whether or not this flock, which was quite distinctly marked by the unusual presence of *P. rapae*, would rest at the grove. As I was walking, some forty minutes elapsed from the time when I first saw the butterflies and the time when I arrived at the desired locality. Here I found that there were numbers of *Anosia plexippus*, *Colias philodice* and also *Pieris rapae*, so in all probability the flock that I had seen did stop at the grove. Apparently this is a regular and well recognized resting point with the migrating insects.

I traced this course of flight several miles northwest and also about seven miles to the southeast of Charles City. It is well defined and as shown, is used by large numbers of insects. It is, however merely a local element of a larger route that roughly passes across almost the full widths of Floyd and Cerro Cordo Counties.

In 1917 the Monarch migration began in the latter part of August, although the Sulphur migration did not commence until about the middle of September. On August 30, I observed a large and continuous flight of Monarchs at a point in the east-central portion of Cerro Gordo County. Here the butterflies skirted the lower portion of a seventy-foot bluff and at that point were flying almost due east but further investigation showed that as soon as this chain of hills disappeared the flight turned to the southeast. The next day I observed large numbers of Monarchs and Clover Sulphurs at a point about eight miles to the southeast of the point where I had noted the flight on the day before. It is notable that while this line of flight is some miles to the west of the one first described, it has the same general direction, both following the general trend of stream flow.

At Charles City there were large numbers of migrating Monarchs on September 5, but the migration reached its height from the twelfth to the fifteenth, and on these latter days a considerable percentage of *Colias* was found in the flocks studied. At no time was *Pieris rapae* noted in any of the flocks, though the species was fully as abundant as usual.

In none of the migrations have there been any indications that the same routes were used by birds or other insects, as for instance the dragonflies. Neither was any point noted where the path of migration became extremely narrow. In the spring, usually about the first of June, a few battered and weatherworn Monarchs appear, but there is no return of the Sulphurs. The Mourning Cloaks (*Vanessa antiopa*) often is found, in hibernated specimens, as early as April 1, and thus appears to be the earliest of the butterflies of that vicinity.

The accompanying sketch-map gives the two main routes of butterfly migration in Floyd and Cerro Gordo Counties, as indicated by these studies.

My Favorite Song Bird.

BY BROTHER ALPHONSUS, C. S. C.

The question is often asked, "What is your favorite song bird?" To the bird lover there are so many songsters that are his favorites that it is not always easy to answer this question. But if an answer must be given he will probably single out one that is dear to him for many reasons. Such a bird is the song sparrow.

When February is drawing to a close occasionally there are a few fine days when the sun shines brightly, and there is just a hint of the approaching spring. On such days those who are accustomed to take daily walks will surely hear what they may call "the first spring notes" of a bird, and this songster is the song sparrow. And when summer is losing its intense heat toward the end of August, and nearly every other note has died away, the sweet singer of late February will be true to his name and greet us with his cheery strain.

It is probably the long song season of the song sparrow that contributes most to make him a favorite song bird with many nature lovers. And then his melody is one of the finest in the whole gamut of song that comes from the throats of birds. Besides great variety in the musical effort of this sparrow, there is an absence of the plaintive quality that is so marked a feature in the performances of many of our birds. These sad strains are especially noticeable in such species as the rose-breasted grosbeak, vesper sparrow, field sparrow and indigo bird.

The nesting habits of the song sparrow are interesting to the student of bird life. It is possible that this species may have three broods, for young birds are fledged early in May, and nests with young in them may be found late in August. Many of the nests are built in the grass, not far from walks where people pass frequently. Last August I found a nest placed in a small sapling near the pier in St. Joseph's Lake, at Notre Dame, where bathers certainly made plenty of noise. The confiding character of the song sparrow is a trait that increases our love for the bird.

When nearly all the birds of summer have departed, and the cold days of late autumn and early winter send a chill through our bodies, we can still find a few song sparrows on our walks. Now they are no longer in song, yet the memory of their singing remains.

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J. A. NIEUWLAND, C. S. C., Ph. D., Sc. D., Editor

CONTENTS

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The Missouri Muhlenbergias.

BY BENJAMIN FRANKLIN BUSH.

Any one in recent years attempting to name specimens of MUHLENBERGIA by the books, must have been struck by the wide difference of opinion in the presentation of the species in the Robinson and Fernald Gray's New Manual, and the Britton and Brown Illustrated Flora. This difference of opinion in treating the species of this genus in some cases is so marked as to cause one to wonder if there is not something wrong with our understanding of the species. This difference of opinion is most marked with the members of the *Mexicana* group, a most perplexing and critical one, the species of which present so many variations in culms, leaves and floral characters.

It was formerly thought that the species of this, and those of the *Acroxis* group, were either awned or awnless, this belief causing much confusion in the treatment of the species and the naming of specimens: but it began to be suspected that those species which were habitually awnless sometimes presented awned forms, and those species that were ordinarily awned, sometimes presented awnless forms. This suspicion was first voiced by Scribner,[1] who announced that M. MEXICANA and M. SOBOLIFERA often or occasionally presented awned forms, and he went so far as to describe awned forms of these species,[2] and noted that M. TENUIFLORA and M. TORREYI were occasionally awnless.

My conclusions after a careful examination of several hundred sheets of specimens, are, that Scribner was correct in the main, but that what he took to be awned forms or varieties of M. MEXICANA and M. SOBOLIFERA are really good distinct species, which I herein propose as new.

[1] Scribner, Rhodora 9:18. 1907.
[2] Scribner, Rhodora 9:18. 1907.

Hitchcock in the Robinson and Fernald Gray's New Manual in 1908, presented ten species and one variety for the territory commonly embraced in the Manual region, presenting M. FOLIOSA Trinius, for the first time, this having been previously restored by Scribner,[1] and to it he referred M. AMBIGUA Torrey, which I am inclined to think is a good species. M. MEXICANA is there said to have the culms retrorsely strigose below the nodes, and to have the lemmas acuminate or awned, thus including the M. MEXICANA COMMUTATA of Scribner in his description. It appears to me much better to consider Scribner's variety a distinct species, and thus relieve the real M. MEXICANA of much uncertainty. Hitchcock also includes M. POLYSTACHYA of Mackenzie and Bush in M. MEXICANA, which after an examination of a number of specimens I still consider distinct from that species. He reduces M. PALUSTRIS to a variety of M. SCHREBERI, a disposition once made by Scribner,[2] but it seems more natural to keep this distinct from that species. The description of M. SCHREBERI is so drawn as to include M. SCHREBERI CURTISETOSA of Scribner, which seems to me to be sufficiently distinct to recognize as a species. M. GLABRIFLORA of Scribner is not mentioned in the Manual, Hitchcock evidently not understanding this species.

Nash in the Britton and Brown Illustrated Flora, second edition, in 1913, presents eleven species, ten of these given by Hitchcock in the Manual, and one other, M. AMBIGUA Torrey. In the treatment of the species in this work, Nash gives specific rank to M. PALUSTRIS and M. AMBIGUA, refers M. FOLIOSA of Trinius to M. MEXICANA, ignores M. POLYSTACHYA of Mackenzie and Bush, and M. SCHREBERI CURTISETOSA, and briefly mentions M. GLABRIFLORA which seems to me to be an excellent species. In his description of the MEXICANA group, Nash does not speak of the retrorsely scabrous character of the culms just below the nodes of some of the species, evidently thinking this character not worthy of mention.

Many years ago Prof. Dewey wrote the account of the Grasses for the Manual of the Plants of Western Texas,[3] in which the ranges of some of our species is given, no doubt based on specimens in the Herbarium of the Department of Agriculture. The ranges given of several of our species in this work has been modified largely by

[1] Scribner, Rhodora 9:18. 1907. [2] Scribner, Rhodora 9:18. 1907.

[3] Dewey, Man. of the Plants of Western Texas, 1892.

numerous collections and critical study of several species. Prior to 1905, several of the species now included in the genus MUHLENBERGIA, were included in the genus *Sporobolus*, when Dr. Rydberg[1] transferred some of the species to this genus. These species seem to me to be intermediate between MUHLENBERGIA and *Sporobolus*, and could with equal propriety be included in the genus *Sporobolus* or in MUHLENBERGIA, but I leave these species in MUHLENBERGIA as placed there by Dr. Rydberg. But there is a group of species having single, terminal panicles with flowers on long capillary pedicels, the type of which is *Stipa capillaris* Lamarck, that seems to me to be very distinct from the other species commonly included in the genus MUHLENBERGIA. This group of species is so distinct from the other species of MUHLENBERGIA in rootstocks, ligules, panicles, flowers and habit, that I think there is no doubt that they are certainly distinct from that genus. The earliest available name for this group of species seems to be PODOSEMUM Desvaux, in Nouv. Bull. Soc. Philom. 2:188. 1810, where the genus is established and *Stipa capillaris* Lamarck is cited as the type. The genus is more fully described in Beauvois Agrost. 29, 1812.

I have therefore decided to follow Desvaux in placing some of the species formerly included in the genus MUHLENBERGIA in the genus PODOSEMUM, but present the single species occurring in the State along with the other species of MUHLENBERGIA, to which it has generally been referred.

In this, my presentation of the Missouri species, I differ somewhat from the treatment of both Hitchcock and Nash, in the works mentioned above, and have more nearly agreed with Scribner in recognizing the species, and have been compelled to describe one new species, being unable to refer the specimens to any described species.

I have seen nearly all the Missouri material in existence of the species of MUHLENBERGIA, through the kindness of Dr. J. M. Greenman, curator of the Missouri Botanical Garden Herbarium, Prof. A. S. Hitchcock, Agrostologist in charge of the Grasses in the United States National Museum Herbarium, Prof. Wm. Trelease of the University of Illinois, Dr. J. A. Nieuwland of the University of Notre Dame, and Mr. Kenneth K. Mackenzie of East Orange, New Jersey, to whom I am under many obligations;

[1] Rydberg, Bull. Torr. Club, 32:1905.

to Prof. Hitchcock and Dr. George T. Moore of the Missouri Botanical Garden, I am under obligations for numerous citations furnished and for verifications of publications; to all of the above I herein return thanks for the many courtesies extended.

For the Missouri species now included, or were formerly included, in the genus MUHLENBERGIA, I offer the following:

KEY TO THE MISSOURI MUHLENBERGIAS.

Panicles contracted, narrow, often numerous, often slender, the branches short, erect or appressed; ligules usually short or minute. 1. MUHLENBERGIA.

Panicles open, single, terminal, very large, their branches long and spreading, slender, the pedicels hair-like, drooping; ligules elongated; lemmas with long awns. 2. PODOSEMUM.

1. MUHLENBERGIA SCHREBER; Gmelin, Syst. Nat. 2:171. 1791.

A genus of about 30 species, mostly American, a few Asiatic, divisible into several rather well-marked groups, the type-species MUHLENBERGIA SCHREBERI Gmelin. As here treated, the species naturally fall into four groups or sections as follows:

Glumes wanting, minute or very short, or in one species a little longer, blunt or obtuse or in one species acuminate; plants decumbent at the base, from weak or slender rootstocks; lemmas usually long-awned or in one species rather short-awned.

A. MUHLENBERGIA proper.

Glumes broad, ovate, acute, much shorter than the lemmas; lemmas acute or awned; rootstocks stout, scaly.

B. STENOCLADIUM section.

Glumes narrow, acuminate or aristate, nearly as long as or exceeding the lemmas in length; rootstocks stout, scaly.

C. ACROXIS section.

Glumes broad, cuspidate; panicle very much contracted, narrow; plants without rootstocks.

D. EUCLADIUM section.

A. MUHLENBERGIA proper.

Glumes less than one-fourth the length of the spikelets, minute or wanting, blunt or obtuse; lemmas with awns 3-5mm. long; rootstocks rather weak. 1. MUHLENBERGIA SCHREBERI.

Glumes one-fourth to one-half as long as the spikelets, ovate-acuminate; lemmas with awns 1-2 mm. long; rootstocks much stouter. 2. MUHLENBERGIA CURTISETOSA.

B. STENOCLADIUM section.

1. Spikelets 1.5-2mm. long; lemmas awnless; infranodes[1] minutely scabrous just below the glabrous nodes; glumes two-thirds to three-fourths as long as the scabrous lemmas, ovate to broadly lanceolate, cuspidate. 3. MUHLENBERGIA SOBOLIFERA.

1. Spikelets 2.5-4mm. long; lemmas awned or rarely awnless; glumes lanceolate or broadly lanceolate. 2.

2. Spikelets 2.5-3mm. long; infranodes glabrous; nodes glabrous; culms low, much-branched; panicles numerous, upper usually short-exserted; awns 3-4mm. long.
4. MUHLENBERGIA BRACHYPHYLLA.

2. Spikelets 3-4mm. long; infranodes retrorsely pubescent; nodes pubescent; culms usually tall, little branched; panicles usually few, usually long-exserted; glumes very broad, ovate-lanceolate, cuspidate, scabrous, clasping, one-half to two thirds as long as the scabrous slender lemmas; lemmas usually with long awns, rarely awn-pointed or awnless; awns 5-10mm. long.
5. MUHLENBERGIA TENUIFLORA.

C. ACROXIS section.

1. Glumes much exceeding the lemmas, generally twice as long, about 5mm. long, awned-acuminate; lemmas acuminate-attenuate.
6. MUHLENBERGIA RACEMOSA.

1. Glumes about as long as the lemmas, or slightly longer, or mostly a little shorter, less than 5mm. long, glabrous or rarely slightly scabrous. 2.

2. Panicles ovoid or subpyramidal, or sometimes linear, numerous, short-exserted, or partially included in the upper sheaths not dense nor glomerate-flowered. 3.

2. Panicles oblong or cylindrical, or sometimes linear, more or less glomerate, or sometimes loosely flowered. 5.

3. Panicles numerous, rather long, more or less open; lemmas long-awned. 7. MUHLENBERGIA COMMUTATA.

[1] The term infranode is here employed to designate that portion of the culm just below the node, corresponding to the upper part of the internode.

3. Panicles numerous, rather short, somewhat dense or more or less open; lemmas not awned. 4.

4. Panicles numerous, rather short, more or less dense; lemmas not awned, perfectly glabrous. 8. MUHLENBERGIA GLABRIFLORA

4. Panicles numerous, more or less open, often slender; lemmas not awned, pubescent at the base; infranodes perfectly smooth; nodes glabrous. 9. MUHLENBERGIA MEXICANA.

5. Panicles few, short, dense, glomerate, oblong or cylindrical; flowers usually purplish; lemmas awn-pointed or somewhat aristate; glumes mucronate or aristate, subequal; infranodes retrorsely scabrous: nodes glabrous.

10. MUHLENBERGIA FOLIOSA.

5. Panicles numerous or sometimes fewer, filiform, linear or oblong, dense or rather loose. 6.

6. Panicles usually few, usually short-exserted, linear or filiform; infranodes retrorsely scabrous; nodes glabrous; flowers not crowded, in rather long, erect branches, usually green or stramineous; spikelets 2.5-3mm. long; lemmas usually long-awned, or rarely awnless. 11. MUHLENBERGIA TORREYI.

6. Panicles numerous, dense, slender, elongated, usually long-exserted; infranodes minutely scabrous or nearly glabrous; lemmas acuminate, rarely awned, villous with very long hairs at the base; spikelets 2-2.5mm. long. 12. MUHLENBERGIA POLYSTACHYA.

D. EUCLADIUM section nova.

Culms strictly erect, not rooting at the lower nodes, minutely retrorsely puberulent; glumes broad, one-half as long as the spikelet or more, acuminate or cuspidate; lemmas awnless, long-acuminate or cuspidate; no creeping scaly rootstocks; panicles slender, the branches appressed. 13. MUHLENBERGIA CUSPIDATA.

1. MUHLENBERGIA SCHREBERI J. F. Gmelin, Syst. Nat. 2:171. 1791.

Muhlenbergia diffusa Willd. Sp. Pl. 1:320. 1798.

Dilepyrum minutiflorum Michx. Fl. Bor. Am. 1:40. 1803.

Muhlenbergia diffusa Schreber, Gram. 2:143, 1810.

Muhlenbergia diffusa Schreb., Bush in Flora of Jackson County, Missouri, No. 864, 1885; Tracy in Flora of Missouri, No 1641, 1886; Eggert in Catalogue of Plants of Saint Louis, Missouri, 1891; Daniels in Flora of Columbia, Missouri, No. 75, 1907; Palmer in

Catalogue of Plants of Jasper County, Missouri, Nos. 988, 990 and 3488, 1916.

Muhlenbergia diffusa Willd., Mackenzie and Bush in Manual of the Flora of Jackson County, Missouri, No. 6, 1902.

Muhlenbergia Schreberi J. F. Gmelin, Palmer in Catalogue of Plants of Jasper County, Missouri, Nos. 1376, 2646 and 2894, 1916.

Northern Texas and northward, Dewey in Manual of the Plants of Western Texas.

Me. to Ont. Minn. and southward, Hitchcock in Manual.

Me. and southern Ontario to Minn. Fla. Kans. and Texas, Nash in Flora.

Me. to Minn. south to Fla. and Texas, Nash in Illustrated Flora.

Massachusetts to Nebraska, south to Florida, Texas and Mexico.

SPECIMENS EXAMINED:

MASSACHUSETTS:

Amherst, *Girard* 40, 1872, M. B. G. Herb. No. 80109;
Farmington, *Smith*, September, 1897, M. B. G. Herb. No 79741.

NEW YORK:

Buffalo, *Clinton*, date not given, M. B. G. Herb. N. 79859;
Pennyan, *Sartwell*, date not given, M. B. G. Herb. No. 79625, the plant marked 1 on this sheet;
Pennyan, *Sartwell*, date not given, M. B. G. Herb. No. 79582, the plant marked 1 on this sheet.

NEW JERSEY:

Hoboken, collector and date not given, M. B. G. Herb. No. 79991;
Hoboken, collector and date not given, M. B. G. Herb. No. 79989;
Hoboken, collector and date not given, M. B. G. Herb. No. 79974;
Hoboken, collector and date not given, M. B. G. Herb. No. 79889;
Pemberton, *Willmarth*, August 25, 1876, U. S. Herb.;
Without definite locality, *Digyn*, date not given, M. B. G. Herb. No. 79974.

PENNSYLVANIA:

Manayunk, *Redfield*, September 19, 1870, M. B. G. Herb. No. 79858;

Philadelphia, *Digyn*, date not given, M. B. G. Herb. No. 79887;

Philadelphia, *Scribner* 313, October, 1881, U. Ill. Herb.;

Stoneroad's Mill, *Keller*, October 5, 1901, M. B. G. Herb. No. 79868;

West Chester, *W. D.*, date not given, M. B. G. Herb. No. 79773;

Without definite locality, *Sartwell*, date not given. M. B. G. Herb. No. 79776;

York County, *Glatfelter*, September, 1899, M. B. G. Herb. No. 80096;

MARYLAND:

Chevy Chase, *Mosher*, September 15, 1915, U. Ill. Herb.;

Harper's Ferry, *Holm*, October 6, 1912, M. B. G. Herb. No. 779204.

DISTRICT OF COLUMBIA:

Great Falls of the Potomac, *Holm*, October, 1913, U. Ill. Herb.; Pine Branch, Ball 54, August 25, 1909, M. B. G. Herb. No. 79872.

OHIO:

Cincinnati, *Lloyd* 575, September 9, 1890, M. B. G. Herb. No. 79885.

VIRGINIA:

Loudoun County, *Helms*, August, 1888, U. Ill. Herb.;

Munden, *Mackenzie* 1764, September 3-19, 1905, M. B. G. Herb. No. 79843.;

TENNESSEE;

Knoxville, *Ruth* 59, September, 1898, M. B. G. Herb. No 79867.

KENTUCKY:

Bowling Green, *Price*, June 1890, M. B. G. Herb. No. 79847;

Bowling Green, *Price*, May, 1897, M. B. G. Herb. No. 79846.

Wasiota, *Kearney* 383, September, 1893, M. B. G. Herb. No. 79992.

ILLINOIS:

Lisle, *Umbach,* July 4, 1896, M. B. G. Herb. No. 80090;
Mascoutah, *Welsch,* 1862-1871, U. Ill. Herb.;
Mount Carmel, *Schneck,* September 15, 1904, U. Ill. Herb.;
Peoria, *Brendel,* date not given, U. Ill. Herb.;
St. Clair County, *Eggert,* September 11, 1877, M. B. G. Herb. No. 739941;
St. Clair County, *Eggert,* September 11, 1877, M. B. G. Herb. No. 739683.
St. Clair County, *Eggert,* September 11, 1877, M. B. G. Herb. No. 739391;
St Clair County, *Eggert,* September 11, 1877, M. B. G. Herb. No. 79851;
St. Clair County, *Eggert,* September 11, 1877, M. B. G. Herb. No. 79841;
St. Clair County, *Eggert,* September 11, 1877, M. B. G. Herb. No. 79854;
Taylorville, *Andrews,* August 28, 1898, U. Ill. Herb;
Urbana, *Gibbs,* September 26, 1898, U. Ill. Herb;
Urbana, *G. P. C.* October 1, 1895, U. Ill. Herb:
Urbana, *Seymour,* September 28, 1880, U. Ill. Herb.
Wabash County, *Schneck,* July, 1900, U. Ill, Herb;
Wabash County, *Schneck,* date not given, U. Ill. Herb.;
Wady Petra, *Chase* 1165, September 25, 1904, U. Ill. Herb.;
Wady Petra, *Chase* 1270, September 23, 1906, U. Ill. Herb.;
Wady Petra, *Chase* 1277, October 7, 1906, U. Ill. Herb.;
Wady Petra, *Chase* 682, October 7, 1906, M. B. G. Herb. No. 80128.

MISSOURI:

Aberdeen, *Davis* 1147, September 24, 1911, M. B. G. Herb. No. 709388;
Allenton, *Letterman,* August 30, 1892, M. B. G. Herb. No. 709388;
Campbell, *Bush,* September 11, 1893, M. B. G. Herb. No. 772800
Carterville, *Palmer* 1984, July 8, 1901, M. B. G. Herb. No. 757390;
Carthage, *Trelease,* September 18, 1998, M. B. G. Herb. No. 79864;

Cedar County, *Trelease*, July 30, 1897 M. B. G. Herb. No. 79862;
Clayton, *Letterman*, date not given, M. B. G. Herb. No 796012;
Cliff Cave, *Kellogg* 30, October 10, 1901, U. S. Herb. No. 950188;
Cliff Cave, *Kellogg*, October 10, 1901, M. B. G. Herb. No. 79798;
Congo, *Hoffman*, October 10, 1916;
Dodson, *Hoffman*, September 13, 1916;
Dunklin County, *Trelease*, August 20, 1897, M. B. G. Herb. No. 79861;
Eolia, *Davis* 1435, October 23, 1911, U. S. Herb. No. 674025;
Eolia, *Davis* 1435, October 23, 1911, M. B. G. Herb. No 709445;
Forest Park, *Eggert*, September 21, 1875, M. B. G. Herb. No. 79855;
Galena, *Palmer* 6481, October 16, 1913, M. B. G. Herb. No. 717420;
Galloway, *Standley* 9345, August 26, 1912, U. S. Herb. No. 688260;
Greene County *Blankinship* 2821, July 29, 1889, M. B. G. Herb, No. 80047;
Indian Hill, *Trelease*, September 28, 1897, M. B. G. Herb. No. 79863;
Jackson County, *Bush*, September 27, 1893, M. B. G. Herb. No. 80049;
Jefferson County, *Eggert*, September 9, 1896, M. B. G. Herb. No. 79849;
Jerome, *Kellogg*, 184, October 1, 1913, M. B. G. Herb. No. 719727;
Martin City, *Mackenzie* 482, September 18, 1901;
McDonald County, *Bush* September 1, 1893, M. B. G. Herb. No. 80046;
Monteer, *Bush* 4888, October 10, 1907, M. B. G. Herb. No. 79831;
Oronogo, *Palmer*, 988, September 15, 1907, M. B. G. Herb. No. 757385;
Oronogo, *Palmer* 988, September 15, 1907, M. B. G. Herb. No. 79828;

Prosperity, *Palmer* 990, August 20, 1907, M. B. G. Herb. No. 757389;

Prosperity, *Palmer* 990, August 20, 1907, M. B. G. Herb. No. 79827;

Silica, *Eggert*, September 15, 1891, M. B. G. Herb. No. 79851;

South St. Louis, *Kellogg*, September 7, 1900, M. B. G. Herb. No. 79877;

Springfield, *Standley*, 9728, August 31, 1912, U. S. Herb. No. 688645;

St. Louis, *Eggert*, October, 1875, M. B. G. Herb. No. 82696;

St. Louis *Engelmann*, August 1841,, M. B. G. Herb. No. 79688;

St. Louis, *Glatfelter*, date not given, M. B. G. Herb. No. 80060;

St. Louis, *Pammel*, October, 1886, M. B. G. Herb. No 79842;

Stone County *Trelease*, September 10, 1898, M. B. G. Herb. No. 79865;

Sugar Creek, *Mackenzie*, September 6, 1896;

Swan, *Bush*, 380, September 24, 1899, M. B. G. Herb. No. 79857;

Thornton, *Mackenzie* 656, October 18, 1901, M. B. G. No. 79865;

Turner, *Standley* 8794, September 4, 1912, U. S. Herb. No. 687669;

Webb City, *Palmer* 1376, June 7, 1908, M. B. G. Herb. No. 757388;

Webb City, *Palmer* 2646, September 8, 1909, M. B. G. Herb. No. 80063;

Webb City, *Palmer* 2646, September 8, 1909, M. B. G. Herb. No. 757391;

Webb City, *Palmer* 3488, October 7, 1911, M. B. G. Herb. No. 709005;

Webb City, *Palmer* 3488, October 7, 1911, M. B. G. Herb. No. 757386;

Whiteside, *Davis* 28, September 12, 1911 M. B. G. Herb. No. 765895;

Whiteside, *Davis* 1008, September 12, 1911 M. B. G. Herb. No. 673927;

Whiteside, *Davis* 1008, September 12, 1911, M. B. G. Herb. No. 709063;

NORTH CAROLINA:

Aiken, *Ravenel,* September, 1866, M. B. G. Herb. No. 79691.

IOWA:

Ames, *Pammel* 73, August, 1909, M. B. G. Herb. No. 80074;

Clinton, *Pammel* 247, September 4, 1896, M. B. G. Herb. No. 79980;

Clinton, *Pammel* 247, September 4, 1896, M. B. G. Herb. No. 79850;

College Park, *Johnson*, October 1898, M. B. G. Herb. No. 79884;

Columbus Junction, *Pammel* 1502, date not given ,M. B. G. Herb. No. 79876;

Des Moines, *Pammel* 653, July 14, 1897, M. B. G. Herb. No. 79848;

DeWitt, *Pammel* 1455, September 9, 1898, M. B. G. Herb. No. 79874;

Dixon, *Snyder* 735, September 23, 1897, M. B. G. Herb. No 79882;

Iowa City, *Hitchcock*, 1888, M. B. G. Herb. No. 79879;

Iowa City, *Hitchcock,* date not given, M. B. G. Herb. No. 79983;

Iowa City, *Hitchcock*, date not given, M. B. G. Herb. No 79982;

Iowa City, *Hitchcock*, date not given, M. B. G. Herb. No. 79746;

Mount Ayr, *Beard* 642, September 25, 1907, M. B. G. Herb. No. 79722;

Mount Pleasant, *Witte* 993, October 1, 1897, M. B. G. Herb. No. 79881;

Muscatine, *Mackenzie* 749, September 10, 1894.

NEBRASKA:

Bellevue, *Hayden,* July, 1853-54, M. B. G. Herb. No. 79690;

GEORGIA:

Leslie, *Harper* 1716, October 7, 1902, M. B. G. Herb. No. 79869;

(To be continued.)

Book Review.

BY J. LUNELL.

The Sixth Biennial Report of the Director of the Agricultural College Soil and Geological Survey of North Dakota to the Governor of North Dakota (1911-1912) by Herbert A. Hard. Chapter XI: Plant Survey of Barnes County by H. F Bergman. Chapter XII: Flora of North Dakota by H. F. Bergman.

In briefly reporting these publications written by an author who professes views often diametrically opposed to my own I would feel sorry if some reader considered this paper a missile from enemy trenches intending to hurt. Nor is it a peace message. By all means I wish it to be permeated by a spirit of fairness.

I shall not repeat what I have said once before about the vital defects of plant surveys. I am glad that they are abolished within our state. There are more sensible, quicker and less expensive methods for exploring the flora of a land area. The catalogue of Barnes County plants in chapter XI. is as complete as can be expected from the few seconds or minutes spent on each different square yard of its surface, perhaps never to be visited again, and no fault can be found with the collector.

I can not refrain here from calling attention to many inconsistencies or discrepancies, not to say contradictions, to be found in the nomenclature adopted in chapters XI and XII. As the report evidently is written not only for a few botanists of the state, but for any and all of our interested citizens, no matter what standing they occupy, one name for the same plant ought to have been preferred, and if this were thought insufficient, synonyms ought to have been added parenthetically. Such uniformity ought to have been welcome to the readers and facilitate their efforts to master the contents of the book. The more liberal views in chapter XI have a tendency of becoming narrowed down "to the first principles" in chapter XII as f. i. *Potamogeton richardsonii* to *P. perfoliatus, Alisma subcordatum* to *A. plantago-aquatica, Salicornia herbacea* to *S. europaea, Atriplex ovata* to *A. suckleyana, Salsola tragus* to *S. kali, Delphinium albescens* to *D. penardi, Prunus melanocarpa* to *P. virginiana, Viola scabriuscula* to *V. pubescens, and Viola subvestita* to *V. adunca.* Here we find that the perferred name in chapter XI is the synonym in chapter XII, while only one name is given in chapter XI. Two species in Chapter XI have often been reduced to one in chapter XII: *Dondia depressa* and *erecta* to *D. depressa*, *Actaea rubra* and *eburnea* to *A. rubra*, *Crataegus chrysocarpa* and *rotundifolia* to *C. chrysocarpa*, *Kuhnistera candida* and *oligophyllato Petalostemon candidus*. A floral "melting pot" established merely in part is undesirable. Contradictions are by no means rare: *Onosmodium molle* Michx. of chapter XI has (correctly) been called *O. occidentale* in chapter XII, where it is told also that this is *not O. molle* Michx: still the Barnes County plant belongs here, as the genus has only one species within the state. Other species regarding which "to be or not to be is the question," are: *Lepidium apetalum* Willd. (Chapter XI) and *L. apetalum* authors, not Willd. (Chapter XII): *Atriplex hastata* L. (chapter XII) and *A. carnosa Nels.* (A. hastata Am. authors not L. (chapter XII); *Smilax herbacea* L. (chapter XII) and *Nemexia pulverulenta* (*S. herbacea* Am. authors) in chapter XI; *Viola canadensis* L. (chapter XI) and *V. rugulosa* Greene (*V. canadensis* auth. not L.) in chapter XII. Another group of plants is not mentioned in chapter XII, i. e. they are not supposed to grow in North Dakota while they are enumerated in chapter XI as Barnes County plants: *Equisetum variegatum*, *Thalictrum dioicum*, *Xanthium speciosum*, *Antennaria campestris* (though perhaps this species has been dumped in the melting pot and was meant as a part of *A. neglecta* in chapter XII) and *Helianthus strumosus*. We do not attempt to solve this mystery.

The following remarks are to be applied exclusively to chapter XII (the flora). A lamentable defect with the work is that it does not report the total number of plants known within the state up to the date of publication (1917). A check list (of 1912?) containing 962 numbers can be considered its precursor. Based on this list, though with many additions and exclusions, the revised flora was emitted, but the original number of 962 was retained (if my count is correct). A conservative estimate would add at least 25 per cent to this number, even if all proposed new species and varieties were to suffer an indiscriminate universal slaughter, as the retained old species mainly would fill the vacancies.

Such author names as Greene, Rydberg, Aven Nelson, Fernald, representing as brilliant stars on the botanical firmament as the Polar Star in the space, (*Stella Polaris nescit occasum*) are conspicuous by their scarcity or absence or misapplication (analogy *lucus a non lucendo*.)

In recording localities the short method applied for *Ranunculus Cymbalaria* and *Brassica juncea* is commendable. The term "Throughout the state" ought to have been used for all those common plants found everywhere by everyone.

Giving in most cases a large number of localities and crediting the collectors is just as much waste, the more culpable during times when the federal administration instructs its employees to save paper. The records for most other plants not belonging to this class are numerous and the more valuable as so many of them have their place in history. When the war came, what little of the virgin prairie was left had to be utilized for grain production and pasturing of beef cattle, and very little ground beside the section lines was left as a refuge for the wild flowers.

I shall not raise any quarrel by dropping adverse remarks that signify my individual views regarding the preferred species names. Nor shall I resent that among the plants collected by me and for which I have been credited in the flora, a not trifling number has been passed under names not at all attributable to me. I shall only mention critically a few particulars.

Malva rotundifolia L., as described in the key, is identical with the plant bearing that name in American manuals. *M. rotundifolia* L. in European floras comes very near to or is identical with the M. *borealis* of the key. It is an intricate proposition to decide which view is right or wrong.

Steironema membranaceum Greene is represented only by the type at the University of Notre Dame, Ind., and in my herbarium. The Pleasant Lake specimen of 1912 was erroneously distributed under this name.

Dracocephalum Nuttallii (*Physostegia parviflora*). If somebody wishes to reduce *P. formosior* to synonymy, he at least ought to connect it with *P. virginiana*, not with this species!

Fragaria virginiana Duch. Why not as well take the full step and call it *F. vesca* L. and avoid the anxiety and worry we other poor fellows have experienced in trying to master a delicate differentiation between proposed species?

Oxytropis. Almost all our species have been reduced to synonymy under *Aragallus Lamberti*, and there is poor reason then to exempt *A. monticola* from a similar fate. This would be accomplished by making the floral limit 12-25mm. (in place of 16-25mm.) and disregard the color difference which is not respected anyway, subsequently in the text allotted to the species. Our genus would be confined to two lilliputian species, *A. deflexus* and *A. splendens*, and one giant *A. Lamberti*, all with splendid differential limits, and it would be a more perfect system. A beautiful card-castle of proposed species torn down at the same time would add to the "victory," but this calamity ought not to disturb the sleep of the just.

Xanthium. "*Interdum dormitat bonus Brittonus*" most likely thought Dr. Bergman when he found that Dr. Britton, who had only one native species in his Ill. F., had allowed 7 additional native species to slip into his manual. This rate of admittance of species no doubt was too fast to win Dr. Bergman's approval, and he took a middle course in his flora, admitting just 2 species: 1) *X. canadense* (which assimilated *X. Pennsylvanicum*); and 2) *X. echinatum* which included *X. glanduliferum*, and at the same time he mustered into service under said name a specimen of *X. speciosum* collected by me at Minot Aug. 20, 1905. *X. commune* and *X. acerosum* have not even received an honorable mention but they would in all probability have been incorporated with *X. echinatum.*

Arnica fulgens Pursh. The name of the Dakota plant is correctly *A. pedunculato* Rydb. or *A. monocephala* Rydb.

Alisma brevipes Greene (*A. superbum* Lunell). The synonymy was proposed, if I am not mistaken, in the N. Am. Flora and adopted in Rydb. Rocky Mt. Flora and in this report. The outside world has not yet seen the real type of my *A. superbum.* It is in my herbarium and will be open to inspection under certain conditions.

Potamogeton pectinatus. The specimen cited from Lake Ibsen is *P. Friesii*, and I can not imagine how it was labeled otherwise.

Avena Torreyi Nash. Known since the beginning of this century also from the Devil's Lake Chatauqua grounds, where it has been collected by me repeatedly.

If asked for my impression of the botanical part of this report I venture to say this: While teaming with an abundance of knowledge amassed from the year of 1753 until the first part of this century, it has either from waning interest in the subject or from difficulties in reaching the material to be studied, or on account of its author's removal from this botanical field—not paid sufficient attention to the notable advances of the latest years.

Leeds, North Dakota.

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VOL. VI. MAY–JULY, 1919 NOS. 3, 4

THE AMERICAN MIDLAND NATURALIST

Devoted to Natural History, Primarily that of the Prairie States

Published by the University of Notre Dame,
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J. A. NIEUWLAND, C. S. C., Ph. D., Sc. D., Editor

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VOL. VI. MAY-JULY, 1919. NO. 3, 4.

The Missouri Muhlenbergias.---II.

BY BENJAMIN FRANKLIN BUSH.

KANSAS:

Manhattan, *Kellerman*, September 25, 1885, M. B. G. Herb. No. 79969;

Manhattan, *Kellerman*, September 25, 1885, M. B. G. Herb. No. 79977;

Manhattan, *Kellerman*, September 16, 1888, M. B. G. Herb. No. 79984;

Wyandotte, *Mackenzie*, October 3, 1897.

ALABAMA:

Cullman, *Eggert*, September 15, 1897, M. B. G. Herb. No. 79853.

FLORIDA:

Apalachicola, *Chapman*, date not given, M. B. G. Herb. No. 785588;

MISSISSIPPI:

Biloxi, *Tracy*, September 1, 1899;

Panola, *Eggert*, September 17, 1896, M. B. G. Herb. No. 79732;

Panola, *Eggert*, September 17, 1876, M. B. G. Herb. No. 79728;

Starkville, *Kearney*, 16, September 27, 1896, M. B. G. Herb. No. 79979;

Starkville, *Tracy*, July 18, 1888, M. B. G. Herb. No. 79981.

LOUISIANA:

Feliciana, *Mohr*, September, U. S. Herb. No. 722798;

Natchitoches, *Palmer* 6774, October 1, 1915, M. B. G. Herb. No. 794768.

Arkansas:

Benton County, *Plank*, Summer, 1900, M. B. G. Herb. Herb. No. 82685;

Fulton, *Bush* 897, September 18, 1900 M. B. G. Herb. No. 79870;

Texarkana, *Heller* 4161, August 27, 1898, M. B. G. Her. Herb. No. 79883;

Oklahoma:

Verdigris, *Bush* 768, August 2, 1894, M. B. G. Herb. No. 79970.

Texas:

Columbia, *Bush* 1461, October 12, 1900, M. B. G. Herb. No. 79871;

Dallas, *Reverchon* 661, 1873, M. B. G. Herb. No. 79612;

Dallas, *Reverchon* 2252, October 5, 1900, M. B. G. Herb. No. 79845;

Dallas, *Reverchon* 4207A, 1881, M. B. G. Herb. No 79844;

Elmo, *Reverchon* 3532, October 22, 1902, M. B. G. Herb. No. 79894;

Elmo, *Reverchon* 3538, October 22, 1902, M. B. G. Herb. No. 79860;

Elmo, *Reverchon* 3538, October 22, 1902, M. B. G. Herb. No. 79892;

Galveston Bay, *Joor*, October 19, 1884, M. B. G. Herb. No. 79856;

Houston, *Lindheimer*, September, 1841, M. B. G. Herb. No. 79693;

Industry, *Wurzlow*, 1891, U. Ill. Herb.;

Kerrville, *Hitchcock* 5315, June 22, 1910, U. Ill. Herb.; October 9, 1901, M. B. G. Herb. No. 75877;

Marshall, *Bush* 1011,

Palestine, *Joor*, October 21, 1884, M. B. G. Herb. No. 79870;

Rusk County, *Vinzent* 55, August, M. B. G. Herb. No. 79873;

San Antonio, *Bush* 826, September 18, 1901, M. B. G. Herb. No. 79873;

Without definite locality, *Lindheimer*, date not given, M. B. G. Herb. No. 79990;

Without definite locality, *Reverchon*, date not given, M. B. G. Herb. No. 80105;

Without definite locality, *Reverchon*, date not given, M. B. G. No. 79893;

MEXICO:

Coatepee *Hitchcock* 6663, September 2-4, 1910, U. Ill. Herb.

2. MUHLENBERGIA CURTISETOSA (Scribner) Bush, n. sp.

Muhlenbergia Schreberi curtisetosa, Scribner Rhodora 9:17. 1907.

SPECIMENS EXAMINED:

MISSOURI:

Eagle Rock, *Bush* 377, September 24, 1896, M. B G. Herb. No. 294597.

Eagle Rock, *Bush* 377, September 24, 1896, U. S. Herb. No. 294597;

Eagle Rock, *Mackenzie*, September 24, 1896.

ILLINOIS:

Champaign, *Clinton* 92, date not given, U. S. Herb. No. 952420;

Without definite locality, *Wolf*, 1881, U. S. Herb. No. 952419, TYPE of *Muhlenbergia Schreberi curtisetosa*.

3. MUHLENBERGIA SOBOLIFERA (Muhl.) Trin. Gram. Unifl. 189, 1824.

Agrostis sobolifera Muhl.; Willd. Enum. 95. 1809.

Trichochloa sobolifera (Muhl.) Trin. Fund. Agrost. 117. 1820.

Muhlenbergia sobolifera Trin., Bush in Flora of Jackson County, Missouri, No. 860, 1885; Tracy in Flora of Missouri, No. 1645, 1886; Eggert in Catalogue of Plants of Saint Louis, Missouri, 1891.

Muhlenbergia sobolifera (Muhl.) Trin., Mackenzie and Bush in Manual of the Flora of Jackson County, Missouri, No. 1, 1902; Daniels in Flora of Columbia, Missouri, No. 70, 1907; Palmer in Catalogue of Plants of Jasper County, Missouri, Nos. 753, 856, 858, 1375, 2529, 2617, 2546, 3463, 3467 and 3475, 1916.

Northern Texas and northward, according to Dewey in Manual, l. c., referring of course to *M. setigera* q. v.

N. E. to Minn. and southward, according to Hitchcock in Manual.

N. H. and Mass. to Minn. Va. Tenn. and the Ind. Terr., according to Nash in Flora.

N. W. to Minn. south to Va. Tenn. and the Ind. Terr., according to Nash in Illustrated Flora.

From New York and New Jersey to Nebraska, Missouri, Kansas and Northern Arkansas.

SPECIMENS EXAMINED:

NEW YORK:

Ithaca, *Rowlee*, 1889, M. B. G. Herb. No. 79759;
Pennyan, *Sartwell*, date not given, M. B. G. Herb. No. 79629;
Western New York, *Gray*, date not given, M. B. G. Herb. No. 79627.

PENNSYLVANIA:

Chester County, *Canby*, 1865, M. B. G. Herb, No 79751;
Conewago, *Heller* 4792, September 27, 1907, M. B. G. Herb. No. 79758.

MARYLAND:

Harper's Ferry, *Holm*, June 10, 1912, U. Ill. Herb.;
Harper's Ferry, *Holm*, June 10, 1912, M. B. G. Herb. No. 779176.

DISTRICT OF COLUMBIA:

Washington, *Ball and Paddock* 26, August 7, 1899, M. B. G. Herb. No 79767.

ILLINOIS:

Belleville, *Engelmann*, August, 1833, M. B. G. Herb. No. 79660, the plant marked 2 on this sheet;
Centerville, *Eggert*, August 31, 1877, M. B. G. Herb. No 79752;
Centerville, *Eggert*, August 31, 1877, M. B. G. Herb. No 79753;
Centerville, *Eggert*, August 31, 1877, M. B. G. Herb. No. 79754;
Centerville, *Eggert*, August, 31, 1877, M. B. G. No. 79834;
Centerville, *Eggert*, August 31, 1877, M. B. G. Herb. No. 767046;
Mount Carmel, *Schneck*, October 20, 1881, U. Ill. Herb.;
Peoria, *Brendel*, date not given, U. Ill. Herb.;
Peoria, *McDonald*, August, 1888, M. B. G. Herb. No. 773046;
Taylorville, *Andrews*, August 20, 1898, U. Ill. Herb.;
Taylorville, *Andrews*, August 26, 1898, U. Ill. Herb.;
Wabash County, *Schneck*, July 1, 1879, U. Ill. Herb., the plant marked B on this sheet;
Wabash County, *Schneck*, September 1, 1879, U. Ill. Herb.;
Wabash County, *Schneck*, September 6, 1879, U. Ill. Herb.;
Wabash Conty, *Schneck*, August 17, 1880, U. Ill. Herb.

MISSOURI:

Allenton, *Letterman*, August, 1876, M. B. G. Herb. No. 772801;
Allenton, *Letterman*, August, 1893, M. B. G. Herb. No. 772803;
Bagnell, *Trelease*, September 22, 1897, M. B. G. Herb. No.79765

Bagnell, *Trelease*, September 18, 1897, M. B. G. Herb. No. 79760;
Big Bend of the Meramec, *Glatfelter*, September 15, 1891, M. B. G. Herb. No. 80064;
Cliff Cave, *Kellogg* 32, October 10, 1901, M. B. G. Herb No. 79800;
Cliff Cave, *Kellogg*, October 10, 1901, M. B. G. Herb. No. 950200;
Current River, Carter County, *Trelease*, September 10, 1897, M. B. G. Herb. No. 79763;
Dodson, *Bush* 1868, August 24, 1903, M. B. G. Herb. No. 79755;
Dodson, *Bush* 1868, August 24, 1903, M. B. G. Herb. No. 79756;
Dodson, *Hoffman* 145, September 17, 1916;
Eolia, *Davis* 1440, October 23, 1911, M. B. G. Herb. No. 709440;
Greene County, *Bush* 4814, September 4, 1893, M. B. G. Herb. No. 80038;
Independence, *Bush*, 1884, U. S. Herb. No. 746205;
Jackson County, *Bush*, September 4, 1893, M. B. G. Herb. No. 80040;
Joplin, *Trelease*, October 7, 1897, M. B. G. Herb. No. 79761;
McDonald County, *Bush*, September 1, 1893, M. B. G. Herb. No. 80037.
Meramec Spring, Phelps County, *Trelease*, September 25, 1898, M. B. G. Herb. No. 79764;
Noel, *Palmer* 4176, September 8, 1913, M. B. G. Herb. No. 717316;
Noel, *Palmer* 4254, September 10, 1913, M. B. G. Herb. No. 717317;
Pearl, *Standley* 9230, August 22, 1912, U. S. Herb. No. 688145;
Randolph, *Mackenzie* 370, October 2, 1898;
Sibley, *Bush* 4814, August 31, 1907, M. B. G. Herb No. 78930;
Sulpher Springs, Jefferson County, *Trelease*, October 23, 1898, M. B. G. Herb. No. 79762;
Swope Park, *Mackenzie* 432, September 13, 1901;
Swope Park, *Stigall* 50, September 16, 1906, M. B. G. Herb. No. 80054.

Webb City, *Palmer* 753, July 22, 1906, M. B. G. Herb. No. 8055;
Webb City, *Palmer* 856, July 22, 1906, M. B. G. Herb. No. 756979;
Webb City, *Palmer* 1375, August 4, 1908, M. B. G. Herb. No. 756957;
Webb City, *Palmer* 1375, August 4, 1908, M. B. G. Herb. No. 80056;
Webb City, *Palmer* 2546, July 22, 1909, M. B. G. Herb. No. 757604;
Webb City, *Palmer* 2546, July 22, 1909, .M B. G. Herb. No. 80058;
Webb City, *Palmer* 2549, July 19, 1909, M. B. G. Herb. No. 756956;
Webb City, Palmer 2617, September 2, 1909, M. B. G. Herb. No. 80061;
Wicks, *Kellogg* 31, July 20, 1898, U. S. Herb. No. 709440;
Wicks, *Kellogg* 31, July 20, 1898, M. B. G. Herb. No 79766.

IOWA:

Steamboat Rock, *Pammel, Hume,* and *Fitz* 1346, date not given, U. S. Herb. No. 79771;
Winterset, *Carver* 1928, 1894, M. B. G. Herb. No. 79769;

KANSAS:

Cherokee County, *Hitchcock* 889, 1896, M. B. G. Herb. No. 79636;
Rosedale, *Mackenzie*, July 19, 1896;

NEBRASKA:

Weeping Water, *Williams*, August, 1899, M. B. G. Herb. No. 79628.

ARKANSAS:[1]

Eureka Springs, *Palmer* 4425, September 20, 1913, M. B. G. Herb. No. 716987.

Culms much branched from the base, 3-4 dm. tall, smooth, erect; infranodes slightly strigose below the glabrous nodes, at least the lower; leaves numerous, 5-10 cm. long, 3-5 mm, wide; panicles slender 1-1.5dm. long, the short branches oppressed; spikelets 2-2.5 mm. long, acute, somewhat crowded; glumes broadly ovate, acute or acuminate, one- to two-thirds as long as the floret;

1 MUHLENBERGIA SETIGERA (Scribner) Bush, n. sp.
Muhlenbergia sobolifera setigera Scpibner, Rhodora 9:18. 1907.

lemma slender acuminate, hairy-tufted at the base, attenuate into a slender awn 1-5 mm. long.

Differs from *M. sobolifera* in having shorter, much-branched culms, shorter and narrower leaves, shorter and denser panicles, longer and narrower florets which are awned. Was referred by Vasey to *M. sylvatica, M. sylvatica, var., M. sobolifera, M. sobolifera* var., and *M. Willdenovii.*

Scribner based *M. sobolifera setigera* on Reverchon's 70 and 1054, referring to it also his No. 30, but gives neither dates not localities for the type specimens. Many years ago Reverchon sent to Dr. George Vasey of the Department of Agriculture, specimens of Grasses to be determined, and these were numbered from 1 up, usually marking "Vasey" on his labels.

The specimens of *Muhlenbergia* which I am referring to this new species, which he sent to be named, were reported by Vasey under five names, *M. sylvatica, M. sylvaitca* var.—, *M. sobolifera, M. sobolifera* var.—, and *M. Willdenovii.* Believing these to be distinct species and varieties, Reverchon numbered one 1049, another 1050 and so on up to 1054, these being the numbers given to these species and varieties in his MS. list of Texas Plants.

But the specimens sent to Dr. Vasey with numbers on the labels, and other numbers bearing the same numbers do not agree, and I feel confident that Reverchon used the same numbers over and over.

I have seen several of Reverchon's No. 70, supposedly part of the No. 70 sent to Vasey, and these are marked *M. sylvatica* var. —, presumably a MS. name of Vasey's, but these do not appear to be the same as that examined by Scribner. I have also examined two sheets of specimens marked 30 by Reverchon, collected at Ferris, Texas, but these differ from the No. 30 examined by Vasey and Scribner, and cited by Scribner as belonging to his *M. sobolifera setigera,* in being short-awned. These Ferris specimens are named *M. sobolifera* var.—presumably a MS. name of Vasey's, and the date of collection is stated as 1884 and 1888, while the one cited by Scribner is said to be dated 1885. One of the Ferris specimens is numbered 1665, which makes it apparent that Reverchon separated this variety from *M. sobolifera*, and assigned it a much later number in his MS. list of Texas Plants.

Having been intimately acquainted with Mr. Reverchon, I learned much about his numbering, the earlier collecting being numbered according to his MS. list, which was arranged in accordance with his collecting. When Reverchon first began collecting plants in Texas, in the seventies, the first species he collected he listed as No. 1, the next No. 2, and so on up to about No. 1884, when I persuaded him to adopt the serial system of numbering, beginning with the last number in his MS. list, and giving each collection a different number.

According to this earlier method of numbering, every species bore the same number, no matter where and when collected, as for instance, *M. sobolifera* was No. 1052, and every collection of what he took to be *M. sobolijera* he gave that number to, no matter where it was collected, in 1878, 188c, 1882 or 1885.

I have also examined one sheet of Reverchon's No. 1054, which is labeled *M. Mexicana* by Reverchon, cited by Scribner as part of the type of *M. sobolifefa setigera,* but this appears to me to be only *M. Mexicana.* It differs from *M. sobolifera setigera* in having the lower glumes acuminate and nearly as long as the lemma, the lemma merely acute or acutish and not awned.

SPECIMENS EXAMINED:

OKLAHOMA:

Sapulpa, *Bush* 769, July 22, 1894, M. B. G. Herb. No. 79634, labeled *M. sobolifera* by Bush;

Verdigris, *Bush* 770, August 2, 1894, U. S. Herb. No. 217323, labeled *M. sobolfera* by Bush and *M. Mexicana* by Scribner.

TEXAS:

Dallas, *Reverchon* 1054, September, 1880, U. S. Herb. No. 49861, labeled *M. Mexicana filiformis* by Reverchon, and *M. sobolifera* by Scribner;

Dallas, *Reverchon* 2253, October 5, 1900 U. S. Herb. No. 411579, labeled *M. Mexicana* by Bush, and *M. sylvatica* by Scribner;

Dallas, *Reverchon* 42073, August 26, 1880, U. S. Herb. No. 501272, labeled *M. tenuiflora* by Bush;

Dallas, *Reverchon* 2253, October 5, 1900, M. B. G. Herb. No. 75666, labeled *M. Mexicana by* Reverchon;

Dallas, *Reverchon* 2253, October 5, 1900, M. B. G. Herb. No. 75665, labeled *M. Mexicana* by Bush;

Dallas, *Reverchon* 2253, October 5, 1900. M. B. G. Herb. No. 75646, labeled *M. Mexicana* by Bush;

Dallas, *Reverchon* 1052, 1882, M. B. G. Herb. No. 79768, labeled *M. sobolifera* by Reverchon;

Dallas, *Reverchon* 4207, August, 1880, M. B. G. Herb. No. 79757, labeled *M. sobolifera* by Bush;

Dallas County, *Reverchon*, date not given, M. B. G. Herb. No. 79719, labeled *M. sylvatica* by Reverchon;

Ferris, *Reverchon* 30, 1884, M. B. G. Herb. No. 80712, labeled *M. sobolifera* var. — by Reverchon, evidently a MS. name of Vasey's;

Ferris, *Reverchon* 30, 1884, M. B. G. Herb. No. 80111, labeled *M. sobolifera* var. — by Reverchon, no doubt part of sheet No. 80112;

Ferris, *Reverchon* 16y65, 1888, M. B. G. Herb. No. 80710, labeled *M. sobolifera* var. — by Reverchon;

Without definite locality, *Reverchon* 70, 1879, type, U. S. Herb. No. 49863, labeled *M. Willdenovii* by Reverchon and Scribner, and *M. sylvatica* var. — by Scribner;

Without definite locality, *Reverchon* 70. date not given, M. B. G. Herb. No. 80082, labeled *M. Willdenovii* by Reverchon, and evidently co-type of Scribner's variety;

Without definite locality, *Reverchon*, date not given, presumably the same collection as No. 70 on sheet No. 80082, M. B. G. Herb. No. 80084, labeled *M. sylvatica* by Reverchon.

Without definite locality, *Reverchon* 1049, 1881, possibly the same collections as specimens on sheet No. 80084, M. B. G. Herb. No. 80083, labeled *M. sylvatica* var. — by Reverchon, probably a MS. name of Vasey's;

Without definite locality, *Reverchon* 1052, date not given, marked "127 Vasey," labeled *M. solobifera* by Reverchon, probably being the name supplied by Vasey;

Without definite locality, *Reverchon*, M. B. G. Herb. No. 79891;

Without definite locality, *Reverchon* 1054, date not given, M. B. G. Herb. No. 75661;

Without definite locality, *Reverchon* 30, 1885, U. S. Herb. No. 952417, labeled *M. Mexicana*, and *M. sobolifera* var. — by Scribner;

Without definite locality, but presumably Dallas, *Reverchon* 1054, 1880, U. S. Herb. No. 49862, labeled M. *sobolifera*, and *M. Willdenovii* by Scribner.

4. MUHLENBERGIA BRACHYPHYLLA Bush, n. sp.

Culms 2-4 dm. tall, much branched, much branched from the base, the old culms stramineous, shining; infranodes glabrous; nodes glabrous; leaves numerous, short, narrow, the larger 5-7 dm. long, the upper reduced to 1-2 dm.; principal nerves of the larger leaves 7-9; panicles terminal on the culms and branches, and from all the upper and middle sheaths, numerous, very slender, short, the divisions appressed, the terminal and those terminating the branches usually short-exserted, those from the lowest sheaths usually long-exserted on very slender peduncles; spikelets 3mm. long, rather slender; glumes broadly lanceolate, attenuate or cuspidate, about one-half as long as the lemma; lemmas lanceolate, awned, minutely bearded at the base, sometimes awnless or short-awned; awns slender, about as long as the lemmas or sometimes shorter.

Type specimens collected at Webb City, Missouri, *Palmer* 2734, September 20, 1909, specimens in the Herbarium of the Missouri Botanical Garden, sheet No. 757387.

The species here proposed has been referred to *M. Torreyi* on the one hand and to *M. tenuiflora* on the other, but differs conspicuously from these species in being lower, more branched, in having more numerous leaves which are shorter and narrower, with but 7-9 principal nerves, in having numerous panicles, which are mostly short-exserted, in having glabrous yellow polished infranodes and glabrous nodes. It is much nearer *M. Mexicana*, to which it bears a strong resemblance, but differs in having shorter and broader glumes, awned lemmas, and long-exserted panicles from the lower sheaths.

SPECIMENS EXAMINED:

MISSOURI:

Golden City, *Palmer* 4575, October 6, 1913, M. B. G. Herb. No. 717221;

Webb City, *Palmer* 2734, September 20, 1909, M. B. G. Herb. No. 757387, TYPE;

Webb City, *Palmer* 2734, September 20, 1909, M. B. G. Herb. No. 80062, TYPE collection.

ILLINOIS:

Bluffs Lake, *Eggert*, September 24, 1875, M. B. G. Herb. No. 79733.

5. MUHLENBERGIA TENUIFLORA (Willd.) B. S. P. Cat. Pl. N. Y. 67, 1888.

Agrostis tenuiflora Willd. Sp. Pl. 1:364, 1787.

Agrostis pauciflora Bush, Fl. Am. Sept. 1:63, 1814.

Trichochloa longiseta Trin. Agrost. 117, 1820.

Muhlenbergia Willdenovii Trin. Gram. Unifl. 188, 1824.

Muhlenbergia Willdenovii Trin., Tracy in Flora of Missouri, No. 1647, 1886; Eggert in Catalogue of Plants of Saint Louis, Missouri, 1891.

Muhlenbergia tenuiflora (Willd.) B. S. P., Mackenzie and Bush in Manual of the Flora of Jackson County, Missouri, No. 5, 1902; Daniels in Flora of Columbia, Missouri, No. 74, 1907.

Northern Texas to Mass. and Minn., Dewey in Manual of the Plants of Western Texas.

Mass. to Ont. Minn. and southward, Hitchcock in Manual.

Mass. to S. Ont. Minn. Ala. and Texas, Nash in Flora.

Mass. to Minn. Ala. and Texas, Nash in Illustrated Flora.

SPECIMENS EXAMINED:

West Haven, *Kirk* 976, August 17, 1913, U. S. Herb. No. 725822, labeled *M. tenuiflora* by Kirk, and *M. sobolifera setigera* by the Department of Agriculture.

NEW YORK:

Pennyan, *Sartwell*, date not given, M. B. G Herb. No. 79582, the plant marked 2 on this sheet;

Western New York, *Gray*, date not given, M. B. G. Herb. No. 79587.

ONTARIO:

Foster's Flats, *Macoun* 26, 242, July 11, 1901, U. S. Herb. No. 952525.

NEW JERSEY:

Cranberry Lake, *Mackenzie* 2453, September 16, 1906, M. B. G. Herb. No. 80101;

Sussex County, *Mackenzie* 1095, September 25, 1904;

Sussex County, *Mazckenzie* 2453, September 16, 1906.

PENNSYLVANIA:

Germantown, *Digyn*, date not given, M. B. G. Herb. No. 79583.

DISTRICT OF COLUMBIA:

Washington, *Ward*, July 28, 1878, M. B. G. Herb. No. 80085.

OHIO:

Margaretta Ridge, *Moscley*, July 28, 1896, U. S. Herb. No. 431146.

TENNESSEE:

Cowan, *Ruth* 26, July, 1898, U. S. Herb. No. 952526.

KENTUCKY:

Big Black Mountain, *Kearney* 234, August, 1893, U. S. Herb. No. 952527;

Big Black Mountain, *Kearney* 234, August, 1893, U. S. Herb. No. 822978;

Big Black Mountain, *Kearney* 234, August, 1893, M. B. G. Herb. No. 79586;

Harlan Court House, *Kearney* 33, August, 1893, U. S. Herb. No. 952528;

Harlan Court House, *Kearney* 33, August, 1893, U. S. Herb. No. 822979;

Harlan Court House, *Kearney* 33, August, 1893, M. B. G. Herb. No. 79588;

Pineville, *Mackenzie* 962, August–September, 1904.

ILLINOIS:

Edgemont, *Craig*, October 23, 1910, M. B. G. Herb. No. 82662;
Elgin, *Vasey*, date not given, U. Ill. Herb.;
Peoria, *Brendel*, date not given, U. Ill. Herb.;
Peoria, *McDonald*, August, 1889, M. B. G. No. 773047;
St. Clair County, *Eggert*, August 3, 1877. M. B. G. Herb. No. 79838;

St. Clair County, *Eggert*, August 3, 1877, M. B. G. Herb. No. 739936;

St. Clair County, *Eggert*, August 3, 1877, N. D. Herb. No. 8143;
Urbana, *Seymour* and *White*, September 26, 1886, U. Ill.
Wabash County, *Schneck*, July 2, 1879, in part, the plant marked A on this sheet, U. Ill. Herb.;

Wabash County, *Schneck*, September 4, 1904. U. Ill. Herb.

MISSOURI:

Allenton, *Letterman*, August 1, 1900, M. B. G. Herb. No. 867670;

Allenton, *Letterman*, August 1, 1900. M. B. G. Herb. No. 772805;

Sibley, *Mackenzie* 548 A, October 2, 1901;

Without definite locality, *Bush*, date not given, U. S. Herb No. 950198.

NORTH CAROLINA:

Montreat, *Standley* and *Bollman* 9966 August 23, 1913. U. S. Herb. No. 688883;

Waynesville, *Standley* 3687, September 9, 1910, U. S. Herb. No. 514551.

MICHIGAN:

Saugatuck, *Umbach*, August 5, 1898.

IOWA:

Iowa City, *Hitchcock*, date not given, M. B. G. Herb. No. 79585;

Winterset, *Carver* 260, September, 1884, M. B. G. Herb. No. 82688;

ALABAMA:

Jackson County, *Chase* 4490, October 15, 1907, U. S. Herb. No. 590834;

Jackson County, *Chase*, October 15, 1907, U. Ill. Herb.

ARKANSAS:

Mount Mena, *Trelease*, October 1, 1898, M. B. G. Herb. No. 79444.

OKLAHOMA:

Sapulpa, *Bush* 773, September 20, 1894, M. B. G. Herb. No. 79621.

6. MUHLENBERGIA RACEMOSA (Michx.) B. S. G. Prel. Cat. N. Y. 67. 1888.

Agrostis racemosa Michx. Fl. Bor. Am. 1:53. 1803.

Agrostis setosa Muhl. Gram. 68. 1817.

Trichochloa glomerata Trin. Fund. Agrost. 117. 1820.

Trichochloa calycina Trin. Fund. Agrost. 117. 1820.

Polypogon racemosus (Michx.) Nutt. Gen. 1:51. 1818.

Muhlenbergia glomerata (Trin.) Gram Unifl. 191. 1824.

Muhlenbergia glomerata ramosa Vasey, Cat. Grasses U. S. 40. 1885. 1885.

Muhlenbergia racemosa ramosa (Vasey) Beal, Grasses U. S. 2:253. 1896.

Muhlenbergia glomerata Trin., Bush in Flora of Jackson County, Missouri, No. 564, 1882; Tracy in Flora of Missouri, No. 1642, 1886; Eggert in Catalogue of Plants of Saint Louis, Missouri, 1891.

Muhlenbergia racemosa (Michx.) B. S. P., Mackenzie and Bush in Manual of the Flora of Jackson County, Missouri, No. 4, 1902; Daniels in Flora of Columbia, Missouri, No. 72, 1907.

N. F. to Wash. and B. Col. and southward in the East to N. Car., and in the West to Texas (?), N. Mex. and Ariz., Scribner and in the West to Texas (?), N. Mex. and Ariz., Scribner in Rhodora, l. c.

N. F. to N. J. and southward, Hitchcock in Manual.

N. F. to B. Bot., N. J., N. Car., Mo. and N. Mexico, Nash in Flora.

N. F. to B. Col. south to N. J. and N. Mex. Nash in Illustrated Flora.

New Foundland to Washington, south to Alabama and Nevada.

SPECIMENS EXAMINED:

NEWFOUNDLAND:

Exploits River and Badger Brook, *Robinson* and *Schrenk* 196, August 13, 1894, M. B. G. Herb. No. 80096;

Exploits River and Badger Brook, *Robinson* and *Schrenk* 196, August 13, 1894, M. B. G. No. 79741.

MAINE:

Crystal, *Knight*, September 15, 1905;

Mount Desert Island, *Rand* and *Redfield*, August 21, 1897, M. B. G. Herb. No. 79710;

St. Francis, *Fernald* 169, August 21, 1889, M. B. G. Herb. No. 79967.

NEW HAMPSHIRE:

Gilmanton, *Blake*, September 6, 1861, M. B. G. Herb. No. 79909;

Sanbornton, *Carter*, 128, September 20, 1902, U. Ill. Herb.

VERMONT:

Bellows Falls, *Carey*, 1741, M. B. G. Herb. No. 79677.

CANADA:

Lamberton, *Glatfelter*, August 2, 1892, M. B. G. Herb. No. 80092.

NEW YORK:

Bergen, Collector not given, August 30, 1907, U. Ill. Herb.;

Niagara Falls, *Engelmann*, August, 1840, M. B. G. Herb. No. 79678;

Niagara Falls, *Morong*, August 28, M. B. G. Herb. No. 78010;

Pennyan, *Sartwell*, date not given, M. B. G. Herb. No. 79961;

Western New York, *Gray*, date not given, M. B. G. Herb. No. 79965;
Western New York, *Gray*, date not given, M. B. G. No. 79962;
Western New York, *Gray*, date not given, M. B. G. No. 79676;
Without definite locality, collector and date not given, M. B. G. Herb. No. 79954.

ONTARIO:
Bicaber, *Hoy*, August, 1883, M. B. G. Herb. No. 79624;
Lambton County, *Glatfelter*, August 22, 1892, M. B. G. Herb. No. 80066.

NEW JERSEY:
Cranberry Lake, *Mackenzie* 2428, September 16, 1906, M. B. G. No. 80100.
Mount Arlington, *Mackenzie* 918, August 21, 1904;
Sussex County, *Mackenzie* 2428, September 16, 1906;
Without definite locality, *Curtis* M. B. G. Herb. No. 79675;

INDIANA:
Wells County, *Deam*, September 11, 1901, M. B. G. Herb. No. 80076.

ILLINOIS:
Augusta, *Mead*, 1843, M. B. G. Herb. No. 82695;
Bluffs Lake, *Eggert*, September 11, 1877, M. B. G. Herb. No. 79908;
Champaign, *Clinton*, October 1, 1895. U. Ill. Herb.;
Chicago, *Glatfelter* 643, August 20, 1893, M. B. G. Herb. No. 80071;
Dupont, *Eggert*, September 11, 1877, M. B. G. No. 739390;
Dupont, *Eggert* 11, 1877, M. B. G. Herb. No. 738989;
Dupont, *Eggert*, September 11, 1877, M. B. G. Herb. No. 772999;
Dupont, *Eggert*, September 11, 1877, M. B. G. Herb. No. 79840;
Dupont, *Eggert*, September 11, 1877, N. D. Herb. No. 8144;
Dupont, *Eggert*, September 11, 1877, N. D. Herb. No. 8140;
East Alton, *McDonald*, August, 1897, U. Ill. Herb.;
Elgin, *Sherff* 1946, September 14, 1912. U. Ill. Herb.;
Falling Springs, *Engelmann*, September, 1844, M. B. G. Herb. No. 79673, evidently part of the collection sheet

No. 79674, the plant marked A on that sheet exactly matching this;

Lake Villa, *Gleason* and *Shobe* 128, August 6, 1906, U.Ill. Herb.;

Lake Villa, *Gleason* and *Shobe* 200, August 9, 1900, U. Ill. Herb.;

Oquawka, *Patterson*, September, year not given, M. B. G. Herb. No. 772777;

Peoria, *Brendel*, date not given, U. Ill. Herb.;

Princeville, *Chase* 940, October 14, 1900, U. Ill. Herb.;

Princeville, *Chase* 1269, September 23, 1906, U. Ill. Herb.;

Wady Petre, *Chase* 1943, September 22, 1908, U. Ill. Herb.;

Without definite locality, *Patterson*, date not given, M. B. G. Herb. No. 785591.

MISSOURI:

Banks of the Mississippi, presumably just South of Saint Louis, *Engelmann*, August, 1843, the plants marked B on this sheet, the other plant marked A on this sheet evidently belonging to sheet No. 79673;

Congo, *Hoffman*, October 7, 1916;

Courtney, *Bush* 6508, October 16, 1911, U. S. Herb. No. 673597;

Creve Coeur Lake *Kellogg* 28, September 25, 1901, U. S. Herb No. 950202;

Creve Coeur Lake, *Norton*, September 11, 1898, M. B. G. Herb. No. 82683;

Dodson, *Hoffman*, September 10, 1916;

Hannibal, *Davis* 1044, September 16, 1911, U. S. Herb. No. 673942;

Hannibal, *Davis* 1044, September 16, 1911, M. B. G. Herb. No. 709096;

Jackson County, *Bush* 59, August 26, 1890, M. B. G. Herb. No. 768677;

Jackson County, *Bush* 1876, August 28, 1891, M. B. G. Herb. No. 80054;

Jackson County, *Bush*, September 11, 1892, M. B. G. Herb. No. 80044;

Jackson County, *Bush*, September 22, 1893, M. B. G. No. 80050;

Jackson County, *Bush* 405, September 22, 1892, U. S. Herb. No. 950210;

Jefferson Barracks, *Eggert*, September 11, 1877, M. B. G. Herb. No. 79907;
Randolph, *Mackenzie* 368, October 2, 1898, M. B. G. Herb. No. 89720;
Randolph, *Mackenzie* 369, October 2, 1898;
Sheffield, *Hoffman*, October 7, 1916;
Sheffield, *Mackenzie* 658, October 18, 1901;
St. Louis, *Eggert* 225 a, September 4, 1877, U. S. Herb. No. 950203, exactly same date and collection as specimens on sheet No. 79907;
St. Louis, *Engelmann*, date not given, M. B. G. Herb. No. 79963.

Panicum Lineare, Linn.

BY OLIVER A. FARWELL.

In the Species Plantarum Ed. 2, Vol. 1, p. 85, 1762, Linnaeus published *Panicum lineare* as a new species with the following description: "Panicum spicis digitatis subquaternis linearibus, flosculis solitariis secundis muticis. Habitat in Indiis. Culmi prostrati, laeves, ramosi. Spiculae lineares, rectae, angustae. Flores subtus alterni. Calycis squama exterior brevior, patens, rachi adherens."

There is no specimen in the Linnaean Herbarium and there is no reference to older authors. The species must be interpreted from the description alone. It is self evident from the diagnosis that the species belongs to the Digitaria group. It can not be *P. Dactylon* Linn. since it is *laeves* and *prostrate* while the latter has the spikes *basi interiore villosis* and the plant is *sarmentis repentibus;* it can not be *P. sanguinale* Linn. or *P. filiforme* Linn. since in these the flowers are *in pairs* while in *P. lineare* they are placed *singly.* The habitat *in Indiis* may mean India and the East Indies, or it may mean in both the East and West Indies. Linnaeus used it both ways, I believe, but in the present instance the presumption is that he meant in both the East and West Indies since in the Mantissa II 323, 1771 he refers to his *P. lineare,* without comment, the *P. lineare* Burm. Ind. 25, t. 10. f. 2 and the *Gramen*

Dactylon, etc., Sloane, hist. 1, p. 113, t. 70, f. 3. We can not, therefore, neglect a study of the West Indian species in endeavoring to ascertain the proper application of the Linnaean name. Mr. Hitchcock in Contributions U. S. Nat. Herb. XII, pp, 134, 142 and 209, 1908–9, has shown that the Sloane reference belongs to what is now known as *Syntherisma setosa* (Desv.) Nash or *S. digitata* (Swz.) A. S. Hitch.; he combines under the latter name two forms that have been variously considered as distinct species or as varieties of *Panicum sanguinale* Linn. Grisebach, Flora Br. W. Ind. 544, 1864, has described these West Indian forms as *pilose;* therefore, they can scarcely be considered as belonging to *P. lineare* Linn. which was described as *laeves.* It has been customary to accept Burmann's *Panicum lineare* Fl. Ind. 25, pl. 10, fig. 2 (fig. 3 of the plate) as typifying the Linnaean species but this can not be adhered to as it did not make its appearance until 6 years after Linnaeus had published his *P. lineare.* Burmann uses the Linnaean diagnostic description verbatim and the references to Sloane mentioned above, with the added remark:—"Specimina ex India missa variant spicis saepe binis linaeribus and flosculis alternis." Since Linnaeus assisted Burmann in the preparation of his Flora Indica, the above phrase seems to indicate that the former thought that the variable specimens from India were not typical of his *P. lineare* but could be referred to it; also it may be considered as more evidence that the original habitat "in Indiis" as given by Linnaeus did not include India but referred more especially to the East and West Indian Archipelagoes. It seems probable that fig. 2 (which is fig. 3 of the plate due to a transposition of the numbers) represents the variable plants of India mentioned in the supplementary paragraph. Hooker, Flora Br. India VII, 289, 1897 refers Burmann's *P. lineare* to *Cynodon Dactylon* (Linn.) Pers. I have seen specimens of the latter from India that might be said to be fairly well represented by Burmann's figure if it may be viewed in the light of a *very crude drawing.* The Index Kewensis, Vol. II, 415, 1895, refers it to *Paspalum brevifolium* Fluegge; but Hooker, l, c., 18, describes this species as with *geminate* flowers, one sessile and the other pedicelled which is at wide variance with Burmann's figure, and the Linnaean description. The Index Kewensis recognizes *Panicum glabrum* Gaud. as a valid species; also *P. lineare* Linn. as a valid species of N. America but I am unable to interpret it.

The Linnaean description as compared with modern day descriptions is rather incomplete; in so far as it goes, however, it is characteristic of the plant that has generally been known as *Panicum glabrum* Gaud. Likewise, by the process of eliminating all related species which it can not possibly be, we gradually come to the same species, *Panicum glabrum* Gaud. The last sentence of the Linnaean description referring to the exterior glume spreading and adhering to the rachis is not always apparent but I have seen just such a condition in some specimens of *Digitaria humifusa* collected in Michigan. This species is not usually accredited to the "Indies" in botanical manuals but Hooker l. c., 17, gives it for the Himalaya Mts. and as far south as Simla, and the Index Kewensis to North Temperate and Tropical regions. Perhaps Linnaeus was misinformed as to its distribution and as happened in other cases with him, gave accordingly a wrong habitat. The more important synonyms are given below.

Digitaria linearis (Linn.) Pers. Syn. 1, 85, 1805; Crep. Man. ed. 2, 335, 1866. *Panicum linearis* Linn. Sp. Pl. Ed. 2, Vol. 1, 85, 1762; Burm. Fl. Ind. 25 pl. 10 fig. 2 (3), 1768; Krock. Fl. Siles. 1, 95, 1787. *Syntherisma linearis* (Linn.) Nash, Bull. Torr. Bot. Club, XXII, 420. 1895. *Panicum Ischaemum* Schreb. ex Schweigg. Spec. Fl. Erlang, I, 16, 1804. *Digitaria humifusa* Pers., l. c. *Paspalum ambiguum* Lam. and D. C., Fl. Fr. III, 16, 1805. *Syntherisma glabrum* Schrad. Fl. Germ. 163, t. 3. fig. 7, 1806.

I wish to thank Dr. Nieuwland of Notre Dame for courtesies shown me in connection with this study.

Department of Botany,
Park, Davis & Co., Detroit, Mich.

Our Sparrows.

BY BROTHER ALPHONSUS, C. S. C.

In this article I have not made an exhaustive study of each species, but have given their more striking characteristics as these were learned through observation. As the Song Sparrow is the commonest of all our sparrows, as well as the most gifted as a songster, I have written a fuller account of this species. Four sparrows—Henslow's, Lark, Swamp, and Savanna—are either rare or very rare; and so I have not attempted to write even a brief biography of these species. The most that could be said of them would be to set down the few records which I have made of these sparrows, and that I have already done in previous articles.

Song Sparrow.

Melospiza fasciata.

Observations of this species will show many differences in different years. I shall not attempt here to note all the various records I have made of the species for many years but have selected the months from October 1912 to April 1913 for special study.

The song season of this sparrow gradually draws to a close at the end of August; but after a month of silence, about the 1st of October, when there are often fine days, some loud notes of the species may be heard for a few days. And later in the month, even as late as the 20th, a few feeble notes will occasionally be heard. After that date only call-notes are uttered, and during November the Song Sparrow may not be recorded frequently. In December 1912, I made two records of the species—on December 5, and 14. Previous to the first date, the bird had not been seen since November 25; and after the second date, there were no more records during the winter months.

Very often the Song Sparrow will begin to sing a little, late in February, but in 1913 the first subdued notes were heard on the 11th of March. The next day three were heard, one singing louder than the others. On March 13, I heard the fine notes of a Song Sparrow in the same place and in the same manner as an individual of the species had sung last year. All this would seem to indicate that the same bird had returned again to the same locality. The Song Sparrow is a great lover of water, and his matchless strain will be heard oftenest near lakes and streams.

The Song Sparrow is the favorite song bird of many bird lovers. This is probably so both because of its long song season and the quality of its notes. Strong, clear, varied, melodious—these are characteristics of the Song Sparrow's singing. An absence of the plaintive element that is so evident in such species as the Field and Vesper Sparrows, makes the Song Sparrow a blithe and cheery songster. The abundance of this species gives the student of bird music an excellent opportunity to appreciate its powers of song. As the birds usually sing in the vicinity of their nests, it is easy to become acquainted with a number of Song Sparrows within a limited area. And one of the most striking things about these sparrows is the superiority of some as singers over others of the same species. Another characteristic of this sparrow is its confiding disposition. Often an observer may approach very near a singing Song Sparrow without disturbing it in the least. Frequently I have passed beneath them in low trees, and not intimidated them.

This confidence in man that is so remarkable a trait of the Song Sparrow is also shown by the place it may select as the site for its nest. Usually placed on the ground, but sometimes in a very small tree or in large flower stalks, the nest is not seldom near a path or in a garden where people pass frequently. And the nest may be examined without undue anxiety on the part of the old birds, which will do no more than utter their characteristic call-note nearby. I am inclined to believe that this sparrow may have three broods, for I found a nest which was occupied by the young birds until August 23, 1918. There were three fledglings in the nest. On the morning of the 24th, as I approached the vicinity of the nest, I heard the call-notes of the young birds and the old, and I at once concluded that the nest must be vacant. On examination I found that it was empty. The nest was well constructed of twigs as the outer part, which was lined within by grasses. A heavy rain the day before did nothing more than wash out the nest.

Vesper Sparrow.

Poocaetes gramineus.

The Vesper Sparrow's date of migration in spring is about the same as that of the Chipping Sparrow—late in March or early in April. And it also resembles the latter species in not being abundant until the end of April. The sweet, continuous strain of the Vesper Sparrow has often been noted by writers on bird life; yet as compared with the matchless melody of the Song Sparrow the performance is inferior. Perhaps the plaintive quality of the song is its most pleasing feature; sweetness, too, it has to a marked degree. This bird is an inhabitant of the outlying fields and the pastures, where from fence post or tree near the roadside its strains are wafted on the breezes. In the evening several Vesper Sparrows may be heard singing in different parts of a farm, and the effect of the song at such a time is suggestive of the peacefulness of country life. The bird nests on the ground, but conceals the location so well that few observers ever find the site. This sparrow has the habit of running ahead of a person who may approach it; and when finally flashed, it always shows in flight the outer white tail feathers. In flying, it goes swift and low, with a slightly undulating movement.

Field Sparrow.

Spizella pusilla.

The Field Sparrow is an early arrival in spring, coming some years in the last week in March. It begins to sing on the first day of its appearance, or rather one will likely hear the bird before seeing it. The Field Sparrow inhabits both fields and woods, where its plaintive notes may be heard almost continuously. There is less variety in the Field Sparrow's song than in the Vesper's or Song Sparrow's, but the quality of the notes is hardly less inferior to that of those famous songsters. The call-note of this species resembles that of the Tree Sparrow. So much alike are these two sparrows that beginners will for some time find it difficult to distinguish between them. The Field Sparrow departs for the south about the same time as the Tree Sparrow arrives here from the north. Autumn records of the Field Sparrow are rare after October 15. The nest of this bird is placed on the ground, and can be discovered by watching the old birds carry food to their young. When the fledlings have left the nest, families of Field Sparrows may be frequently found. I have noted partial abinoes in this species more than in any other.

Chipping Sparrow

Spizella socialis.

The Chipping Sparrow usually arrives in the early part of Apil, but I have found as many as ten days difference between dates of arrival. At first the species is not abundant, being seen mostly in pairs or singly. Rarely a small flock of Chipping Sparrows may be seen in spring. The note of this sparrow may be heard as soon as the bird comes. In quality the song is the least pleasing of all the sparrows. But what it lacks in musical powers it more than makes up for by its charming disposition. Perhaps there is no other bird that is so sociable as the Chipping Sparrow. This fearlessness makes it easy to study the species. The nest is usually placed low in bushes or small evergreens, where the eggs or young may be observed without annoying the old birds. For some unaccountable reason many abandoned nests of this species may be discovered. In some places the Chipping Sparrow is rarely found, and it surprised me to be told by a friend who is an excellent observer that this bird is hardly ever seen in what is known as the Chicago Area.

Tree Sparrow.
Spizella monticola.

The Tree Sparrow arrives here from the north usually in the latter part of October, and remains until early in April. However, there are long periods, especially when the snow is deep, in which no Tree Sparrows appear. One winter, after December 5, the species was absent 47 days. In winter these sparrows are never abundant; small flocks or only several are usually found. In late autumn, and especially in early spring, the Tree Sparrow is most common. About March 20, the first notes of their beautiful song may be heard; it resembles somewhat that of the Goldfinch, but is stronger and sweeter. When a number sing together in some hedge-row, the effect is very fine. The song season of the Tree Sparrow is brief—about three weeks. Some springs when the weather is very inclement these birds rarely sing. I remember one spring which was so cold that I did not hear the song once.

White-Throated Sparrow.
Zonotrichia albicollis.

This beautiful sparrow first appears in our latitude about the third week in April, and tarries with us until early in May. In autumn it returns the first week in October, and stays until the end of the month. The White-throats are partial to the ground, where they feed among the dead leaves. Here an observer may obtain a good view of their markings, which are so harmoniously blended that he can not fail to be pleased with them. Both in spring and autumn, the species is probably the most abundant of all sparrows. It has a trustful disposition, and will invade city parks in great numbers. There is a peculiar, plaintive quality in the notes of the White-throated Sparrow, and little variety, so that the song is not notably fine.

WHITE-CROWNED SPARROW.

Zonotrichia leucophrys.

This handsome sparrow is thought by some bird lovers to be as beautiful as the White-Throated Sparrow. The erect posture the White-Crowned Sparrow takes when perched in some low tree or in a hedge gives an observer an excellent opportunity to admire the striking appearance of the bird. Its arrival in spring occurs in the early part of May, and in autumn about the middle of October.

Some years I have failed to make any records in autumn, and even in spring this species is never common. I have known one good observer who never made a record of the White-crowned Sparrow in this locality (northern Indiana). The song of this sparrow is seldom heard; and while somewhat similar in quality to that of the White-throated Sparrow, I think it is fuller and stronger.

FOX SPARROW.

Passerella iliaca.

This is the largest of our sparrows. It arrives early in April, and remains two or three weeks before finally disappearing. Autumn records of the species are usually rare. I have found the Fox Sparrow quite locally distributed; and when its habitat is found, the birds may be seen frequently during their stay with us. The song may not be heard at all during some springs; but usually a regular observer will some cool morning be cheered by the strong, musical notes of the Fox Sparrow.

GRASSHOPPER SPARROW.

Ammodramus savannarum passerinus.

This small and somewhat elusive sparrow is an inhabitant of clover or alfalfa fields. Here it becomes quite abundant, but strange to say is usually over-looked even by keen observers. I daresay that rarely will any but the most painstaking persons find this species without the help of some one who knows the bird well. Its appearance is not remarkable, and a clear view of its markings will be necessary to be sure of its identification. I have never found the Grasshopper Sparrow before May, but I believe it must arrive in April. The note of this sparrow is another difficulty to the beginner, for hardly will the uninitiated take the feeble utterance of the Grsshopper Sparrow for the song of a bird.

NOTE

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THE EDITOR, Notre Dame, Indiana.

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VOL. VI. SEPTEMBER, 1919. NO. 5,

The Missouri Muhlenbergias.---III.

BY BENJAMIN FRANKLIN BUSH.

IOWA:

Ames, *Ball* 113, August 5, 1896, M. B. G. Herb. No. 79950;
Ames, *Ball* 113, August 5, 1896, M. B. G. Herb. No. 79904;
Ames, *Hitchcock*, August, 1889, M. B. G. Herb. No. 79922;
Ames, *Hitchcock*, date not given, M. B. G. Herb. No. 79960;
Armstrong, *B. S.*, September, 1895, M. B. G. Herb. No. 79749
Armstrong, *Cratty*, August 21, 1897, M. B. G. Herb. No. 79910;
Dakota City, *Pammel*, August 8, 1896, M. B. G. Herb. No. 79951;
Iowa City, *Hitchcock*, August, 1888, M. B. G. Herb. No. 79911;
Ledyard, *Pammel* and *Cratty* 760, August 28, 1897, M. B. G. Herb. No. 79921;
Ledyard, *Pammel* and *Cratty* 760, August 28, 1897, M. B. G. Herb. No. 79925;
Ledyard, *Pammel* and *Cratty* 760, August 28, 1897, M. B. G. Herb. No. 80106;
Ledyard, *Pammel* and *Cratty* 760, August 28, 1897;
Mount Pleasant, *Mills* 13, 1894, M. B. G. No. 79927;
Muscatine, *Mackenzie* 781, September 26, 1894;
Sioux City, *Wakefield*, August 30, 1887, M. B. G. Herb. No. 79949;
Tabor, *Pammel* 778, September 20, 1897, M. B. G. No. 79906;
Tabor, *Pammel* 778, September 20, 1897, M. B. G. Herb. No. 79917;
Webster City, *Pammel* 274, June 15, 1895, M. B. G. Herb No. 79948;

West Union, *Whitmere* 248, July 6, 1896, M. B. G. Herb. No. 79947;
Winterset, *Carver*, date not given, M. B. G. Herb. No. 79924.

WISCONSIN:
LaCrosse, *Hale*, 1861, M. B. G. Herb. No. 75629;
Mirror Lake, *Eggert*, August, 24, 1903, M. B. G. Herb. No. 82672;
Prairie du Chien, *Hale*, 1861, M. B. G. Herb. No. 75648;
St. Croix, *Hale*, M. B. G. Herb. No. 79956;
St. Croix, collector not given, but probably *Hale*, date not given, M. B. G. Herb. No. 79699.

MINNESOTA:
Detroit, *Seymour*, August 24, 1884, U. Ill. Herb.;
Lake Minnetonka, *Glatfelter*, October 3, 1898, M. B. G. Herb. No. 80089;
Sandy Lake, *Sandberg* 783, August 12, 1891, U. Ill. Herb.;
Spirit Lake, *Geyer*, September, 1838, M. B. G. Herb. No. 79685.

KANSAS:
Manhattan, *Norton*, September, 1893, M. B. G. Herb. No. 79926;
Manhattan, *Norton*, October 22, 1892, M. B. G. Herb. No. 79940;
Riley County, *Norton* 596, September 3, 1895, M. B. G. Herb. No. 79946.

NEBRASKA:
Along the Missouri to the Mountains, *Hayden*, July 8, 1854, M. B. G. Herb. No. 79681:
Fort Union, *Hayden*, 1855, M. B. G. Herb. No. 79684;
Fort Union, *Hayden*, date not given, M. B. G. Herb. No. 79964;
Nuckolls County, *Hedgcock* 348, July, 1886, M. B. G. Herb. No. 79807;
Nuckolls County, *Hedgcock*, July 3, 1899, M. B. G. Herb. No. 79806;
Omaha, *Eastman*, October 1, 1915, U. Ill. Herb.;
Thomas County, *Rydberg* 1762, September 13, 1893, U. Ill. Herb.
Without definite locality, *Hayden*, 1853-54, M. B. G. Herb. No. 82657.

DAKOTA:

Without definite locality, *Vasey*, 1888, M. B. G. Herb. No. 79912.

SOUTH DAKOTA:

Brookings, *White*, August 3, 1908, M. B. G. Herb. No. 79802;
Brookings, *White*, August 3, 1908, M. B. G. Herb. No. 79803.

NORTH DAKOTA:

Benson County, *Lunell*, August 5, 1906;
Benson County, *Lunell*, August 26, 1906, U. S. A. Herb.;
Fargo, *Seymour*, August 23, 1884, U. S. A. Herb.;
Grand Falls, *Brannon*, 52, July 1, 1886, M. B. G. Herb. No. 79905;
Lake Ibsen, *Lunell*, July 29, 1900, U. S. Herb. No. 746130.

ALABAMA:

Without definite locality, *Buckley*, date not given. M. B. G. Herb. No. 79955.

OKLAHOMA:

Snyder, *Eggert*, September 19, 1903, M. B. G. Herb. No. 82673;
Snyder, *Eggert*, September 18, 1903, M. B. G. Herb. No. 82674.

TEXAS:

Without definite locality, *Reverchon* 1677, October 25, 1874, M. B. G. Herb. No. 80108.

NEW MEXICO:

Animas Creek, *Metcalfe*, 1142, July 13, 1904, M. G. B. Herb. No. 79801;
Animas Creek, *Metcalfe*, 1142, July 13, 1904, M. B. G. Herb. No 79824;
Dona Ana County, *Wooton* and *Standley* 3342, September 25, 1908;
Lucero's Ranch, *Ellis* 18, August 10, 1914, M. B. G. Herb. No. 760268;
Mesilla Park, *Standley*, September 29, 1906, M. B. G. Herb. No. 80103;
Picos, *Standley*, 4921, August 15, 1908, M. B. G. Herb. No. 79823;
River Mimbres, *Bigelow*, November 5, 1851, M. B. G. Herb. No. 79966;

Without definite locality, *Fendler*, 965, 1847, M. B. G. Herb. No. 79682;
Without definite locality, *Fendler*, 966, 1847, M. G. B. Herb. No. 79683;
Without definite locality, *Fuller*, date not given, M. B. G. Herb. No. 78953;
Without definite locality, *Wright* 1888, 1851-52, M. B. G. Herb. No. 79680.

COLORADO:

Black Cañon, *Baker* 686, August 11, 1901, M. B. G. Herb. No. 79918;
Boulder Cañon, *Daniels* 526, August 21, 1906, No. B. G. Herb. No. 80077;
Brighton, *Johnston* 389A, September 15, 1908, M. B. G. Herb. No. 80102;
Cañon City, *Brandegee* 3457, 1872, M. B. G. Herb. No. 79725;
Cañon City, *Brandegee* 970, 1874, M. B. G. Herb. No. 79724;
Colorado Springs, *Chase* 5279, August 28 to September 5, 1908, U. S. A. Herb.;
Deer Run, *Baker* 910, August 21, 1901, M. B. G. Herb. No. 79919;
Denver, *Holm* September 14, 1889, U. S. A. Herb.;
Denver, *Holm*, August 6, 1898, U. S. A. Herb.;
Denver, *Holm*, July 15, 1899, M. B. G. Herb. No. 778843;
Fort Collins, *Pammel*, June 29, 1896, M. B. G. Herb. No. 79952;
Fort Collins, collector not given, October 2, 1896, M. B. G. Herb. No. 79945;
Manitou, *Glatfelter*, September 9, 1905, M. B. G. Herb. No. 80087;
Manitou, *Glatfelter*, September 9, 1905, M. B. G. Herb. No. 80121;
Manitou, *Letterman*, August 11, 1884, M. B. G. Herb. No. 772774;
Mountain Valley, *Brandegee* 603, August, 1873, M. B. G. Herb. No. 79724;
Rocky Mountains, *Hall*, 1862, M. B. G. Herb. No. 79910.

WYOMING:

Sundance Mountain, *Chase* 5270, August 25, 1908, U. S. A. Herb.

MONTANA:

Billings, *Seymour*, September 4, 1884, U. S. A. Herb.

WASHINGTON:

Spokane County, *Suksdorf* 947, July 12, 1889, M. B. G. Herb. No. 79959;

Without definite locality, *Tracy*, date not given, M. B. G. Herb. No. 79916;

Without definite locality, collector and date not given, M. B. G. Herb. No. 79928.

ARIZONA:

Nagle's Ranch, *Jones* 6056, September 20, 1894, M. B. G. Herb. No. 80073;

St. John's, *Griffiths* 5182, August 9, 1903, U. S. A. Herb.

NEVADA:

Humboldt Pass, *Watson* 1288, September, 1868, M. B. G. Herb. No. 79613.

UTAH:

Without definite locality, *Jones* 6033, 1894, M. B. G. Herb. No. 79942.

7. MUHLENBERGIA COMMUTATA (Scribner) Bush, n. sp.

Muhlenbergia Mexicana commutata Scribner. Rhodora *9:* 18. 1907.

"Panicles much longer and larger than those of M. MEXICANA; lemmas awned; awns 4-10 mm. long; otherwise much as in *M. Mexicana*."

New York, Delaware, Pennsylvania, Illinois and Minnesota, Scribner, l. c.

Vermont and New York to South Dakota, south to Virginia, Nebraska, Missouri and Oklahoma.

SPECIMENS EXAMINED:

VERMONT:

Rutland, *Kirk*, 974, September 9, 1913, U. S. Herb. No. 725390.

NEW YORK:

Fulton, *Rowlee*, August, 1888, M. B. G. Herb. No. 79739;

Oxford, *Coville*, August 29, 1884, U. S. Herb. No. 295258.

ONTARIO:

Gault, *Herriot*, 80, August 31, 1901, U. S. Herb. No. 952416;

Pelee Point, *Macoun* 26245, August 5, 1901, U. S. Herb. No. 952415.

NEW JERSEY:

Hoboken, collector and date not given, U. S. Herb. No. 746217.

PENNSYLVANIA:

Easton, *Garber*, 1890, U. S. Herb. No. 265677;

Susquehanna, *Kneucker* 315, August, 1901, U. S. Herb. No. 587196;

Susquehanna, *Porter*, August 8, 1895, U. S. Herb. No. 952387;

Susquehanna, *Kneucker* 315, August, 1901, M. B. G. Herb. No. 79740.

VIRGINIA:

Bedford County, *Curtiss*, September, 1873, U. S. Herb. No. 746218;

Bedford County, *Curtiss*, September, 1873, M. B. G. Herb. No. 79727.

ILLINOIS:

Peoria, *McDonald*, September, 1900, U. S. Herb. No. 746214;

Wady Petra, *Chase*,1540, August 4, 1907, U. S. Herb. No. 645418;

Without definite locality, *Wolf*, 1882, U. S. Herb. No. 952377.

MISSOURI:

Gates, *Standley*, 9382, August 26, 1912, U. S. Herb. No. 688298, in part, the plant marked B on this sheet;

Whiteside, *Davis*, 1030, September 11, 1911, U. S. Herb. No. 673932.

MICHIGAN:

South Lockwood, *Dodge* 17, October 2, 1911, U. S. Herb. No. 952373.

IOWA:

Iowa Lake, *Beatty*, August 27, 1897, M. B. G. Herb. No. 75587;

Johnson County, *Snyder*, September, 1886, M. B. G. Herb. No. 75604.

Mount Pleasant, *Mills* 860, August, 1897, U. S. Herb. No. 328112.

MINNESOTA:

Fort Snelling, *Mearns* 749, September 1, 1891, U. S. Herb. No. 952392.

NEBRASKA:

Weeping Water, *Williams*, date not given, U. S. Herb. No. 952390.

South Dakota:

Iroquois, collector not given, August 15, 1874, M. B. G. Herb. No. 79708;

Tacoma Park, *Griffiths* 780, September 11, 1897, U. S. Herb. No. 79708;

Tacoma Park, *Griffiths* 780, September 11, 1897, U. S. Herb. No. 952394.

Oklahoma:

Verdigris, *Bush* 770, August 2, 1894, M. B. G. Herb. No. 79633;

Verdigris, *Bush* 771, October 5, 1894, M. B. G. Herb. No. 79632.

8. Muhlenburgia glabiflora Scribner, Rhodora 9: 22. 1917. Culms terete, very minutely scabrous for a short distance below the nodes; panicles 2-6 cm. long, occasionally somewhat glomerate, the closely flowered short branches appressed, usually partly enclosed in the subtending leaf-sheaths; spikelets ovate-lanceolate; glumes lanceolate, acute or acuminate-pointed, subequal, a little shorter than, as long as, or a little longer than the lemma, scabrous on the keel excepting near the base; lemmas ovate or oblong, obtuse or submucronate-pointed, scabrous on the heel and lateral nerves above, otherwise smooth, no hair at the base; palea ovate-oblong, obtuse, equalling on a little shorter than the lemma.

Pennsylvania and Maryland, west to Illinois, Missouri and Texas

Specimens Examined:

Pennsylvania:

Wissahickan Creek, *Smith* 84, August, U. S. Herb. No. 952386

Maryland:

Hyattsville, *Scribner*, 1888, U. S. Herb. No. 746131.

Illinois:

Mascoutah, *Welsch*, 1862-1871, U. S. A. Herb.;

Taylorville, *Andrews*, September 10, 1898, U. S. A. Herb.

Missouri:

St. Louis, *Engelmann*, 1842, M. B. G. Herb. No. 79662.

9. Muhlenbergia Mexicana (L.) Trin. Gram. Unifl. 189. 1824.

Agrostis Mexicana L. Mant. 1: 31. 1767.

Agrostis laterflora Michx. Fl. Bor. Am. 1: 53. 1803.

Agrostis clandestina Sprengel, Mont. 1: 32. 1807.

Cinna Mexicana (L.) Beauv. Agrost. 32. 158. 1812.

Trichochloa Mexicana (L.) Grin. Fund. Agrost. 117. 1820.

Muhlenbergia clandestina (Spreng.) Trin. Gram. Unifl. 190. 1824.

Muhlenbergia polystachya Scribner, l. c. 1907, not of Mackenzie and Bush, 1902.

Muhlenbergia polystachya Hitchcock, Gray's New Manual, ed. 7. 127. 1908, not M. &. B.

Muhlenbergia foliosa Nash, Britton and Brown, Illustrated Flora, 2nd ed. 185. 1913, not *M. foliosa* Trin. 1824.

Muhlenbergia Mexicana Trin., Bush in Flora of Jackson County Missouri, No. 862, 1885; Tracy in Flora of Missouri, No. 1642, 1886; Eggert in Catalogue of Plants of St. Louis, Missouri, 1891.

Muhlenbergia Mexicana (L.) Trin., Mackenzie and Bush in Manual of the Flora of Jackson County, Missouri, No. 2, 1902, Palmer in Catalogue of Plants of Jasper County, Missouri, Nos. 1388, 2686, 2797, 3463, 3467 and 3475, 1916.

Muhlenbergia Mexicana filiformis Vasey, Bush in Flora of Jackson County, Missouri, No. 863. 1885.

Muhlenbergia Mexicana filiformis Gray. Eggert in Catalogue of Plants of Saint Louis, Missouri, 1891.

Muhlenbergia Mexicana filiformis Muhl., Tracy in Flora of Missouri, No. 1644, 1886.

N. B. to Ont. S. Dak. and southward, Hitchcock in Manual.

N. B. to W. Ont., N. Car., Tenn., Nebr. and the Ind. Terr., Nash in Flora.

N. B. to Wyo., S. Dak., N. Car., and Texas, Nash in Illustrated Flora.

Massachusetts to North Dakota, south to Alabama and northeastern Texas.

Specimens Examined:

Massachusetts:

Granville, *Seymour* 2, September 15, 1913, M. B. G. Herb. No. 746678;

Norquit, *Sturtevant*, August 31, 1888, M. B. G. Herb. No. 75588;

South Warmington, *Sturtevant* September 11, 1890, M. B. G. Herb. No. 75577;

South Warmington, *Sturtevant*, September 11, 1890, M. B. G. Herb. No. 75576;

South Warmington, *Sturtevant*, September 17, 1890, M. B. G. Herb. No. 75575;

Walpole, *Greenman*, 3236, September 26, 1897, M. B. G. Herb. No. 742290.

CONNECTICUT:

South Canaan, *Greenman* 3229, October 3, 1897, M. B. G. Herb. No. 742285.

Irvin Lakes, *Greenman* 2453, September 25, 1910, M. B. G. Herb. No. 738434.

NEW YORK:

Bergen, collector not given, August 30, 1915, U. S. A. Herb.;

Buffalo, *Clinton* 9272, date not given, M. B. G. Herb. No. 75572;

Ithaca, *Pearce*, October 6, 1883, U. S. Herb. No. 152897;

Ithaca, *Treleare*, August 19, 1878, M. B. G. Herb. No. 75605;

Lebanon Springs, *Harrison*, September 25, 1890, U. S. Herb. No. 952387:

New York, *Coville*, September 24, 1884, U. S. Herb. No. 295257;

New York, *Gerard*, 1882, U. S. Herb. No. 952388;

Western New York, *Gray*, date not given, M. B. G. Herb. No. 75626.

ONTARIO:

Fredericktown, *Fowler*, 1878, U. S. Herb. No. 259605;

Gault, *Herriott* 81, August 31, 1901, U. S. Herb. No. 952412.

NEW JERSEY:

Sussex County, *Mackenzie* 2434, October 16, 1906, M. B. G. Herb. No. 75668.

DELAWARE:

Centreville, *Commons*, October 5, 1873, M. B. G. Herb. No. 75570.

PENNSYLVANIA:

Easton, *Porter*, September 2, 1895, U. S. Herb. No. 952385;

Germantown, *Scribner*, September 28, 1875, U. S. Herb. No. 746128;

Graeff's Landing, *Heller* 4815, September 14, 1901, U. S. Herb. No. 4406273;

Graeff's Landing, *Heller*, September 14, 1901, M. B. G. Herb. No. 75642;

Lancaster, *Heller* 4819, September 12, 1900, U. S. Herb. No. 406277;

Lancaster, *Small*, date not given, U. S. Herb. No. 746125;

Lancaster, *Small*, May, 1891, U. S. Herb. No. 298410;

Mountville, *Eby*, July 8, 1891, M. B. G. Herb. No. 75633;

Philadelphia, *Digyn*, date not given, M. B. G. Herb. No. 79975;

Philadelphia, *Scribner* 105, September, 1875, U. S. Herb. No. 746128;

Westchester, *Deane*, date not given, U. S. Herb. No. 746116;

Westchester, *Deane*, 1827, M. B. G. Herb. No. 82681;

Williamsport, *McMinn*, 1867, U. S. Herb. No. 952384.

MARYLAND:

Chevy Chase, *Mosher*, September 15, 1915, U. S. A. Herb.;

Great Falls of the Potomac, *Ball* 73, September 4, 1899, U. S. Herb. No. 952406;

Great Falls of the Potomac, *Ball* 73, September 4, 1898, M. B. G. Herb. No. 75589.

DISTRICT OF COLUMBIA:

Deanewood, *Chase* 3006 1-2, September 9, 1905, U. S. Herb. No. 746115;

Deanewood, *Chase* 3006 1-2, September 9, 1905, U. S. A. Herb.

High Island, *Dewey* 121, September 7, 1894, U. S. Herb. No. 491691;

High Island, *Dewey* 121, September 7, 1894, U. S. Herb. No. 490690;

Hyattsville, *Holm*, September 18, 1897, M. B. G. Herb. No. 779206;

Long Bridge, *Blanchard*, September 28, 1891, U. S. Herb. No. 311999;

Mount Pleasant, *Chase* 279, September 7, 1905, U. S. Herb. No. 952405;

Potomac Flats, *Ball* 712, October 20, 1906, M. B. G. Herb. No. 952407;

Washington, *Wheeler*, September 20, 1906, U. S. Herb. No. 952404.

OHIO:

Athens, *Ball*, September 21, 1902, U. S. Herb. No. 952382;

Central Ohio, *Sullivant*, date not given, M. G. G. Herb. No. 75624;

Cincinnati, *Lloyd* 574, September 16, 1890, M. B. G. Herb. No. 75624;
Cleveland, *Greenman* 3249, July 29, 1896, M. B. G. Herb. No. 742082;
Liverpool, *Holm*, September 18, 1912, U. S. A. Herb.;
London, *Sharp* 6790, September, October, U. S. Herb. No. 952383;
Sheffield, *Ricksecker* 203, September 25, 1901, U. S. Herb. No. 217632;
St. Marys, *Kneucker* 203, September 25, 1901, U. S. Herb, No. 557160;
St. Marys, *Kneucker* 203, September 25, 1901, M. B. G. Herb. No. 75582.

VIRGINIA:
Waterloo, *Pollard* 757, October 18, 1895, U. S. Herb. No. 307244;
Without definite locality, *Pech*, date not given, U. S. Herb. No. 952408.

WEST VIRGINIA:
Aurora, *Steele* and *Steele*, August 30, 1898, U. S. Herb. No. 359404;
Goose Creek, *Donnell-Smith*, September 8, 1879, U. S. Herb. No. 490294;
Sweet Springs, *Steele* and *Steele* 317, September 15, 1903, M. B. G. Herb. No. 75583;
Sweet Springs, *Steele* and *Steele* 317, September 15, 1898, U. S. Herb. No. 490294.

INDIANA:
Clark County, collector and date not given, U. S. Herb. No. 722787;
Lafayette, *Dorner* 222, September 15, 1901, U. S. Herb. No. 952381;
Russellville, *Grimes* 790, September 11, 1911, U. S. Herb. No. 952380;
Wells County, *Deam*, September 12, 1897.

TENNESSEE:
Knoxville, *Ruth* 807, June, 1888, M. B. G. Herb. No. 75567.

KENTUCKY:
Bell County, *Kearney* 366, September, 1893, U. S. Herb. No. 952418;

Bell County, *Kearney* 366, September, 1893, U. S. Herb. No. 746132;

Bell County, *Kearney* 366, September, 1893, U. S. Herb. No. 822929;

Wasiota, *Kearney* 366, September, 1883, M. B. G. Herb. No. 75631;

Without definite locality, *Short*, 1840, M. B. G. Herb. No. 75607.

ILLINOIS:

Kankakee, *Crampton* 547, September 11, 1913, U. S. Herb. No. 750683;

Mascontah, *Welsch*, 1867-1871, U. S. A. Herb.;

Mount Carmel, *Schneck*, 1879, U. S. Herb. No. 952373;

Mount Carmel, *Schneck*, October, 1879, U. S. A. Herb.;

Mount Carmel, *Schneck*, September 25, 1881, U. S. A. Herb.;

Mount Carmel, *Schneck*, September 8, 1879, U. S. A. Herb;

Peoria, *Brendel*, date not given, U. S. A. Herb.;

Taylorville, *Andrews*, August 2, 1888, U. S. A. Herb.;

Taylorville, *Andrews*, September 12, 1858, U. S. A. Herb.;

Urbana, *Gates*, October 6, 1907, U. S. Herb. No. 645175;

Urbana, *Gibbs*, September 26, 1898, U. S. A. Herb.;

Urbana, *Gibbs* September 27, 1888, U. S. A. Herb.;

Wabash County, *Schneck*, September 18, 1880, U. S. A. Herb.;

Wabash ,County *Schneck*, September 18, 1880. U. S. Herb. No. 746117;

Wady Patra, *Chase* 200, August 31, 1888, U. S. Herb. No. 746123;

Wady Petra, *Chase* 200, August 31, 1888, U. S. Herb. No. 952378;

Wady Petra, *Chase* 1166, September 25, 1904, U. S. Herb. No. 952373:

Wady Petra, *Chase* 1166, September 25, 1904, U. S. Herb. No. 580931;

Wady Petra, *Chase* 1267, September 23, 1806, U. S. Herb. No. 952374;

Without definite locality, *Engelmann*, August, 1883, M. B. G. Herb. No. 79660, the plant marked 1 on this sheet, but I can not be sure that the label cited belongs to the plant marked 1.

MISSOURI:

Aberden, *Davis* 963, September 11, 1911, M. B. G. Herb. No. 709401;

Aberden, *Davis* September 24, 1911, M. B. G. Herb. No. 709375;

Allenton, *Letterman*, August, 1879, M. B. G. Herb. No. 772776;

Clarksville, *Davis* 1117, September 24, 1911, U. S. Herb. No. 673972;

Clarksville, *Davis*, September 24, 1911, M. B. G. Gerb. No. 709316;

Clay County, *Mackenzie* 790, September 21, 1895, M. B. G. Herb. No. 75677;

Clay County, *Mackenzie* 945, September 21, 1895;

Courtney, *Bush* 1154, September 10, 1901, M. B. G. Herb. No. 75568;

Creve Coeur Lake, *Glatfelter* September 11, 1894, M. B. G. Herb. No. 75654;

Creve Coeur Lake, *Glatfelter*, September 17, 1900, M. B. G. Herb. No. 75655;

Creve Coeur Lake, *Kellogg* 29, September 25, 1901, U. S. Herb. No. 950197;

Dodson, *Hoffman* September 10, 1916;

Dodson, *Hoffman* September 10, 1916;

Dodson, *Mackenzie*, May 8, 1875, M. B. G. Herb. No. 75676;

Forest Park, *Glatfelter* 613, September 20, 1891, M. B. G. Herb. No. 75653;

Forest Park, *Glatfelter* 643, September 20, 1891, M. B. G. Herb. No. 75651;

Gates, *Standley* 9382, August 26, 1912, U. S. Herb. No. 688288, in part, the plant marked A on this sheet;

Hannibal, *Davis* 1106, September 19, 1911, M. B. G. Herb. No. 709121;

Hannibal, *Davis* 1106, September 19, 1911, U. S. Herb. No. 673964;

Hannibal, *Davis* 1410, October 18, 1911, M. B. G. Herb. No. 708745;

Jackson County, *Bush* 1726, September 14, 1890, M. B. G. Herb. No. 75673;

Jackson County, *Bush* 1880, September 14, 1890, M. B. G. Herb. No. 75675;
Jackson County *Bush* September 27, 1893, M. B. G. Herb. No. 75678;
Jasper, *Palmer* 1388, September 12, 1909, M. B. G. Herb. No. 75670;
Jasper, *Palmer* 1388, September 12, 1909, M. B. G. Herb. No. 756904;
Jefferson Barracks, *Eggert* September 4, 1877, M. B. B. Herb. No. 739682;
Jefferson Barracks, *Eggert*, September 4, 1897, M. B. G. Herb. No. 75658;
Jefferson Barracks, *Eggert* September 4, 1877, M. B. G. Herb. No. 739940;
Kansas City, *Stigall* 49, October 20, 1902, M. B. G. Herb. No. 75672;
Lee's Summit, *Mackenzie* 419, September 9, 1901;
McDonald County, *Bush*, September 1, 1893, M. B. G. Herb. No. 75672;
Oakwood, *Davis* 130, October 6, 1911, M. B. G. Herb. No. 756896;
Scotland, *Palmer* 2686, September 12, 1909, M. B. G. Herb. No. 75652;
Scotland, *Palmer* 2686, September 12, 1909, M. B. G. Herb. No. 757605;
Shannon County, *Bush*, October 21, 1893, M. B. G. Herb. No. 75671;
Shannon County, *Bush*, October 21, 1893, M. B. G. Herb. No. 75673;
Sheffield, *Mackenzie* 563, October 18, 1901;
Sibley, *Mackenzie* 563, October 2, 1901;
Springfield, *Weller* 53, September 13, 1890, U. S. Herb. No. 950196;
St. Louis, *Eggert* 223a, October 7, 1897, U. S. Herb. No. 950195;
St. Louis, *Pammel*, October, 1886, M. B. G. Herb. No. 79335;
St. Louis County, *Eggert*, September 11, 1897, M. B. G. Herb. No. 75640;
St. Louis County, *Eggert*, September 11, 1877, M. B. G. Herb. No. 739939;

St. Louis County, *Eggert*, September 11, 1877. M. B. G. Herb. No. 739388;
St. Louis County, *Eggert*, September 11, 1877, M. B. G. Herb. No. 75657;
St. Louis County, *Eggert*, September 11, 1877, M. B. G. Herb. No. 75641;
Swan, *Bush* 460, September 24, 1899, M. B. G. Herb. No. 75574;
Swope Park, *Mackenzie* 437, September 13, 1901;
Turner, *Standley* 9851, September 5, 1912, U. S. Herb. No. 688766;
Webb City, *Palmer* 2797, September 29, 1909, M. B. G. Herb. No. 75656;
Webb City, *Palmer* 2757, September 29, 1909, M. B. G. Herb. No. 756902;
Webb City, *Palmer* 3463, September 17, 1911, U. S. A. Herb.;
Webb City, *Palmer* 3463, September 17, 1911, M. B. G. Herb. No. 709108;
Webb City, *Palmer* 3463, September 17, 1911, M. B. G. Herb. No. 756899;
Webb City, *Palmer* 3463, September 17, 1911, M. B. G. Herb. No. 709021;
Webb City, *Palmer* 3463, September 17, 1911, M. B. G. Herb. No. 756900;
Webb City, *Palmer* 3475, September 17, 1911, M. B. G. Herb. No. 709006;
Webb City, *Palmer* 3475, September 17, 1911, M. B. G. Herb. No. 756903;
Webb City, *Palmer* 3475, September 17, 1911, M. B. G. Herb. No. 756901;
Whiteside, *Davis* 1030, September 11, 1911, M. B. G. Herb. No. 709077;
Whiteside, *Davis* 1010, September 11, 1911, M. B. G. Herb. No. 709228;
Whiteside, *Davis* 1011, September 11, 1911, U. S. A. Herb.;
Whiteside, *Davis* 1030, September 11, 1911, U. S. Herb No. 673932;
Whiteside, *Davis* 1011, September 11, 1911, U. S. Herb. No. 673925;

Without definite locality, collector not given, August, 1881, M. B. G. Herb, No. 75625.

North Carolina:

Biltmore, *Biltmore Herbarium* 657b, September 12, 1898, M. B. G. Herb. No. 75603;

Biltmore, *Biltmore Herbarium* 657b, September 12, 1898, U. S. Herb. No. 335376;

Magnetic City, *Wetherby* 24, September 20, 1895, U. S. Herb. No 952410;

Mountains of North Carolina, *Boynton*, 1888, U. S. Herb. No. 852411;

Without definite locality, *Boynton*, date not given, U. S. Herb. No. 746129.

Iowa:

Amana, *Schadt* 657, September 21, 1897, M. B. G. Herb. No. 75601;

Carroll, *Simon* 1018, September 21, 1897, M. B. G. Herb. No. 75635;

Chariton, *Mallory* 799, October 2, 1897, U. S. Herb. No. 75634;

Dakota City, *Pammel* 211, August 8, 1896, M. B. G. Herb. No. 79615;

De Witt, *Pammel* 1451, September 9, 1898, M. B. G. Herb. No. 75593;

Dixon, *Snyder* 734, September 21, 1897, M. B. G. Herb. No. 75602;

Iowa City, *Hitchcock*, 1889, M. B. G. Herb. No. 75584;

Iowa City, *Hitchcock*, date not given, M. B. G. Herb. No. 75622;

Iowa City, *Hitchcock*, date not given, U. S. Herb. No. 733277;

Iowa City, *Somes* 3868, September 9, 1909, U. S. Herb. No. 672490;

Mount Ayr, *Beard* 638, September 25, 1897, M. B. G. Herb. No. 75595;

Mount Pleasant, *Mills*, 1894, M. B. G. Herb. No. 75620;

Mount Pleasant, *Mills*, 1894, U. S. Herb. No. 952397;

Mount Pleasant, *Mills*, 1894, M. B. G. Herb. No. 75598;

Mount Pleasant, *Mills*, 1894, U. S. Herb. No. 952397;

Mount Pleasant, *Mills*, 1894, U. S. Herb. No. 952398;

Mount Pleasant, *Mills*, 1894, U. S. Herb. No. 952399;

Mount Pleasant, *Mills* 17, 1894, M. B. G. Herb. No. 75599;
Mount Pleasant, *Mills* 17, 1894, M. B. G. Herb. No. 75597;
Mount Pleasant, *Mills* 860, 1897;
Mount Pleasant, *Mills* 860, August, 1897, M. B. G. Herb. No. 75596;
Mount Pleasant, *Mills* 860, August, 1897, M. B. G. Herb. No. 75600;
Mount Pleasant, *Mills* 860, August, 1897, M. B. G. Herb. No. 75660;
Mount Pleasant, *Mills* 860, August ,1897, M. B. G. Herb. No. 75663;
Muscatine, *Reppert*, September 6, 1887, M. B. G. Herb. No. 75616;
Sheldahl and Slater, *Pammel* 1465, September 17, 1898, M. B. G. Herb. No. 75591;
Turin, *Pammel*, September 8, 1894, U. S. Herb. No. 746124.

MINNESOTA:
Detroit, *Seymour*, August 22, 1884, U. S. A. Herb.;
Fort Snelling, *Mearns* 771, August 31, 1891, U. S. Herb. No. 952391;
Houston County, *Freiburg*, July, 1912, M. B. G. Herb. No. 763870;
St. Cloud, *Campbell* 1877, U. S. Herb. No. 952393.

KANSAS:
Cullison, *Norris* 218, September, 1887, M. B. G. Herb. No. 79833;
Manhattan, *Hitchcock* 3836, September 27, 1908, U. S. A. Herb. No. 952402;
Manhattan, *Hitchcock* 3836, September 27, 1908, U. S. A. Herb.
Manhattan, *Hitchcock* 3844, September 27, 1908, U. S. Herb. No. 952403;
Manhattan, *Norton*, October 11, 1892, M. B. G. Herb. No. 75608;
Manhattan, *Novigh*, October 2, 1887, M. B. G. Herb. No. 75609;
McFarland, *Hitchcock* 7831, October 17, 1910, U. S. Herb. No. 952400;
Riley County, *Norton* 592a, September 9, 1895, M. B. G. Herb. No. 75614;

Riley County, *Norton* 597a, September 9, 1895, U. S. Herb. No. 353373;

Rockport, *Bartholomew*, September 12, 1889, M. B. G. Herb. No.4767491.

NEBRASKA:

Omaha, *Eastman*, September 14, 1915, U. S. A. Herb.

SOUTH DAKOTA:

Oak Lake, *Griffiths* and *Schlosser* August, 1892, U. S. Herb. No. 210915;

Pearl Creek, *Thornber*, August 15, 1894, M. B. G. Herb. No. 75659;

Sioux Falls, *Thornber* August ,1882, M. B. G. Herb. No. 75632;

Trent, *Ball* and *Ball*, September 26, 1903, U. S. Herb. No. 952395.

NORTH DAKOTA:

Fargo, *Waldron*; August 14, 1890, U. S. Herb. No. 952396;

Fargo, *Waldron* and *Moons*, August 20, 1901, U. S. Herb. No. 406356;

Pembina, *Havard* 3, date not given, U. S. Herb. No. 152896.

ALABAMA:

Without definite locality, *Buckley*, September, 1841, M. B. G. Herb. No. 79664.

ARKANSAS:

Fulton, *Bush* 980, September 19, 1900, M. B. G. Herb. No. 75588.

OKLAHOMA:

Ottawa, *Stevens* 2458, August 27, 1913, U. S. A. Herb.;

Sapulpa, *Bush* 772, September 21, 1894, M. B. G. Herb. No. 75610;

Sapulpa, *Bush* 1396, September 27, 1895, M. B. G. Herb. No. 75612;

Stillwater, *Waugh*, September 6, 1893, M. B. G. Herb. No. 75611;

Stillwater, *Waugh* 2146, September 27, 1893, M. B. G. Herb. No. 75613.

TEXAS:

Dallas, *Reverchon* 1054, October 1880, U. S. Herb. No. 822932, labelled M. MEXICANA FILIFORMIS by Reverchon, and M. FOLIOSA AMBIGUA by Hitchcock.

Dallas, *Reverchon* 2330, date not given, M. B. G. Herb. No. 82679;
Dallas, *Reverchon* 2330, date not given, M. B. G. Herb No. 75538;
Dallas, *Reverchon* 2330, date not given, M. B. G. Herb No. 75568;
Granbury, *Reverchon* 4110, September 7, 1903, M. B. G. Herb. No. 75664;
Without definite locality, *Reverchon* 1054, date not given, M. B. G. Herb. No. 75661.

10. MUHLENBERGIA FOLIOSA Trin. Gram. Unifl. 190. 1824.
Agrostis filiformis Willd. Enum. Hort. Berol. 1: 95. 1809,
Agrostis filiformis Sprengel 1802.
Agrostis foliosa hortulana R. &. S. 2: 373. 1817.
Agrostis filiformis Muhl. Gram. 66. 1817, not *Agrostis filiformis* Sprengel 1802.
Trichochloa Coliosa Trin. Fund. Agrost. 117. 1820.
Cinna filiformis (Willd.) Link, Enum. Mort. Berol. 1: 70. 1821.
Agrostis lateriflora filiformis (Willd.) Torr. Fl. 1: 86. 1824.
Muhlenbergia Mexicana filiformis (Willd.) Scribner, Mem. Torr. Club 5: 36. 1894.
Muhlenbergia Mexicana of American authors in large part, not Trinius 1824.
Muhlenbergia Mexicana Nash in part in Illustrated Flora, not of Trinins 1824.
Muhlenbergia ambigua Hitchcock in part in Manual, not M. AMBIGUA Torrey 1843.

Me. to Ont. S. Dak. and southward, Hitchcock in Manual. Not recognized by Nash in Flora.

Not recognized by Nash in Illustrated Flora.

Maine and Quebec, westward to North Dakota and Wyoming, southward to North Carolina and Arizona.

SPECIMENS EXAMINED:

MAINE:
Auburn, *Merrill* 13, August, 1898, U. S. Herb. No. 952483;
Bangor, *Knight* 3, August 7, 1904, U. S. Herb. No. 952474;
Bradley, *Briggs* 10, September, 1891, U. S. Herb. No. 952479;
Brownfield, *Merrill* 18, August 24, 1896, U. S. Herb. No. 952484;

Cumberland, *Chamberlain* 453, September 6, 1902, U. S. Herb. No. 746194;
Dover, *Fernald* 526, September, 1891, U. S. Herb. No. 952480;
Foxcraft, *Fernald* 523, September 5, 1894, U. S. Herb. No. 952482;
Foxcraft, *Fernald* 523, September 5, 1894, U. S. Herb. No. 952482;
Madison, *Fernald* 529, August 1, 1892, U. S. Herb. No. 952481;
Orono, *Fernald* 524 September 13, 1890, U. S. Herb. No. 952473;
Orono, *Harvey* and *Harvey* 1270, June 1890, U. S. Herb. No. 952511;
St. Francis, *Fernald* 170, August 18, 1893, M. B. G. Herb. No. 75630;
St. Francis, *Fernald* 170, August 18, 1893, U. S. Herb. No. 204116;
St. Francis, *Fernald* 170, August 18, 1893, U. S. Herb. No. 822926.

QUEBEC:
Montreal, *Mohr*, August 10, 1883, U. S. Herb. No. 722799.

NEW HAMPSHIRE:
Manchester, *Batchelder* September 25, 1910, U. S. Herb. No. 952476;
Peterboro, *Deane* and *Batchelder*, August 30, 1910, U. S. Herb. No. 952476;
Peterboro, *Deane* and *Batcheldr*, August 30, 1910, U. S. Herb. No. 952477;
Wolfsborough, *Conant*, September, 1881, U. S. Herb. No. 952475.

VERMONT:
Burlington, *Jones* 1678, September 8, 1892, U. S. Herb. No. 647813;
Rutland, *Kirk* 1032, August 15, 1913, U. S. Herb. No. 725801;
Rutland, *Kirk* 1033, August 15, 1913, U. S. Herb. No. 725802.

MASSACHUSETTS:
Essex County, *Conant*, 1879, U. S. Herb. No. 952472;
Framingham, *Smith*, September, 1894, M. B. G. Herb. No. 79914;
South Hadley, *Cook*, 1887, U. S. Herb. No. 277074;

Southampton, collector and date not given, M. B. G. Herb. No. 785517.

RHODE ISLAND:

Limestone Rock, *Greenman* 2528, October 2, 1910, M. B. G. Herb. No. 740428.

Providence, *Olney* September, U. S. Herb. No. 852471.

NEW YORK:

Hinckley, *Mabeur* 3348, August 7, 1911, U. S. Herb. No. 952469;

Ithaca, collector not given, October 26, 1892, M. B. G. Herb. No. 75643;

Ithaca, collector not given, August 25, 1893, M. B. G. Herb. No. 75644;

Ithaca, *Rowles*, September 4, 1894, U. S. Herb. No. 952468;

Lake George, *Vasey* 1882, U. S. Herb. No. 952452;

Lebanon Springs, *Harrison*, September 19, 1890, U. S. Herb. No. 952470;

Oxford, *Coville*, September 11, 1885, U. S. Herb. No. 295252;

Pennyan, collector and date not given, but probably *Sartwell*, M. B. G. Herb. No. 75606;

Wayne County, *Mankensen*, October 8, 1869, U. S. Herb. No. 822927;

Western New York, *Gray*, date not given, M. B. G. Herb. No. 75643;

Western New York, *Gray*, date not given, M. B. G. Herb. No. 75623;

Western New York, *Gray*, date not given, M. B. G. Herb. No. 75627.

CANADA:

Without definite locality, *Shepard* date not given, M. B. G. Herb. No. 75628.

ONTARIO:

Birch Island, *Macoun* 26246, U. S. Herb. No. 952486;

Gault, *Herriott* 83, September 6, 1901, U. S. Herb. No. 952490;

Gault, *Merriott*, September 5, 1898, U. S. Herb. No. 952489;

Johnstone's Harbor, *Macoun* 26248, U. S. Herb. No. 952487;

Point Edward, *Macoun* 26247, U. S. Herb. No. 952485;

Point Pelee, *Dodge* 19, September 17, 1911, U. S. Herb. No. 952491;

Rockcliffe, *Macoun* 86177, August 10, 1911, M. B. G. Herb. No. 744523.

Our Flycatchers.

BY BROTHER ALPHONSUS, C. S. C.

WOOD PEWEE.

Myiochanes virens

Our commonest flycatcher is the Wood Pewee. Although it is found in greater abundance in woods and groves, yet the bird may also be heard in the shade trees on the streets of our smaller cities. No other flycatcher has so musical a note as the Pewee. All day long through spring and summer its silvery song may be enjoyed by the bird lover. This species arrives here after the middle of May and remains until late in September. During this month the song gradually ceases. The nest of the Pewee, which is saddled on a limb of any kind of tree, may not be easily seen. The structure is small and almost looks like a protuberance on the branch where it is placed. But a keen and practised eye will note the nest, which will soon be visited by the mother bird. After the young are fledged they make themselves conspicious by their querulous disposition, often darting after one another with great pugnacity. In flycatching the Pewee is fearless and graceful, sometimes passing within a few feet of a pedestrian. The presence of this interesting species is one of the notable features of our lawns and parks.

PHOEBE.

Sayornis phoebe

This flycatcher is common in some localities, and very rare or entirely absent in others. It is hard to explain this rarity or absence; for even when suitable nesting-places, like grottoes, are available, still the bird may avoid a certain territory during most of the spring and summer. In early spring, usually in the latter part of March, the first Phoebes appear, and they may be seen for several weeks afterward. The Phoebe is always the first of the fly catchers to arrive in spring and the last to leave in autumn. As already intimated this species builds its nest under some kind of shelter, like an outhouse or a bridge. Two broods are raised in the same nest, which is always lined with moss. The note of the Phoebe is less musical than the Pewee's; the bird is also less active and graceful in flight. Another characteristic difference between these two species is found in the fact that the Phoebe moves its tail while the bird is perched on a wire or a branch, but the Pewee never indulges in this flirtation. The Phoebe is slightly larger than the Pewee, and not so pleasing in appearance. The large black head of the Phoebe mars its form much.

Crested Flycatcher.

Myiarchus crinitus

This large and beautiful flycatcher is less common than is the Pewee or the Phoebe. The crest, yellow underparts, and chestnut-colored tail give the bird a striking appearance. It is mostly an inhabitant of the woods, and rarely nests in orchards. After the nesting-season the young birds and old ones move about seeking for food. Occasionally they may wander away from their habitat in the deep woods. Then their loud and rather weird-sounding note may be heard in some smaller grove or orchard. However, this species is most easily seen and heard early in May when it first arrives from the South, and before it enters into the deep woods to nest. It is partial to the tree tops, only descending when the lure of its prey brings it to a lower plane. On such occasions the bird may be seen to advantage, and its handsome appearance will challenge the admiration of the observer.

Alder Flycatcher.

Empidonex trailli alnorum

As its name indicates, this species is partial to marshy land, although some individuals prefer high places. I have known an Alder Flycatcher to nest for two seasons in a thick growth of mulberries at the edge of an orchard. I think, too, that such cases are not rare, for I have frequently heard the notes of this flycatcher in thick growths along road-sides. However, to find these birds in abundance you must visit a piece of lowland, where their characteristic note is constantly uttered.

Kingbird.

Tyrannus tyrannus.

Perhaps this flycatcher is better known than any other members of the family. Its habits are such as to attract more attention, while its large size and neat appearance also make the bird conspicuous. Of a general slate color, with a black head, white underparts, and the tail with a white band, the Kingbird is truly a handsome species. Usually the bird shows a preference for wires for perching places. Here it will dart out after insects, or make a sudden sally at any other passing bird. This habit of attacking birds, large or small, has gained for the species the name, Kingbird. According to some farmers the bee-martin, another of the Kingbird's names, is destructive of the life of bees. This is an over-statement of the case, however, for the number of bees taken by any Kingbird is comparatively small, and not sufficient to warrant shooting the birds. Like all of the flycatchers, the Kingbird bathes by dipping into the water. As it flies over the surface of a lake, the bird may dip several times, or it may fly from a perch, dip, and return to the perch again.

Least Flycatcher.
Empidonax minimus

This species is somewhat rare in our locality, and few individuals are found nesting here. It is more common in spring and autumn, when the birds may be seen perched on wire fences near road-sides. In many ways the Least Flycatcher is an under-study of the Phoebe. Like this species it moves its tail when at rest, and also choose similar places to perch. In movements, however, the Least Flycatcher is more active than the Phoebe. Another species that the Least Flycatcher closely resembles in appearance is the Alder Flycatcher, and even an experienced observer can hardly tell the two species apart, unless he hears the notes, which are quite distinctive. They are both about the same size, and their markings are indistinguishable even with field glasses.

Acadian Flycatcher.
Empidonex virescens

This is a bird of deep woods, where its note may be heard, but without usually seeing the singer. It loves the most secluded places in the very depths of the woods where the growth of small trees is thickest. Only a practised observer can readily see the bird, and then only as it flits to and fro flycatching. This is undoubtedly one of the most elusive of our birds, and few amateur bird students seem to find its habitat.

Yellow-bellied Flycatcher.
Empidonax flaviventris

The rarest of our flycatchers is the yellow-billed. Usually late in May a few individuals are seen by the keenest observers, and even they occasionally miss it altogether. In autumn it passes more rapidly south, and few records are made of this species by any bird students. I have never made a single record myself in autumn.

NOTE

Contributions on general and midland natural history will be gladly received. Papers on botany and allied subjects, zoology, geology and physical geography, should be addressed to the editor

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THE EDITOR, Notre Dame, Indiana

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Devoted to Natural History, Primarily that of the Prairie States

Published by the University of Notre Dame,
Notre Dame, Indiana

J. A. NIEUWLAND, C. S. C., Ph. D., Sc. D., Editor

CONTENTS

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The Missouri Muhlenbergias.---IV.

BY BENJAMIN FRANKLIN BUSH.

NEW JERSEY:

Califon, *Fisher*, September 7, 1897, U. S. Herb. No. 952450;
Califon, *Fisher*, September 7, 1897, U. S. Herb. No. 647188;
Califon, *Fisher*, September 7, 1897, U. S. Herb. No. 733809;
Cranberry Lake, *Mackenzie* 2434, September 16, 1906;
Sussex County, *Mackenzie* 2434, September 16, 1906, M. B. G. Herb. No. 75667.

PENNSYLVANIA:

Dillerville, *Porter*, September 16, 1859, U. S. Herb. No. 952451;
Lancaster, *Small*, September 24, 1889, U. S. Herb. No. 746186.

MARYLAND:

Garrett County, *Donnell-Smith*, September 26, 1879, U. S. Herb. No. 822931;
Garrett County, *Donnell-Smith*, September 26, 1879, U. S. Herb. No. 822932.

VIRGINIA:

Luray, *Steele* and *Steele* 125, U. S. Herb. No. 418475;
Luray, *Steele* and *Steele* 125, M. B. G. Herb. No. 75586.

INDIANA:

Lafayette, *Dorner* 68, September 7, 1902, U. S. Herb. No. 952461;
Miller's, *Chase* 662, September 21, 1897, U. S. Herb. No. 746119;
Miller's, *Umbach* 5119, October 2, 1909, U. S. Herb. No. 952458;
Pine, *Umbach* 5073, September 18, 1909, U. S. Herb. No. 952459;

Pine, *Umbach*, September 13, 1897, U. S. Herb. No. 351222;
Tolleston, *Chase* 334, September 23, 1898, U. S. Herb. No. 746120;
Tolleston, *Chase* 334, September 23, 1898, U. Ill. Herb.;
Tolleston, *Chase* 334, September 23, 1898, M. B. G. Herb. No. 75590;
Wells County, *Deam*, September 15, 1901, U. S. Herb. No. 952460.

KENTUCKY:

Without definite locality, *Short*, 1840, M. B. G. Herb. No. 75649.

ILLINOIS:

Algonquin, *Nason*, August 27, 1879, U. S. A. Herb.;
Apple River, *Pepoon* 611, August 18, 1908, U. Ill. Herb.;
Athens, *Hall* 1888, U. S. Herb. No. 952505;
Champaign County, *Burrill*, October, 1871, U. Ill. Herb.;
Joliet, *Skeels* 553, September 28, 1904, U. S. Herb. No. 952462;
Joliet, *Skeels* 553, September 28, 1904, U. S. Herb. No. 746122;
Joliet, *Skeels* 553, September 28, 1904, U. S. Herb. No. 646206;
Lewistown, *Pepoon*, August 1890, M. B. G. Herb. No. 767489;
Oregon, *Waite*, August 17, 1885, U. S. Herb. No. 490959;
Rockford, *Bebb*, date not given, U. S. Herb. No. 952453;
Without definite locality, *Ball*, date not given, U. S. Herb. No. 682507;
Without definite locality, *Gandoger*, 1904, M. B. G. Herb. No. 713648;
Without definite locality, *Wolf*, 1880, U. S. Herb. No. 952457;
Without definite locality, *Wolf*, 1881, U. S. Herb. No. 952455;
Without definite locality, *Wolf*, date not given, U. S. Herb. No. 952456.

NORTH CAROLINA:

Buncombe County, *Biltmore Herbarium* 657a, U. S. Herb. No. 335375.

MICHIGAN:

Cassville, *Dodge*, September 9, 1910, U. S. Herb. No. 952467;
Grindstone City, *Dodge*, September 1, 1912, U. S. Herb. No. 730523;
Imlay City, *Palmer*, September, 1880, U. S. Herb. No. 952465;
Port Austin, *Ball*, September 20, 1902, U. S. Herb. No. 952466.

IOWA:

Ames, *Ball* 115, August 5, 1896, M. B. G. Herb. No. 75618;
Ames, *Pammel* 114, August 8, 1896, M. B. G. Herb. No. 75617;
Clinton, *Pammel* 251, September 4, 1896, M. B. G. Herb. No. 75619;
Iowa City, *Hitchcock*, 1888, M. B. G. Herb. No. 75585;
Muscatine County, *Pammel* and *Reppert*, 1861, September 10, 1898, M. B. G. Herb. No. 79770;
Sheldahl, *Pammel, Hume* and *Sample* 1422, M. B. G. Herb. No. 75992;
Sheldahl, *Pammel, Hume* and *Sample* 1422, M. B. G. Herb. No. 75594.

WISCONSIN:

Left Foot Lake, *Schuette*, August 31, 1883, U. S. Herb. No. 751731;
Milwaukee, *Chase* 1948, August 11, 1902, U. S. Herb. No. 746118;
Williams Bay, *Umbach* 4696, September 2, 1909, U. S. Herb. No. 952460;
Williams Bay, *Umbach* 4721, September 3, 1909, U. S. Herb. No. 952463.

MINNESOTA:

Battle Lake, *Sheldon*, August, 1892, U. S. Herb. No. 952444;
Fergus Falls, *Sheldon*, August, 1892, U. S. Herb No. 952445;
Fort Snelling, *Mearns* 794, September 13, 1891, U. S. Herb. No. 952443;
Groveland, *Oswald*, 1911, U. S. Herb. No. 730775.

KANSAS:

Kingman County, *Carleton* 549, September 30, 1891, U. S. Herb. No. 952442;
Riley County, *Norton* 597, August 18, 1895, M. B. G. Herb. No. 75615.

NEBRASKA:

Big Sandy Creek, *Clements* 2848, August 9, 1893, U. S. Herb. No. 221806;
Central Nebraska, *Rydberg* 1686, August 12, 1893, M. B. G. Herb. No. 75636;
Natteck, *Rydberg* 1756, September 11, 1893, U. S. Herb. No. 208268;

Natteck, *Rydberg* 1764, September 13, 1893, U. S. Herb. No. 208267;

South Fork of Dismal River, *Rydberg* 1686, August 12, 1893, U. S. Herb. No. 208269;

Talmage, *Elmore* 92, August 6, 1896, U. S. Herb. No. 952441;

Thedford, *Rydberg* 1704, August 19, 1893, U. S. Herb. No. 208266.

South Dakota:

Bear Creek, *Over* 2335, September 1, 1913, U. S. Herb. No. 693343;

Mill City, *Griffiths* 723, August 27, 1897, U. S. Herb. No. 952448;

Huron, *Griffiths* 6, August 25, 1896, U. S. Herb. No. 952449.

North Dakota:

Devil's Lake, *Hitchcock* 5061, U. S. Herb. No. 952447;

Devil's River, *Hitchcock* 5061, U. Ill. Herb.

Manitoba:

Elm Park, *Macoun* 13213, August 11, 1896, U. S. Herb. No. 952488.

Mississippi:

Starkville, *Tracy* June 21, 1892, U. S. Herb. No. 952495.

New Mexico:

Socono County, *Metcalfe* 359, August 3, 1903, M. B. G. Herb. No. 75637;

Socono County, *Metcalfe* 359, August 3, 1903, U. S. Herb. No. 952494;

Socono County, *Metcalfe* 359, August 3, 1903, U. S. Herb. No. 495426;

Without definite locality, *Fendler* 764, M. B. G. Herb. No. 79687.

Colorado:

Denver, *Ward*, August 19, 1891, U. S. Herb. No. 152895.

Wyoming:

Tower, *Griffiths* 521, August 12, 1897, U. S. Herb. No. 952493.

Arizona:

Wilgus Creek, *Blumer* 1784, October 12, 1907, M. B. G. Herb. No. 75660;

Wilgus Creek, *Blumer*, October 20, 1907, U. S. Herb. No. 952491.

11. Muhlenbergia Torreyi (Kunth) Hitchcock, ined.

Agrostis diffusa Muhl. Gram. 64. 1817, not *Agrostis diffusa* Host. 1809.

Agrostis sylvatica Torr. Fl. U. S. 1: 87. 1824, not *Agrostis sylvatica* L. 1763.

Agrostis Torreyi Kunth. Enum. Pl. I: 226. 1838, replacing *Agrostis sylvatica* Torrey.

Muhlenbergia sylvatica (Torr.) Torr. Cat. Pl. N. Y. State, 188. 1840.

Muhlenbergia sylvatica gracilis Scribner, grans. scans. Acad. Sci. 9: 116. 1885, not *N. gracilis* Kanth, 1829.

Muhlenbergia umbrosa Scribner, Rhodora 9: 20. 1907.

Muhlenbergia umbrosa attenuata Scribner, Rhodora 9: 21. 1907.

Muhlenbergia sylvatica T & G., Bush in Flora of Jackson County, Missouri, No. 861, 1885; Tracy in Flora of Missouri No. 1646, 1886; Eggert in Catalogue of Plants of Saint Louis, Missouri, 1891; Mackenzie and Bush in Manual of the Flora of Jackson County, Missouri, No. 7, 1902; Daniels in Flora of Columbia, Missouri, No. 73, 1907.

Muhlenbergia sylvatica Torr., Palmer in Catalogue of Plants of Jasper County, Missouri, Nos. 218 and 3187. 1916.

Me. to Dak. and southward to Missouri and Kansas, according to Scribner, l. c.

N. B. to Ont. Ia. and southward, Hitchcock in Manual.

N. B. to Ont. Minn. N. Car. Tenn. Nebr. and the Ind. Terr., Nash in Flora.

Maine to Minnesota, south to Arizona, Virginia and Texas.

SPECIMENS EXAMINED:

MAINE:

Dover, *Fernald* 528, September 3, 1894, U. S. Herb. No. 952428;

Moscow, *Chamberlain*, August 29, 1902, U. S. Herb. No. 491269;

Orono, *Knight*, September 17, 1905;

St. Francis, *Fernald* 171, August 15, 1893, M. B. G. Herb. No. 79617.

MASSACHUSETTS:

Essex County, *Conant*, August ,1880, U. S. Herb. No. 952429;

Essex County, *Conant*, 1880, U. S. Herb. No. 952430;

South Hadley, *Cook* 1887, U. S. Herb. No. 277075;

Without definite locality, *Chapman*, date not given, M. B. G. Herb. No. 785595.

CONNECTICUT:

Windsor, *Bissell*, September 16, 1906, U. S. Herb. No. 952431.

NEW YORK:

Bergen, collector not given, August, 1887, U. Ill. Herb.;

Ithaca, collector not given, August 25, 1893, M. B. G. Herb. No. 79737;

Lake George, *Vasey*, 1882, U. S. Herb. No. 952432;

Lake George, *Vasey*, 1882, U. S. Herb. No. 952433;

North Hannibal, *Pearce*, September 13, 1883, U. S. Herb. No. 152900;

Pennyan, *Sartwell*, date not given, M. B. G. Herb. No. 79625,

Wayne County, *Mackenzen*, September 16, 1870, U. S. Herb. No. 822959.

NEW JERSEY:

Hoboken, collector and date not given, M. B. G. Herb. No. 79654;

Hoboken, collector and date not given, M. B. G. Herb. No 79626;

Stockholm, *Van Sickle*, August 1, 1895, U. S. Herb. No. 244234.

PENNSYLVANIA:

Germantown, *Digyn*, date not given, M. B. G. Herb. No. 79584;

Philadelphia, *Smith* 85, date not given, U. S. Herb. No. 552434;

Quakertown, *Moyer*, August, 1877, U. S. A. Herb.;

Without definite locality, *McMinn*, date not given, U. S. Herb. No. 952435.

MARYLAND:

Bradley Heights, *Chase* 6859, U. Ill Herb.

OHIO:

Milan, *Moseley*, August 27, 1894, M. B. G. Herb. No. 79588.

VIRGINIA:

Sweet Springs, *Steele* 298, September 12, 1903, M. B. G. Herb. No. 79743.

WEST VIRGINIA:

Goose Creek, *Donnell-Smith*, September 12, 1879, U. S. Herb. No. 822961;

Goose Creek, *Donnell-Smith*, September 12, 1879, U. S. Herb. No. 822961;
Sweet Springs, *Steele* and *Steele*, 298, September 12, 1903, U. S. Herb. No. 490276.

TENNESSEE:
Cocke County, *Kearney*, September 1, 1897, U. S. Herb. No. 952427;
Knoxville, *Ruth* 3, date not given, U. S. Herb. No. 952426;
Suwanee, *Eggert*, September 10, 1898, M. B. G. Herb. No. 79721;
Suwanee, *Eggert*, September 10, 1898, M. B. G. Herb. No. 79734.

ILLINOIS:
Athens, *Hall*, September, 1874, U. S. Herb. No. 952436;
Beardstown, *Geyer*, 1842, M. B. G. Herb. No. 79661;
Bluffs Lake, *Eggert*, September 24, 1875, M. B. G. Herb. No. 79735;
Edgemont, *Craig*, October 23, 1910, M. B. G. Herb. No. 82663;
Menard County, *Hall*, date not given, U. Ill. Herb.;
Mount Carroll, *Shimek*, October, 1891, U. S. Herb. No. 952438;
Oquawka, *Patterson*, September, 1898, M. B. G. Herb. No. 75662;
Peoria, *Brendel*, date not given, U. Ill. Herb.;
Peoria, *Brendel*, date not given, U. Ill. Herb.;
Peoria, *Brendel*, date not given, U. Ill. Herb.;
Princeville, *Chase* 941, October 14, 1900, M. B. G. Herb. No. 79747;
Princeville, *Chase* 941, October 14, 1900, U. S. Herb. No. 746215;
Taylorville, *Andrews*, August 24, 1898, U. Ill. Herb.;
Taylorville, *Andrews*, August 26, 1898, U. Ill. Herb.;
Taylorville, *Andrews*, August 27, 1898, U. Ill. Herb.;
Taylorville, *Andrews*, August 28, 1898, U. Ill. Herb.;
Taylorville, *Andrews*, September 10, 1898, U. Ill. Herb.;
Taylorville, *Andrews*, September 12, 1898, U. Ill. Herb.;
Urbana, *Gibbs*, September, 1898, U. Ill. Herb.;
Wabash County, *Schneck*, September 4, 1900, U. Ill. Herb.;

Without definite locality, *Andrews*, date not given, U. Ill. Herb.;

Without definite locality, *Engelmann*, date not given, M. B. G. Herb. No. 79660, in part the plant marked 3 on this sheet, but as there are 3 distinct species on this sheet, and 3 labels, it is impossible to tell which plants the labels belong to;

Without definite locality, *Wolf* 318, date not given, U. Ill. Herb.;

Without definite locality, *Wolf* 1882, U. S. Herb. No. 952437.

MISSOURI:

Aberdeen, *Davis*, September 24, 1911, U. S. Herb. No. 673648;

Allenton, *Letterman*, August, 1876, M. B. G. Herb. No. 772799;

Allenton, *Letterman*, September, 1892, M. B. G. Herb. No. 772902.

Bagnell, *Trelease*, September 22, 1897, M. B. G. Herb. No. 79742;

Carthage, *Palmer* 218, September 7, 1902, M. B. G. Herb. No. 756905;

Cliff Cave, *Norton*, August 26, 1899, M. B. G. Herb. No. 82694;

Columbia, *Tracy*, August 11, 1884, M. B. G. Herb. No. 79736;

Creve Coeur Lake, *Kellogg* 26, September 25, 1901, U. S. Herb. No. 950192;

Creve Coeur Lake, *Kellogg* 27, September 25, 1901, U. S. Herb. No. 750194;

Creve Coeur Lake, *Kellogg*, September 25, 1901, M. B. G. Herb. No. 79799;

Dodson, *Mackenzie*, September 26, 1896;

Gates, *Standley*, 9382, August 26, 1912, U. S. Herb. No. 688298, in part, the plant marked B on this sheet;

Ironton, *Russell*, August, 1897, M. B. G. Herb. No. 79723;

Jackson County, *Bush*, September 27, 1893, M. B. G. Herb. No. 80039;

Jefferson Barracks, *Eggert*, September 4, 1877, M. B. G. Herb. No. 767490;

Jefferson Barracks, *Eggert*, September 4, 1877, M. B. G. Herb. No. 79730;

Jefferson Barracks, *Eggert*, September 4, 1877, M. B. G. Herb. No. 739938;
Jefferson Barracks, *Eggert*, September 4, 1877, M. B. G. Herb. No. 79731;
Jefferson Barracks, *Eggert*, September 4, 1877, M. B. G. Herb No. 739938;
Jefferson Barracks, *Eggert*, September 4, 1877, M. B. G. Herb. No. 79839;
Jefferson Barracks, *Eggert*, September 4, 1877, N. D. Herb. No. 8388;
Monteer, *Bush* 4887, October 10, 1907, M. B. G. Herb. No. 79832;
Monteer, *Bush*,4887, October 10, 1907;
Sarcoxie, *Palmer* 3187, September 18, 1910, M. B. G. Herb. No. 757392;
Sarcoxie, *Palmer* 3187, September 18, 1910, M. B. G. Herb. No. 79804;
Sibley, *Bush* 4822, August 21, 1907, M. B. G. Herb. No. 79829;
Sibley, *Bush* 4822, August 21, 1907, U. S. Herb. No. 590886;
Sibley, *Mackenzie* 548, October 2, 1901;
Springfield, *Standley* 8546, August 31, 1911, U. S. Herb. No. 687497;
St. Louis, *Eggert* 226, August 3, 1877, U. S. Herb. No. 950193;
Swan, *Bush* 603, September 28, 1899, U. S. Herb. No. 362266;
Swope Park, *Mackenzie* 427, September 13, 1901;
Terre Bleue Creek, *Trelease*, August 30, 1898, M. B. G. Herb. No. 79745.

MICHIGAN:

Lapeer, *Dodge* 18, August 17, 1911, U. S. Herb. No. 952439.

IOWA:

Ames, *Bessey* October 18, 1872, M. B. G. Herb. No. 79748;
Clinton, *Pammel* 250, September 4, 1896, M. B. G. Herb. No. 79616;
Clinton, *Pammel* 250, September 4, 1896, U. S. Herb. No. 294631;
Dakota City, *Pammel* 111, August 8, 1896, M. B. G. Herb. No. 79727;
Dakota City, *Pammel* 111, June 29, 1886, U. S. Herb. No. 952440;

Fayette County, *Fink* 461, August, 1894, U. S. Herb. No. 230547.

MINNESOTA:

St. Anthony Park, *Oswald*, 1911, U. S. Herb. No. 730777.

KANSAS:

Manhattan, *Hitchcock*, October 21, 1892, M. B. G. Herb. No. 79614;

Manhattan, *Kellerman*, 1888, U. S. Herb. No. 228628;

McFarland, *Hitchcock* 7832, October 17, 1910, U. S. Herb. No. 952401;

Riley County, *Norton* 598, September 28, 1895, M. B. G. Herb. No. 79614;

Riley County, *Norton* 598, September 28, 1895, M. B. G. Herb. No. 353374.

NEBRASKA:

Red Cloud, *Bates*, September 13, 1906, U. S. Herb. No. 559653.

ARKANSAS:

Benton County, *Plank* 60, date not given, U. S. Herb. No. 952425;

Benton County, *Plank*, Summer, 1900, M. B. G. Herb. No. 82686;

Benton County, *Plank*, Summer, 1900, M. B. G. Herb. No. 82687;

Benton County, *Plank*, Summer, 1900, M. B. G. Herb. No. 82678.

TEXAS:

Dallas County, *Reverchon* 1050, September, 1873, M. B. G. Herb. No. 80080;

Without definite locality, *Nealley* 403, 1889, U. S. Herb. No. 952424, labeled *M. umbrosa* by Scribner;

Without definite locality, *Nealley*, 1890, U. S. Herb. No. 952414;

Without definite locality, *Reverchon*, date not given, M. B. G. Herb. No. 80114;

Without definite locality, *Reverchon*, date not given, M. B. G. Herb. No. 80115;

Without definite locality, *Reverchon*, date not given, M. B. G. Herb. No. 80116;

Without definite locality, *Reverchon* 31, 1885, U. S. Herb. No.

952423, labeled *M. sylvatica* var.—and *M. Willdenovii by* Scribner;

Without definite locality, *Reverchon* 71, U. S. Herb. No. 952413, labeled *M. sylvatica* and *M. sobolifera* by Scribner, and *M. Mexicana* by Hitchcock.

ARIZONA:

Grapevine Cañon, *Toumey* 168, July 30, 1891, U. S. Herb. No. 952422;

Without definite locality, *McDougal*, 1891, U. S. Herb. No. 952421.

12. MUHLENBERGIA POLYSTACHYA Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 23, 1902.

Muhlenbergia Mexicana Scribner, l. c., in part, not *M. Mexicana* Trin, 1824.

Muhlenbergia Mexicana Hitchcock in Manual in part, not *M. Mexicana* Trin. 1824.

Not mentioned by Nash in the Illustrated Flora. Missouri and Illinois to Wisconsin.

This species has been neglected or misunderstood since it was first described, and in order that my readers may see how very different it is from *M. Mexicana,* to which it has been referred by two agrostologists, I herewith present the original description;

M. POLYSTACHYA Mackenzie & Bush, n. sp. 2 feet high, erect, much branched; leaves 1 1-2 inches to 2 1-2 inches long, 1 line to 2 lines wide; panicles on peduncles 1 inch to 5 inches long, long-exserted, densely flowered, the lower branches separated; flowers nearly sessile, 1 line long; the glames as in the last (*M. Mexicana*); hairs at base of flowering glume copious, 1-3 to 1-2 length of glume. Open rocky woods east of Sibley. August-October.

SPECIMENS EXAMINED:

MISSOURI:

Sibley, *Bush*, October 14, 1901;

Sibley, *Bush* 4171, October 10, 1906, U. S. Herb. No. 950396, with lemmas awned;

Sibley, *Mackenzie* 637, October 14, 1901, TYPE.

ILLINOIS:

Fulton County, *Wolf*, date not given, U. S. Herb. No. 952504;

Urbana, collector not given, 1876, U. Ill. Herb.;

Wady Petra, *Chase* 1268, September 23, 1906, U. S. A. Herb.;

Wady Petra, *Chase* 1268, September 23, 1906, U. S. Herb. No. 952454.

WISCONSIN:

Ashland, *Hitchcock* 5095, September 27, U. S. Herb. No. 952500;

Without definite locality, *Wood*, 1887, U. S. Herb. No. 952501;

Without definite locality, *Wood*, 1887, U. S. Herb. No. 952502.

13. MUHLENBERGIA CUSPIDATA (Torr.) Rydberg, Bull. Torr. Club, 32: 599. 1905.

Vilfa cuspidata Torr.; Hook. Fl. Bov. Am. 2: 238. 1840.

Sporobolus cuspidatus (Torr.) Wood, Bot. & Fl. 385. 1870.

Sporobolus brevifolius Scribner, Mem. Torr. Club. 5: 39, 1894, in small part, not *Agrostis brevifolia* Nuttall 1818, nor *Muhlenbergia brevifolia* (Nutt.) Nash.

Sporobolus cuspidatus (Torr.) Wood, Mackenzie and Bush in Manual of the Flora of Jackson County, Missouri, No. 4. 1902; Daniels in Flora of Columbia, Missouri, No. 81, 1907, but very doubtful, as this species is not known to get as far east in Missouri. Dr. Daniels has omitted several very common species of *Sporobolus* from his Flora, and I suspect that one of these has been mistaken for *M. cuspidata*.

Wisc. to Mo. and southward, Hitchcock in Manual.

Mani. to the N. W. Terr. south to Mo. and Kans., Nash in Flora.

Mani. to Alberta, south to Mo. and Kans., Nash in Illustrated Flora.

Manitoba to Wisconsin, Northern Illinois, Missouri and Colorado.

SPECIMENS EXAMINED:

ALBERTA:

Calgary, *Hitchcock* 4977, September 19-22, 1909, U. Ill. Herb.

NORTH DAKOTA:

Leeds, *Lunell*, August 20, 1906, U. Ill. Herb.

WISCONSIN:

St. Peter's River, *Thurber*, date not given, U. Ill. Herb. No. 79663.

IOWA:

Ames, *Hitchcock*, date not given M. B. G. Herb. No. 79630.

ILLINOIS:

Joliet, *Hill* 185, September 6, 1906, U. Ill. Herb.;

Joliet, *Hill* 185, October 9, 1906, U. Ill. Herb.;

Will County, *Hill*, August 16, 1912, U. S. Herb. No. 950191, all these Illinois collections a notable eastern extension of the range of this species.

MISSOURI:

Atchison County, *Bush* 4233, August 5, 1893, U. S. Herb. No. 950190;

Cockrell, *Bush* 6479, September 23, 1911, U. S. Herb. No. 673563;

Greenwood, *Bush* 4125, September 19, 1906, U. S. Herb. No. 590408;

Jackson County, *Bush* 1879, August 24, 1891, M. B. G. Herb. No. 80043;

Watson, *Bush* 783, October 1, 1895, U. Ill. Herb.

KANSAS:

Decatur County, collector and date not given, M. B. G. Herb. No. 79631;

Riley County, *Norton* 595, July 26, 1895, M. B. G. Herb. No. 79635.

COLORADO:

Fort Collins, *Ball*, August 8, 1898, M. B. G. Herb. No. 82684.

NEW MEXICO:

"Cross L" Ranch, *Griffiths* 5461, August 21-24, 1903, M. B. G. Herb. No. 79813;

"Cross L" Ranch, *Griffiths* 5518, August 21-24, 1903, M. B. G. Herb. No. 79814;

Raton Mountains, *Griffiths* 5461, August 18-19, 1903, M. B. G. Herb. No. 79815.

2. PODOSEMUM Desvaux, nouv. Bull. Soc. Philom. 2. 189. 1810. *Muhlenbergia* in large part of American Authors, not of Schreber, 1791.

A large genus of 40 species or more, natives of America, comprising those species with more or less open, large panicles, the branches of which are either drooping or spreading, pedicals slender or capillary, lemmas long-awned, or occasionally short-awned or awnless.[1] A single species occurs in our territory.

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[1]The center of abundance of PODOSEMUM species seems to be in Western Texas, to which region *P. capillare* does not appear to extend, it being the center of a group of three species belonging to the South Atlantic region. In a subsequent paper I shall discuss some of the many allies of *P. capillare*.

1. Podosemum capillare (Lamarck) Desv. Nouv. Bull. Soc. Philom. 2: 188. 1810.

Stipa capillaris Lam. Tabl. Encycl. 1: 158. 1791.

Muhlenbergia capillaris (Lam.) Trin. Gram. Unifl. 191. 1824.

Muhlenbergia filipes Chapman, Fl. S. U. S. 603, 1897, in part, not M. filipes M. A. Curtis, 1843.

Muhlenbergia capillaris Kunth, Tracy in Flora of Missouri, No. 1640, as from Boone County, Missouri, collected by Galloway, but not given by Daniels in his Flora of Columbia, Missouri, 1907, and no specimens known from north of the Missouri River.

Muhlenbergia capillaris (Lam.) Trin., Palmer in Catalogue Plants of Jasper County, Missouri, No. 2828, 1916.

Central Texas to Fla. and Va., according to Dewey in Manual of the Plants of Western Texas.

Mass. to Fla. west to Mo. and Texas, Hitchcock in Manual.

Mass. N. J. and Mo. to Fla. the Ind. Terr. and Texas, Nash in Flora.

Mass. to Kans. Fla. and Texas, Nash in Illustrated Flora.

New Jersey southward along the coast to Florida, west to Texas, aud in the interior to Tennessee, Kentucky, Illinois, Southern Missouri and Oklahoma, therefore being largely a coast species; no specimens have been seen from east of New Jersey or west of Eastern Texas.

Specimens Examined:

New Jersey:

Atlantic County, *C. A. Gross*, September 3, 1897;

Millburn, *Mackenzie* 580, September 20, 1903;

Sussex County, *Mackenzie* 1121, September 25, 1904.

Maryland:

Glen Echo, *Steele*, September 25, 1904, U. S. A. Herb.;

Great Falls of the Potomac, *Ball* 72, September 4, 1899, M. B. G. Herb. No. 79791.

District of Columbia:

Great Falls of the Potomac, *Holm*, October 13, 1898, M. B. G. Herb. No. 779209;

Washington, *Ward*, September, 1875, M. B. G. Herb. No. 75887.

Virginia:

Bedford County, *Curtiss*, September, M. B. G. Herb. No. 772781;

Bedford County, *Curtiss*, September 1-20, 1873, M. B. G. Herb. No. 79774.

NORTH CAROLINA:

Biltmore, *Biltmore Herbarium* 656a, September 13, 1898, M. B. G. Herb. No. 79795;

Without definite locality, *Curtis*, date not given, M. B. G. Herb. No. 79651;

Without definite locality, *Curtis*, date not given, M. B. G. Herb. No. 80007.

GEORGIA:

Leslie, *Harper* 1723, October 8, 1902, M. B. G. Herb. No. 79786.

ALABAMA:

Mobile, *Mohr*, September, 1893, M. B. G. Herb. No. 79782.

FLORIDA:

Duval County, *Curtiss* 3401, September, M. B. G. Herb. No. 79775;

Gainesville, *Chase* 4269, September 30 to October 3, 1901, U. S. A. Herb.;

Jacksonville, *Curtiss* 3401, September, M. B. G. Herb. No. 80002;

Jacksonville, *Curtiss* 4049, October 6, 1893, M. B. G. Herb. No. 767219;

Jacksonville, *Curtiss* 4050, October 16, 1893, M. B. G. Herb. No. 767200;

Lake City, *Bitting* 785, September 8, 1892, M. B. G. Herb. No. 79796;

Lee County, *Gandoger*, September, 1900, M. B. G. Herb. No. 713891;

Sanibel, *Hitchcock* 466, July, August, 1900, M. B. G. Herb. No. 79789;

Without definite locality, collector and date not given, M. B. G. Herb. No. 79995;

MISSISSIPPI:

Biloxi, *Earle*, October 8, 1897, U. Ill. Herb.;

Biloxi, *Earle*, October 8, 1897, M. B. G. Herb. No. 79795;

Biloxi, *Tracy* 4637, October 4, 1898, M. B. G. Herb. No. 79794.

LOUISIANA:

Red River, *Hale*, date not given, M. B. G. Herb. No. 79601;
Without definite locality, *Hale*, date not given, M. B. G. Herb. No. 79699.

TENNESSEE:

Knoxville, *Ruth*, September, 1892, M. B. G. Herb. No. 773048;
Knoxville, *Ruth* October 6, 1894, M. B. G. Herb. No. 80093;
Knoxville, *Ruth*, October 6, 1894, U. Ill. Herb.;
Knoxville, *Ruth*, October, 1895, M. B. G. Herb. No. 79786;
Knoxville, *Ruth*, October, 1897;
Knoxville, *Ruth* 58, September, 1898, M. B. G. Herb. No. 79785;
Knoxville, *Ruth*, October, 1900;
Sharp Gap, *Ruth*, September, 1890, M. B. G. Herb. No. 773069.

KENTUCKY:

Without definite locality, collector and date not given, M. B. G. Herb. No. 79592.

ILLINOIS:

Union County, *Seymour*, 1881, U. Ill. Herb.

MISSOURI:

Eagle Rock, *Bush* 378, September 18, 1896, M. B. G. Herb. No. 80051;
Eagle Rock, *Bush* 378, September 18, 1896, M. B. G. Herb. No. 80118;
Eagle Rock, *Bush* 378, September 18, 1896, M. B. G. Herb. No. 294602;
Eagle Rock, *Mackenzie*, September 18, 1896;
Joplin, *Palmer* 2828, October 11, 1909, M. B. G. Herb. No. 756897;
Joplin, *Palmer* 2828, October 11, 1909, M. B. G. Herb. No. 756898;
McDonald County, *Bush*, September 1, 1893, M. B. G. Herb. No. 756898;
Monteer, *Bush* 5123, September 10, 1908, M. B. G. Herb. No. 756898;
Monteer, *Bush* 5123, September 10, 1908, M. B. G. Herb. No. 80057;

Monteer, *Bush* 5123, September 10, 1908, M. B. G. Herb. No. 606505;

Swan, *Bush* 642, September 29, 1899, M. B. G. Herb. No. 79776;

OKLAHOMA:

Fonts, *Blankenship* August 28, 1895, M. B. G. Herb. No. 79784;

Sapulpa, *Bush* 767, September 20, 1894, M. B. G. Herb. No. 80003.

TEXAS:

Bowie County, *Eggert* August 27, 1898, M. B. G. Herb. No. 79781;

College Station, *Nealley*, date not given, M. B. G. Herb. No. 79890;

Columbia, *Bush* 1546, October 17, 1900, M. B. G. Herb. No. 79788;

Corsicana, *Reverchon* 3540, September 27, 1902, M. B. G. Herb. No. 79888;

Corsicana, *Reverchon* 3540, September 27, 1902, M. B. G. Herb. No. 79777;

Corsicana, *Reverchon* 3540, September 27, 1902, M. B. G. Herb. No. 79783;

Corsicana, *Reverchon* 3540, September 27, 1902;

Grand Saline, *Reverchon* 2253, October 18, 1900, M. B. G. Herb. No 79790;

Grand Saline, *Reverchon* 2253, October 18, 1900, M. B. G. Herb. No. 79779;

Grand Saline, *Reverchon* 2253, October 18, 1900, M. B. G. Herb. No. 80070;

Polytechnic, *Ruth* 268, October 2, 1911, M. B. G. Herb. No. 710101;

Sheldon, *Reverchon* 4109, September 6, 1903, M. B. G. Herb. No. 79778;

Sheldon, *Reverchon* 4109, September 6, 1903, M. B. G. Herb. No 79889;

Without definite locality, *Drummond* 344, date not given, M. B. G. Herb. No. 79994.

Birds Observed at Notre Dame, Indiana, in the Spring of 1919.

BY BROTHER ALPHONSUS, C. S. C.

NAME OF BIRD	When was it first seen?	About how many were seen?	When was it next seen?	When did it become common?	When was it last seen?	Is it common or rare?	Does it breed near your station?	REMARKS
Bittern	May 4	1				Rare	No	Common in Summer
Blackbird, Crow	Mar. 10	1	Mar. 13	Mar. 15		Com.	Yes	
Blackbird, Red-winged	Mar. 12	2	Mar. 20	Mar. 23		Com.	Yes	
Bluebird	Feb. 28	2	Mar. 2	Mar. 13		Com.	Yes	
Bobolink	May 4	1	May 9	May 12		Com.	Yes	
Bobwhite	June 5	1				Rare	?	
Cardinal						Com.	Yes	Not a migrant
Catbird	May 4	2	May 5	May 10		Com.	Yes	
Cedarbird	May 22	3	May 24	May 29		Com.	Yes	
Chicadee					Apr. 19	Rare	No	Common in autumn
Coot								No Record this spring
Cowbird	Mar. 19	1	Mar. 24	Mar. 25		Com.	Yes	
Creeper, Brown					Apr. 12	Rare	No	
Crow						Com.	Yes	Not a migrant
Cuckoo, Black-billed	May 26	1	May 27	May 29		Rare	Yes	
Cuckoo, Yellow-billed	May 26	1	May 30	May 31		Com.	Yes	
Dickcissel	May 17	1	May 21	May 22		Com.	Yes	
Dove, Mourning	Mar. 25	1	Mar. 29	Mar. 30		Com.	Yes	
Finch, Purple					Apr. 21	Com.	No	A few remained last winter
Flicker	Apr. 3	1	Apr. 4	Apr. 5		Com.	Yes	
Flycatcher, Alder	May 24	1	May 25	May 30		Rare	Yes	
Flycatcher, Acadian	May 26	1				Rare	Yes	Found in dense woods
Flycatcher, Crested	May 9	1	May 12	Ma6 14		Com.	Yes	Nests iregularly
Flycatcher, Least	May 11	1	May 17	May 18		Rare	Yes,	

NAME OF BIRD	When was it first seen?	About how many were seen?	When was it next seen?	When did it become common?	When was it last seen?	Is it common or rare?	Does it breed near your station?	REMARKS
Gnatcatcher, Blue Gray								No record this spring
Goldfinch	Mar. 28	1	Mar. 31	Apr. 5		Com.	Yes	Rare in winter
Goose, Canada	Mar. 4.		Mar. 5				No	
Grosbeak, Rose-breasted	May 3	1	May 15	May 16	May 25	Rare	No	
Gull, Herring						Rare	No	Seen rarely at any time
Hawk, Red-shouldered	May 3	1	May 24	May 26		Rare	No	Breeds in outlying woods
Heron, Great Blue						Rare	No	No record this spring
Heron, Little Green	May 17	1	May 26			Rare	No	More in summer
Indigo Bird	May 11	1	May 15	May 16		Com.	Yes	
Jay, Blue						Com.	Yes	Not a migrant
Killdeer	Feb. 28	1	Mar. 12	Mar. 19		Com.	Yes	
Kingbird	May 5	2	May 18	May 24		Com.	Yes	
Kingfisher	Mar. 6	1	Mar. 16	Mar. 29		Rare		Breeds rarely
Kinglet, Golden-crowned	Apr. 2	1	Apr. 4	Apr. 8	Apr. 11	Com.	No	Golden-crown is more abundant than Ruby-crown
Kinglet, Ruby-crowned	Apr. 6	1	Apr. 8	Apr. 20	May 19	Com.	No	
Loon								No record this spring
Martin, Purple						Rare	No	No suitable nesting sites
Meadowlark	Mar. 1	4	Mar. 4	Mar. 11		Com.	Yes	
Nighthawk	May 6	1				Rare	No	
Nuthatch, White-breasted					Apr. 30	Com.	No	Reappeared June 15
Nuthatch, Red-breasted								No record this spring
Oriole, Baltimore	May 4	5	May 5	May 9		Com.	Yes	
Oriole, Orchard	May 10	1	May 12	May 13		Com.	Yes	
Osprey	May 27	1				Rare	No	
Ovenbird	May 6	1	May 14		May 26	Rare	No	
Owl, Screech	Mar. 21	1				Rare	?	No records in April and May
Pewee, Wood	May 14	1	May 15	May 18		Com.	Yes	
Phoebe	Mar. 20	1	Mar. 22	Mar. 24	May 24	Rare	No	Breeds some seasons

NAME OF BIRD	When was it first seen?	About how many were seen?	When was it next seen?	When did it become common?	When was it last seen?	Is it common or rare?	Does it breed near your station?	REMARKS
Plover, Upland								No records this spring
Redpoll								No records this spring
Redstart	May 6	4	May 9	May 24	May 27	Com.	No	Fewer this spring
Robin	Feb. 28	1	Mar. 1	Mar. 3		Com.	Yes	Has three broods here
Sandpiper, Spotted	Apr. 19	1	Apr. 20	Apr. 24		Com.	Yes	
Sandpiper, Solitary								No records this spring
Sapsucker	Apr. 6	4	April 7	Apr. 8	Apr. 29	Com.	No	
Shrike, Loggerhead	No records this spring					Rare	Yes	Limited distribution
Siskin, Pine								No records this spring
Snipe, Wilson								No records this spring
Snowbird					May 3	Com.	No	
Sparrow, Chipping	Apr. 7	1	Apr. 8	Apr. 9		Com.	Yes	
Sparrow, Field	Mar. 24	2	Mar. 30	Apr. 2		Com.	Yes	
Sparrow, Fox	Mar. 24	1	Apr. 1	Apr. 5	Apr. 7	Rare	No	
Sparrow, Grasshopper	Has a limited distribution					Com.	Yes	No records this sprin
Sparrow, Song	Sang early in February this year.					Com.	Yes	Common last winter
Sparrow, Tree					Mar. 20	Rare	No	
Sparrow, Vesper	Mar. 29	1	Apr. 4	Apr. 5.		Com.	Yes	
Sparrow, White-crowned	May 14	1	May 22		May 22	Rare	No	
Sparrow, White-throated	Apr. 21	1	Apr. 28	May 4	May 18	Com.	No	
Swallow, Barn	May 12	1	May 14	May 17		Com.	Yes	
Swallow, Rough-winged	May 4	5	May 20		May 21	Rare	No	
Swallow, Tree	May 21	5			May 21	Rare	No	
Swift, Chimney.	May 2	6	May 4	May 5		Com.	Yes	
Tanager, Scarlet	May 22	1	May 25			Rare	Yes	Female seen first
Thrasher, Brown	Apr. 10	1	Apr. 12	Apr. 15		Com.	Yes	
Thrush, Hermit	Apr. 1	1	Apr. 4	Apr. 11	Apr. 21	Com.	No	
Thrush, Olive-backed	May 4	1	May 5	May 20	June 5	Com.	No	

NAME OF BIRD	When was it first seen?	About how many were seen?	When was it next seen?	When did it become common?	When was it last seen?	Is it common or rare?	Does it breed near your station?	REMARKS
Thrush, Wood	May 26	2				Rare	No	Seen in a wood seven miles away
Titmouse, Tufted	May 14	1	May 15			Rare	No	Seen irregularly
Vireo, Blue-headed								No record this spring
Vireo, Red-eyed	May 8	1	May 16	May 17		Com.	No	Nests in deep woods
Vireo, Warbling	May 5	5	May 6	May 7		Com.	Yes	Commonest vireo here
Vireo, Yellow-throated	May 4	1	May 12		May 26	Rare	No	
Warbler, Bay-breasted	May 26	6			May 26	Com.	No	
Warbler, Black and White	May 5	1	May 6		May 7	Rare	No	
Warbler, Blackburnian	May 19	1	May 23		May 23	Com.	No	
Warbler, Black-poll	May 19	4	May 21	May 22	May 24	Com.	No	
Warbler, Black-throated Blue	May 9	1			May 9	Rare	No	Seen at Kokomo, Indiana
Warbler, Black-throated Green	May 4	1	May 15	May 19	May 23	Com.	No	
Warbler, Canadian								No records this spring
Warbler, Cape May								No records this spring
Warbler, Chestnut-sided	May 4	1	May 22		May 22	Com.	No	Fewer this spring
Warbler, Magnolia	May 19	3	May 21	May 22	May 27	Com.	No	Fewer this spring
Warbler, Mourning	May 30	1			May 30	Rare	No	
Warbler, Myrtle	Apr. 12	1	Apr. 13	Apr. 19	May 22	Com.	No	
Warbler, Nashville	May 4	1	May 16		May 23	Rare	No	
Warbler, Parula								No records this spring
Warbler, Orange-crowned								No records this spring
Warbler, Palm	May 4	1	May 5	May 6	May 17	Com.	No	
Warbler, Pine	May 4	1			May 4	Com.	No	Rare this spring
Warbler, Prairie								No records this spring
Warbler, Sycamore								No records this spring
Warbler, Tennessee	May 20	1	May 21		May 22	Com.	No	Rare this spring

NAME OF BIRD	When was it first seen?	About how many were seen?	When was it next seen?	When did it become common?	When was last seen?	common or rare?	Does it breed near your station?	REMARKS
Warbler, Wilson	May 22	1			May 22	Com.	No	Rare this spring
Warbler, Yellow	May 4	1	May 5	May 6		Com.	Yes	
Water-thrush, Louisiana								No records this spring
Whip-poor-will	Found in deep woods							No records this spring
Woodpecker, Downy	Six records this spring							Very rare in spring
Woodpecker, Hairy						Rare	No	No records this spring
Woodpecker, Red-headed	Did not migrate this year					Com.	Yes	Stayed all winter
Wren, House	Apr. 19	1	Apr. 20	Apr. 21		Com.	Yes	
Wren, Carolina								No records this spring
Wren, Long-billed Marsh								No records this spring
Yellowlegs								No record this spring
Yellowthroat, Maryland	May 5	1	May 6	May 18		Com.	Yes	

N. B.—The weather in May was unseasonable, and made the month disappointing to observers here.

An All-Day Bird Trip at Washington, D. C.

BY HARRY C. OBERHOLSER.

The spring of 1907 was a remarkable season for birds in the vicinity of Washington, D. C. Particularly was this the case with migrants, and in most other parts of the eastern United States these were also unusually numerous both in species and in individuals. It was the writer's privilege to make an all-day trip on May 13 of that year and the results seem worth a permanent record. For number of species observed in one day, it was, up to that time, the best record made by a single individual about the City of Washington and, in fact, there is to this day only one better.

The weather during much of the spring of 1907 was unusually cool, and this apparently had considerably retarded the general migration of the later species. May 13 was clear and decidedly cool, an ideal day for bird observation.

From the northern part of the City of Washington, the route followed was through the valley of Rock Creek to the National Zoological Park and Cleveland Park; thence by electric car through the city to the Anacostia River at the Anacostia Bridge; from there the route was by rowboat up the Anacostia River to a short distance above Bladensburg, Maryland, and back, with three short excursions on land at as many different points by the way. The return home from the Anacostia River was made by electric car through the city. The time occupied by this trip extended from 4:00 a.m. to 9:00 p.m. The distance covered was 32 miles, distributed as follows: by electric car 9, by boat 16, and on foot 7 miles.

The region traversed included almost all the different kinds of country found about Washington, and our excursion thus resulted in a representative list of birds.

The number of species observed on this day amounted to 103, with a total of 1846 individuals. The following species were unusually numerous for this locality: yellow-shafted flicker, Carolina chickadee, tufted titmouse, white-eyed vireo, American redstart, Maryland yellow-throat, and yellow warbler. From the actual number of individuals noted, the ten most numerous species were the song sparrow, English sparrow, catbird, American redstart, purple grackle, American crow, fish crow, Maryland yellow-throat, spotted sandpiper, and American goldfinch. Although the number of species seen was so large, it included very few of the rarer birds of this vicinity, that possibly of most interest being the blue-winged warbler. In view of the backwardness of the season, there were surprisingly few very late records made on this day. Two ducks, the golden-eye and pintail, however, were present later than in any previous or subsequent year, while the junco had remained also much beyond its ordinary date of departure.

In the following annotated list in order to show the differences in the conspicuousness of the various birds, the number of each species seen is given separately from those that were only heard. This is of further interest as showing how large a part the notes of birds play in their identification in the field.

1. Black-crowned Night Heron. *Nycticorax nycticorax naevius.*
   Common on parts of the Anacostia River. Number seen, 14.
2. Green Heron. *Butorides virescens virescens.*
   Two seen on Anacostia River near Bladensburg.
3. Great Blue Heron. *Ardea herodias herodias.*
   One seen in the same place as the last above named.
4. Greater Scaup Duck. *Marila marila.*
   Three were seen on the Anacotia River near Benning.
5. American Golden-eye. *Clangula clangula americana.*
   Three seen on the Anacostia River near Benning constitute the latest spring record for the species in the vicinity of Washington, the next latest occurrence being April 27, 1918.
6. Pintail. *Dafila acuta tzitzihoa.*
   A single individual seen on the Anacostia River is also the latest spring record for this species about Washington, the next latest being April 17, 1915.
7. American Merganser. *Mergus americanus.*
   Two seen on the Anacostia River.
8. Turkey Vulture. *Cathartes aura septentrionalis.*
   Common on the Anacostia River and in other parts of the more open country. Noted also early in the morning roosting in trees along Rock Creek. Number seen, 46.
9. American Osprey. *Pandion haliaetus carolinensis.*
   One seen on the Anacostia River.
10. Red-shouldered Hawk. *Buteo lineatus lineatus.*

Two seen and two others heard on the bottomlands of the Anacostia River.

11. Broad-winged Hawk. *Buteo platypterus platypterus.*
    One seen in the woods along Rock Creek in the Zoological Park.

12. Bob-white. *Colinus virginianus virginianus.*
    Two heard in the fields near Bladensburg.

13. Lesser Yellow-legs. *Neoglottis flavipes.*
    Two seen in the marshes along the Anacostia River.

14. Solitary Sandpiper. *Tringa solitaria solitaria.*
    Common along the Anacostia River, and noted also on Rock Creek; 13 seen.

15. Spotted Sandpiper. *Actitis macularia.*
    Abundant on the Anacostia River, and noticed also on Rock Creek; 48 seen; 5 heard.

16. Semipalmated Sandpiper. *Ereunetes pusillus.*
    A flock of 6 seen on the shore of Anacostia River.

17. Mourning Dove. *Zenaidura macroura carolinensis.*
    Two seen near the Anacostia River.

18. Northern Flicker. *Colaptes auratus luteus.*
    Noted in nearly all woodlands; 7 seen; 14 heard.

19. Red-headed Woodpecker. *Melanerpes erythrocephalus erythrocephalus.*
    Six heard, chiefly along Rock Creek.

20. Downy Woodpecker. *Dryobates pubescens medianus.*
    Two seen and one heard in the woods along the Anacostia River.

21. Belted Kingfisher. *Streptoceryle alcyon alcyon.*
    Three seen, one heard, on the Anacostia River.

22. Screech Owl. *Otus asio naevius.*
    One seen at its roosting hole in a tree along Rock Creek.

23. Ruby-throated Hummingbird. *Archilochus colubris.*
    One seen in the woods along the Anacostia River.

24. Chimney Swift. *Chaetura pelagica.*
    Common in the city and elsewhere along the route; 39 seen; 7 heard.

25. Wood Pewee. *Horizopus virens.*
    Noted along Rock Creek and in the woodlands bordering the Anacostia River; 2 seen; 7 heard.

26. Acadian Flycatcher. *Empidonax virescens.*
One seen and one heard along Rock Creek.

27. Least Flycatcher. *Empidonax minimus.*
Two heard in the woodlands along the Anacostia River.

28. Phoebe. *Sayornis phoebe.*
Two heard along Rock Creek.

29. Crested Flycatcher. *Myiarchus crinitus crinitus.*
Tolerably common both along Rock Creek and in the woodlands bordering the Anacostia River; 9 heard.

30. Kingbird. *Tyrannus tyrannus tyrannus.*
Noted only along the Anacostia River and on the adjoining uplands; 7 seen; 1 heard.

31. Brown Thrasher. *Toxostoma rufa rufa.*
Noted in various places along the route; 7 seen; 4 heard.

32. Catbird. *Lucar carolinensis.*
Numerous everywhere; 31 seen; 53 heard.

33. Bluebird. *Sialia sialis sialis.*
Noted in the outskirts of the city, and also on the uplands along the Anacostia River; 3 seen; 7 heard.

34. Southern Robin. *Planesticus migratorius achrusterus.*
Observed all along the Anacostia River; 1 seen; 20 heard.

35. Wilson Thrush. *Hylocichla fuscescens fuscescens.*
One heard in the woods along Rock Creek.

36. Gray-cheeked Thrush. *Hylocichla minima aliciae.*
One seen in the woods along the Anacostia River.

37. Olive-backed Thrush. *Hylocichla ustulata swainsoni.*
Tolerably common in the woodlands both along Rock Creek and the Anacostia River; 4 seen; 5 heard.

38. Wood Thrust. *Hylocichla mustelina.*
Abundant in all woodlands; 9 seen; 39 heard.

39. Blue-gray Gnatcatcher. *Polioptila caerulea caerulea.*
Noted in the woods both along Rock Creek and the Anacostia River; 2 seen; 2 heard.

40. House Wren. *Troglodytes aedon aedon.*
Observed chiefly in the woods along Rock Creek; 12 heard.

41. Carolina Wren. *Thryothorus ludovicianus ludovicianus.*
Noted in woods and thickets along both Rock Creek and the Anacostia River; 12 heard.

42. Long-billed Marsh Wren. *Telmatodytes palustris palustris.*
Abundant in the marshes along the Anacostia River; 1 seen; 34 heard.

43. Carolina Chickadee. *Penthestes carolinensis carolinensis.*
Noted in nearly all woodlands; 1 seen; 10 heard.

44. Tufted Titmouse. *Baeolophus bicolor.*
Common in woods everywhere; 42 heard.

45. Blue Jay. *Cyanocitta cristata cristata.*
Noted both along Rock Creek and the Anacostia River; 2 seen; 8 heard.

46. Fish Crow. *Corvus ossifragus.*
Noted both in the city and its environs, and along the Anacostia River; 61 seen; 8 heard.

47. Southern Crow. *Corvus brachyrhynchos paulus.*
More numerous than the Fish Crow, and more generally distributed; 51 seen; 23 heard.

48. White-eyed Vireo. *Vireo griseus griseus.*
Observed in the thickets and undergrowth in the woods, both along Rock Creek and the Anacostia River; 4 seen; 32 heard.

49. Yellow-throated Vireo. *Lanivireo flavifrons.*
Noted in the woodlands along both Rock Creek and the Anacostia River; 13 heard.

50. Red-eyed Vireo. *Vireosylva olivacea.*
Tolerably common in all woodlands; 6 seen; 13 heard.

51. Tree Swallow. *Iridoprocne bicolor.*
Noticed along the lower part of the Anacostia River; 13 seen.

52. Barn Swallow. *Hirundo rustica erythrogastris.*
Noted chiefly along the Anacostia River; 38 seen; 3 heard.

53. Bank Swallow. *Riparia riparia riparia.*
Eight seen in company with other swallows on the Anacostia River.

54. Rough-winged Swallow. *Stelgidopteryx serripennis serripennis.*
Observed chiefly along the Anacostia River, but also on Rock Creek; 33 seen; 2 heard.

55. Purple Martin. *Progne subis subis.*
Five seen over the Anacostia River.

56. American Redstart. *Setophaga ruticilla.*
Abundant in all woodlands; 36 seen; 42 heard.

57. Canadian Warbler. *Wilsonia canadensis.*
Two seen along the Anacostia River.

58. Wilson Warbler. *Wilsonia pusilla pusilla.*
One heard in woodlands along Rock Creek.

59. Hooded Warbler. *Wilsonia citrina.*
One seen in the same place as the last above named.

60. Yellow-breasted Chat. *Icteria virens virens.*
Found along Rock Creek and the Anacostia River; 5 heard.

61. Maryland Yellow-throat. *Geothlypis trichas trichas.*
'Abundant in thickets everywhere; 18 seen; 39 heard.

62. Northern Water-Thrush. *Seiurus noveboracensis noveboracensis.*
One seen in woodland on the border of the Anacostia River.

63. Louisiana Water-Thrust. *Seiurus motacilla.*
Four seen and two heard in the valley of Rock Creek.

64. Oven-bird. *Seiurus aurocapillus.*
Abundant in all woodlands; 7 seen; 26 heard.

65. Kentucky Warbler. *Oporornis jormosus.*
One seen along Rock Creek.

66. Prarie Warbler. *Dendroica discolor.*
Three heard in busy uplands near Bladensburg.

67. Pine Warbler. *Dendroicaa vigorsii vigorsii.*
Three seen and one heard in pine woods near Bladensburg.

68. Black-poll Warbler. *Dendroica striata.*
Two seen in woods along the Anacostia River.

69. Chestnut-sided Warbler. *Dendroica pensylvanica.*
Common in woodlands; 3 seen; 17 heard.

70. Blackburnian Warbler. *Dendroica fusca.*
Two seen in the woods along Rock Creek.

71. Black-throated Green Warbler. *Dendroica virens.*
Noted in woodlands along Rock Creek and the Anacostia River. 1 seen; 5 heard.

72. Myrtle Warbler. *Dendroica coronata coronata.*
Common along Rock Creek and in pine woodlands along the Anacostia River; 26 seen; 2 heard.

73. Black-throated Blue Warbler. *Dendroica caerulescens caerulescens.*
Noted sparingly in the woodlands along Rock Creek and the Anacostia River; 2 seen; 4 heard.

74. Magnolia Warbler. *Dendroica magnolia.*
One seen and three heard in the woods along Rock Creek.

75. Yellow Warbler. *Dendroica aestiva aestiva.*
Found everywhere in thickets; 10 seen; 36 heard.

76. Parula Warbler. *Compsothlypis americana americana.*
Common in woodlands; 8 seen; 21 heard.

77. Northern Parula Warbler. *Compsothlypis americana pusilla.*
One typical male seen in the woods along the Anacostia River.

78. Blue-winged Warbler. *Vermivora pinus.*
Two heard singing in thickets near Rock Creek.

79. Golden-winged Warbler. *Vermivora chrysoptera.*
Two seen in the woods and thickets on the edge of the Anacostia River.

80. Worm-eating Warbler. *Helmitheros vermivorus.*
One seen in the woods along the Anacostia River.

81. Black and White Warbler. *Mniotilta varia.*
Tolerably common and generally distributed in woodlands;

82. Bobolink. *Dolichonyx oryzivorus.*
Three heard on the uplands along the Anacostia River.

83. Meadowlark. *Sturnella magna magna.*
Noted on the outskirts of the city and on the uplands along the Anacostia River; 6 heard.

84. Red-winged Blackbird. *Agelaius phoeniceus predatorius.*
Common in the marshes of the Anacostia River; 9 seen; 9 heard.

85. Baltimore Oriole. *Icterus galbula.*
Noted both in the outskirts of the city and on the uplands along the Anacostia River; 2 seen; 4 heard.

86. Orchard Oriole. *Icterus spurius.*
One seen in a pine grove near Bladensburg.

87. Purple Grackle. *Quiscalus quiscula ridgwayi.*
Abundant everywhere; 60 seen; 17 heard.

88. Scarlet Tanager. *Piranga olivacea.*
Two seen and two heard in the woods along Rock Creek.

89. Summer Tanger. *Piranga rubra rubra.*
One heard singing on the edge of the woodlands along Rock Creek and Cleveland Park.

90. Cardinal. *Cardinalis cardinalis cardinalis.*
Common in thickets; 3 seen; 15 heard.

91. Rose-breasted Grosbeak. *Hedymeles ludovicianus.*
Noted in the woods along Rock Creek; 3 seen; 4 heard.

92. Indigo Bunting. *Linaria cyanea.*
Observed in the woods along Rock Creek, in the fields on the outskirts of the city, and on the uplands near Bladensburg; 4 seen; 3 heard.

93. Chewink. *Pipilo erythrophthalmus erythrophthalmus.*
Common in thickets, chiefly along Rock Creek and the Anacostia River; 5 seen; 13 heard.

94. Swamp Sparrow. *Melospiza georgiana.*
One seen at the head of a tributary of Rock Creek.

95. Song Sparrow. *Melospiza melodia melodia.*
By far the most abundant species observed during the day, and very generally distributed; 13 seen; 165 heard.

96. White-throated Sparrow. *Zonotrichia albicollis.*
Common in thickets, chiefly along Rock Creek; two seen; 17 heard.

97. Field Sparrow. *Spizella pusilla pusilla.*
Tolerably common in fields and pastures; 6 seen; 8 heard.

98. Chipping Sparrow. *Spizella passerina passerina.*
Common except in woodlands; 3 seen; 25 heard.

99. Slate-colored Junco. *Junco hyemalis hyemalis.*
One seen in the undergrowth of low woodland near Bladensburg. This date is unusually late for the species, since its average time of departure is April 30.

100. Grasshopper Sparrow. *Ammodramus savannarum australis.*
One heard singing in a field near Bladensburg.

101. English Sparrow. *Passer domesticus hostilis.*
Abundant in the city and about gardens in the country; 53 seen; 81 heard.

102. Purple Finch. *Carpodacus purpureus purpureus.*
One heard singing on the outskirts of the city.

103. American Goldfinch. *Asragalinus tristis tristis.*
Common almost everywhere; 9 seen; 43 heard.

NOTE

Contributions on general and midland natural history will be gladly received. Papers on botany and allied subjects, zoology, geology and physical geography, should be addressed to the editor.

Matters relating to advertisements are to be taken up with the secretary of the University.

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Household Insects and their Remedies.

BY B. W. SCHEIB.

PREFACE.

Household insects are demanding more attention today than ever before. In the careful research for the causes of human diseases it has been found that many of these pests are carriers of bacteria and disease. In addition to this, they are very annoying and also do hundreds of dollars worth of damage to clothes, household furnishings and supplies. During the past years, the author of this essay has had a great many inquiries for exterminating them. In nearly every case the housewives readily recognized the insects but were not acquainted with the best methods of control. Thus a scientific technical description of each insect was thought to be unnecessary and, in the descriptions given, the writer has tried to use such language that would be readily understood by the average housewife. Usually the housewife is not interested in the insects further than to eradicate the pests. With this in view, the writer has tried to set forth the simplest and most economical remedies for the destruction of some of the most common household insects. The author does not claim to have originated all of these remedies but they have been carefully gleaned from various sources. Nearly all of these remedies have been tried by the writer or on recommendation to his friends and have been found to be most satisfactory.

THE HOUSE FLY.

The most common and most widely distributed household pest is the common house fly (*Muscu domestica*). This insect is now attracting wide attention as a carrier of disease. It has been known to carry typhoid fever, tuberculosis, cholera, cholera infantum and dysentery and no doubt a great many other diseases.

Its early stages are passed in some moist, decaying matter, generally horse manure or barn yard filth. It is not an uncommon thing to find flies feeding on sputum and all kinds of filth; thus they pick up a great number of harmful bacteria on their feet, mouth and hairs and are carried to groceries and other eatables of all sorts. Dr. L. O. Howard has estimated that the house fly is the cause of 250,000 typhoid fever cases in America. As a general rule flies do not travel more than two or three hundred yards away from their breeding place. Bacteria have been known to live in flies for three weeks. Thus flies can distribute bacteria in a great many places without revisiting the source from which it first received its deadly germs.

Since flies are known to carry disease, it is very essential to do everything to get rid of them in our homes. Proper screening of the house is one of the first requisites. The next step should be to remove their breeding places. Manure should be removed at least once a week. Chloride of lime sprinkled over the manure each day will to a large extent prevent their breeding.

I.

Flies may be killed by using the following:

1 oz of formalin 40%
16 oz of sweet milk
16 oz of water

Pour this into a dish and set it where the flies can get at it. It is always well to float a piece of cork or blotting paper on the liquid so the flies can have more room to eat. Flies eat this readily and are killed by the thousands.

II.

The following has been used with good success:

1 cup brown sugar
1 cup of formaldehyde

Mix the two together. Should the solution dry up a little water can be added from time to time.

III.

Take an infusion of

Quassia 1 pt
Brown sugar 4 oz
Ground pepper 2 oz

To be well mixed together and put in small shallow dishes where required.

IV.

Take some jars, mugs or tumblers, fill them half full with soapy water; cover them as jam pots are covered with a piece of paper, either tied down or tucked under a rim. Let this be rubbed inside with wet sugar, mollasses, honey or jam or anything sweet. Cut a small hole in the center large enough for a fly to enter. The flies settle on the top attracted by the smell of the bait; they then crawl through the hole, to feed upon the sweet beneath. Meanwhile the warmth of the weather causes the soapy water to ferment, and produces a gas which overpowers the flies and they drop down into the vessel. Thousands may be destroyed this way and the traps last a long time.

V.

Fly traps and tanglefoot also help in reducing the amount of flies.

VI.

It is not always possible to avoid collections of manure, but these collections or piles may be sterilized successfully and made impossible as breeding nests simply by the generous distribution of sulphate of iron, in liquid or dry form. It gives better results than kerosene, for it does not harm the manure, and the cost is very light. It penetrates everywhere. By keeping constantly in the stable a barrel of this solution of a strength of about two pounds for each gallon of water and using a common sprinkler can, the sterilization would be accomplished at an approximate cost of less than 1 cent per horse per day. Making sanitary all other breeding spots, such as garbage cans and privy boxes may be accomplished by the liquid solution or dry sugar sulphate of iron being distributed freely, thus checking in the earliest stages the development of fly maggots. And this is the time for effective work, because the fly larvae or eggs are exceedingly tenacious of life. Sulphate of iron, being a deodorizer, also removes from the manure pile, the urine soaked stable drains, the outhouse and the garbage pile the pungent ammoniacal fumes and other offensive smells. Use of this chemical in cellars where rotting vegetables may be found purifies the air.

Cloride of lime is also good.

Mosquitoes.

There are a great many species of mosquitoes. They are not only a nuisance but are also conveyors of malaria, yellow fever and denque fever. In some localities a great deal of work has been done to rid the communities of this pest. The immature stage are found in water. They breed in any place where there is open water. Rain water barrels, tin cans, water troughs and stagnant mud holes are generally the breeding places of these pests. The eggs are laid on top of the water in rafts and as they hatch the larva begin feeding upon the minute vegetable and organic matter found in the water. The first step toward exterminating mosquitoes should always be to destroy their breeding places.

Destroying Breeding Places.

One of the best methods is to pour oil upon the surface of the water. All ponds and mud puddles that can be drained should be drained. Rain water barrels and all vessels holding water should be screened. Frequently if the weeds are cut around ditches and low depressions holding water the breeding place will dry out immediately.

All tin cans should be buried or disposed of immediately. All ornamental fish ponds and water gardens should be supplied with fish that will eat the wrigglers.

Screens.

Every home should have the windows and doors thoroughly screened. Twenty meshes to the inch can be relied upon to keep mosquitoes out but fifteen to the inch is better. When mosquitoes are very numerous the screens should be painted lightly with kerosene or oil of citronella. When buying screens it will be found to be more economical to buy the brass wire screen as it will not rust out like iron wire screen. The proper housing and painting of screens will lengthen their period of usefulness materially.

Smudges and Fumigants.

Anything that will make a dense smoke will drive away mosquitoes. The writer has found that straw makes an excellent smudge for out-door parties. Campers frenquently use dried leaves. For household use other material must be used.

I.

Pyrethrin Powder.

Pyrethrin Powder can be purchased at any drug store. The powder should be heaped up on a tin pan in the form of a cone and the tip then lighted. It burns quite readily and makes a dense pugent smoke. If the powder does not burn well it can be sprinkled over red hot coals. This method is not very effective where the windows are left open. The essential thing is the volatile oil given off into the room from the burning powder and stupifies the insect.

II.

Jimson Weed.

Dr. John B. Smith recommends the following:

1 oz of salt peter

3 oz powdered jimson weed (*Dotura stramonium*).

About ten ounces of this should be burned per 1,000 cubic feet of space. He states that the fumes are not injurious to humans, fabrics or metal. The powder should be burned on a tin pan or shovel.

III.

Nimms Culicide.

Mix equal parts by weight of carbolic acid crystals and gum of camphor. The carbolic acid crystals are melted over a gentle heat and poured over the gum. The gum is dissolved and the resultant is a clear liquid with a pleasing ordor. The vapor is not injurious to human beings except when very dense, but it will produce headache if breathed too freely. Rooms should be as nearly air tight as possible.

IV.

Protection from Bites.

One of the best mixtures to keep mosquitoes away is made from the following:

Oil of citronella	1 oz
Spirits of camphor	1 oz
Oil of cedar	½ oz

A few drops on a bath towel and hung on the head of the bed will keep the common mosquito away for a time. Where mosquitoes are real bad some of the liquid should be rubbed on the face and hands. This mixture will not last the entire night.

V.

Mr. E. H. Gane of New York remmonds the following to avoid the odor of the oil of citronella.

Castor oil	1 oz
Alcohol	1 oz

VI.

The writer has found the following to be effective:

Kerosene	1 oz
Oil of cedar	1 oz
Oil of citronella	1 oz

Place a few drops on clothes and hang them near the bed. The odor of this is not offensive.

Cock Roaches.

Cock roaches eat any kind of food, and frequently do a great deal of damage. They are nocturnal and live in damp, dark places. generally about sinks or water places, flour bins and pantries. They have a nauseating odor and want to live around garbage. The thoughts of eating the food is intolerable. By some they are thought to be carriers of disease. There are four kinds of roaches in this country: The American Cock Roach (*Periplaneta americana Linn*), the Oriental Cock Roach (*Blatta orientallis Linn*), Australian Roach (*Periplaneta australasiae Fab*) and the German Roach or "Ceroton Bug" (*Blatella germanica Linn*).

They are wingless and all have flat, thin bodies, and strong, bitting jaws. As they live in cracks and under objects it is not easy to exterminate them. Boiling water and good soap suds will aid some in keeping down this pest. Dr. Hodges states the bat and the common toad to be very effective in exterminating this pest.

I.

Borax is the best cock roach exterminator yet discovered. The cockroach has a peculiar aversion to it, and will never return where it has been once scattered. This salt is perfectly harmless to human being and is to be much preferred.

II.

A mixture of red lead, corn meal and mollasses will be eaten eagerly by them and will soon exterminate them.

III.

Large numbers may be killed by setting out two shallow dishes, one containing flour and plaster of Paris mixed together and the other water. Use four parts of flour to one part of plaster of Paris. Arrange the dishes so that roaches can easily climb on them and from one dish to the other.

IV.

Make a strong decoction of poke roots, when the strength is out of the roots, mix the liquor with molasses and spread it on large plates in the places they frequent. They may be thus slain by the thousands.

V.

Mix equal parts of Persian insect powder and powdered Levantic wormseed, and scatter the mixture about the places which cock roaches frequent.

VI.

Carbon bisulphite may also be used as a fumigant and will undoubtedly prove satisfactory if used in sufficient quantities. This, however, is very inflamable and one must be careful about fire.

VII.

Equal parts of 2% carbolic acid and 2 oz. gum camphor dissolved poured into cracks will get them out where they may easily be killed.

VIII.

Burning pyrethium in infested places is very effective. Room should be closed for several hours.

IX.

Phosphorus paste, which may be purchased at drug stores is claimed to be satisfactory.

X.

Scatter cucumber parings around the parts of the house troubled with these vermins.

House Cricket.

(*Gryllus domesticus Linn*)

These insects are quite common and at times do considerable damage to clothing. They often damage clothes hung in a dark and damp closet or clothespress; also hiding in fireplaces, pantries and baseboards. The house cricket shows a special fondness for liquids such as milk, and may be found in the milk pans if left uncovered. The crickets vary from brown to black according to the species. The head has two very long antennae, the hind legs are large and strongly developed for jumping. The chirping is done entirely by the male by elevating the outer wings or tegminae, and then scraping them together, one over the other, thus producing a vibration. It is supposed to be a call from the male to the female.

I.

Crickets like milk, fresh potatoes, carrots; so many are killed by putting arsenic in the liquid and sprinkling a little on a scraped potato or carrot.

II.

Some find putting a little chloride of lime and powdered tobacco in their holes very effective.

III.

Sprinkle a little quicklime near to the cracks through which they enter the room. The lime may be laid down at night and swept up early in the morning, as it must be kept entirely away from children. This kills many of the crickets and drives them away from the house.

THE LITTLE RED ANT.

(*Monomorium pharaonis Linn*)

The origin of this species is unknown but it is supposed to have been imported. This is one of the most despised, troublesome and prolific of household pests. They nest in partitions, under floors, in all cracks and crevices where it is hard to reach them. These insects pass their entire existance in houses. They are about one-twentieth of an inch in length.

Another ant which is also a nuisance is the black ant. Ants particularly like sugar, syrup and other sweets. Ants are not so destructive to the household supplies, but their faculty of getting into everything makes them very disagreeable to say the least.

Those that are commonly known are all workers. The females stay in the colony and are known by being wingless. These wings are torn off as soon as the ants begin mating. The male usually dies and the female at once goes to her duty of establishing new colonies. Unless the colony can be reached and destroyed all other measures will be of only temporary relief.

I.

If these nests can be reached, a little kerosene or bisulphide of carbon sprayed or injected, is very effective.

II.

Fumigation with hydrocyanic acid gas is advisable in old and badly infested houses. Care must be used with this gas.

III.

To keep ants from climbing upon tables, cupboards, etc., place the legs in small dishes or pans of kerosene or water.

IV.

The writer has found it very effective to keep everything out of the way of these pests. By care they can be done away with almost as easily as flies.

V.

A few leaves of green wormwood scattered on shelves, etc., is good for black ants.

Powdered borax sprinkled in shelves, etc., will aid greatly in eradicating the pest.

VI.

Some people advise using methods of attracting the ants, such as a sponge soaked in sugar and water, and as they gather on the sponge, dip quickly in hot water. Also place a little poison is sugar, lard, etc., and some have found this effective.

Southern Cloth Moth.

(*Tincola viselliella*)

This moth is straw color without spots. The larva spins a silken web, eats hair, feathers and furs.

The Case-Making Clothes Moth.

(*Tinea peltionella Linn*)

These moths, or millers as they are called, are harmless in themselves. Their mission is to lay the eggs for the next generation. These moths are night fliers and one sees them about dusk or during the evening flying about in the dark corners of the room. They are seldom seen during the day time except when driven from their hiding place. The adult moth is very small and delicate. It measures 2-5 of an inch when its wings are expanded. Its fore wings are yellowish-gray, marked with a few undefined brownish spots and fringed toward the outer portion of the posterior margin. The hind wings are of a uniform size, about ⅔ of the length of the fore wings. Its posterior margin has a wide fringe gradually increasing in length toward the base or wing attachment. Their minute white eggs are usually layed in some dark corner on carpets, woolen goods, furs, and etc. The eggs hatch into a small brown headed caterpillar. The larva begins feeding at once and at the same time constructing a small, bag-like case which is made of fragments of wool. The case is enlarged from time to time as the caterpillar grows. When the caterpillar is full grown it closes up the case and goes into the pupa state. They emerge from these cases usually in July or August. There are two other species of clothes moths.

Tapestry Moth.

(*Trichophhaga tapetzella*)

The vasal half of the fore wing of this moth is white and the rest of the wing is black. The larva construct burrows in which it spins its silken lining. It feeds on coarser fabrics, tapestries, carpets, and upholestered goods.

Take equal parts of oil of camphor and spirits of turpentine. Soak blotting paper in the mixture. Let the paper dry, then lay among furs or clothing.

I.

Clothes moth is most destructive in summer, when woolen goods are stored away.

II.

Clothes should be hung out and sunned good and brushed and beaten thoroughly, then packed in a cedar chest or with cedar chips. Clothes should be wrapped in tar, paper, or bags to keep the female from laying her eggs on them.

III.

Benzine and naptha used as a spray is also good.

IV.

Upholstered furniture and rugs should be sprayed with gasoline twice a year.

V.

Naphthaline or moth balls will aid considerable in keeping these moths in control.

Carpet Beetle or Buffalo Moth.

(*Anthrenus scophulariae Linn*)

The adult insect is small, measuring about ⅛ of an inch in length. This beetle is of European origin. They breed especially on Spiraea and it is supposed they are carried into the house on the blossoms of the Spiraea and kindred flowers. The eggs of the adult female hatch out in a few days and commence feeding immediately. They show a preference for woolen goods, furs and feathers, especially places where they are stored, as they are not so likely to be disturbed. They also live in the cracks of floors and feed on the underside of rugs and carpets. This is very destructive. They usually mature three broods yearly, according to the length of the summer.

I.

Spray carpet with gasoline and wash all cracks with hot suds and follow by gasoline.

II.

Benzine and gasoline.

III.

Tar paper on floors will keep them away.

IV.

Iron the carpet a part as a time with a wet cloth. This will kill them.

V.

Mothballs are good to pack with winter clothing.

VI.

Sulphur dioxide generated by burning flowers of sulphur is used, but it blackens silver and changes tints in wall paper, also ruins the colors in woolens.

Silver Fish Moth.

(*Lepisma sp.*)

This insect is of a silvery-gray, wingless and if touched will leave tiny scales on the fingers. These insects are about ⅜ inch long, with two long feelers or antennae protruding from the head, while there is three feelers at the hind end of the body. The pest prefers darkness, and is often found among undisturbed books, papers, or starched linens, as it exists on starchy products. As soon as these insects are disturbed, they may be seen scurrying away to hiding places.

I.

Pyrethrin dusted into places where it hides with kill them.

II.

The frequent handling of articles liable to be attacked is one of the best preventives.

III.

Naphthaline scattered among books and materials containing starchy mixtures is an excellent remedy.

IV.

Gasoline is also used very successfully, but should be used with caution where there are stoves and lights, for when used in large quantities it may cause an explosion or fire.

BOOK LICE.

(*Atropos sp. and Clothilla sp.*)

This insect is always found among old books, papers, starchy materials, and have been known to infest old mattresses. They have a peculiar ticking noise, which they make. They are so small in size, one can hardly see them, and does not really belong to the true lice in size and their foods are mainly starchy foods, while the true lice are sucking insects. The antennae is very long on these pests.

I.

The use of naphthalene in boxes and trunks will aid greatly in keeping these pests away.

II.

Infested mattresses stuffed with straw or corn husks should be ripped up and the contents burned. If the mattress is made of hair, if would pay to have it steam cleaned, thus all insects would be killed.

III.

All cracks and crevices, which are not easily reached by ordinary cleaning, should have a generous application of gasoline.

THE BEDBUG.

(*Cimex lecturius*)

The bedbug is an ancient and cosmopolitan insect. The presence of the bedbug in a house is not necessarily an indication of neglect and carelessness on the part of the housewife. This insect may gain access in spite of the best care and the adoption of all reasonable precaution. They can be carried from place to place in trunks and suit cases by travelers. This insect may migrate from one house to another. They bite during the sleep of their victim and under cover of darkness, hiding during daylight in cracks of old fashioned wooden bedsteads, under loose places in the wall paper, in crevices behind picture moulding, in picture frames, about door or window casings, or base boards. Every housewife is alarmed when she discovers the pest in her home and is always eager to obtain an effective remedy for the extermination of the bedbug.

I.

Crude carbolic acid has been found to be one of the most effective means of destroying bedbugs. This is inexpensive and the fumes are very penetrating. The liquid should be applied with a small brush or feather in all crevices. Walls that are badly infested should be sprayed with equal parts of crude carbolic acid and kerosene.

II.

Kerosene and gasoline will aid in eradicating these nocturnal pests, but can not always be relied upon.

III.

Take everything out of the infected room, plug up all the windows tightly, close all chimneys and empty 1 oz of powdered sulphur on a pan of hot coals, placed in the middle of the floor. Shut the doors and cover all cracks; let the sulphur burn as long as it will. After the sulphur has burned out, paint all the cracks in the floor and around the base board with a strong solution of corrosive sublimate and treat the furniture to the same before replacing it. Corrosive sublimate is deadly poison and should be kept out of reach of children.

IV.

When they make a lodgement in the wall, fill all the apertures with a mixture of soft soap and Scotch snuff. Take the bedstead to pieces and treat that in the same way.

V.

Mix 2 oz. of camphor
4 oz. spirits of turpentine
1 oz. corrosive sublimate
1 pt. alcohol

This should be applied with a brush or a spring-bottom oil can to all cracks and crevices. This is a deadly poison.

Fleas.

(*Pulex serraticeps Gerv.*)

The fleas that are usually found in houses are the common cat and dog fleas. The adults are wingless. The hind legs are strongly developed to enable them to jump great distances. The female lays her eggs loosly in the hair of the cat and dog, and are scattered wherever the animal goes. These eggs hatch out in a few days as larvae. In appearance, they resemble the maggots of the house fly, but are very much smaller. These larvae are full grown in two weeks, when they begin spinning a cocoon about themselves lying in a dormant state from 7 to 12 days, when they come out as an adult flea.

I.

The quarters of the cat and dog should be thoroughly cleaned and disinfected so the fleas will not have a chance to lay their eggs. Sometimes they multiply so rapidly, not having anything animal to feed upon, that they attack people, showing a preference for the lower limbs. The bite of the flea is very annoying to most people.

II.

Fleas will not breed in places where they are likely to be disturbed, so the shaking of rugs, carpets and thorough sweeping of floors will aid greatly in keeping them from breeding in the houses.

III.

Gasoline injected in cracks, crevices and places where they cannot be disturbed by any other means, will kill the larvae.

IV.

Creoline Dip sprayed in the cracks and corners of the kennel and on the dog will exterminate them. This should be done every two weeks.

V.

Fresh pyrethrim powder dusted over carpets, rugs and sofas will afford relief. This powder should be left several days before sweeping it up.

VI.

Insect powder dusted throughly into the animal's hair will cause the fleas to drop off.

VII.

Dogs should be given a lathery bath of warm water and carbolic soap.

VIII.

Flower of sulphur contains sulphurous acid and is fatal to this pest, but care must be taken not to use it near colored flannels as it often destroys the color.

Head Lice.

(*Pediculus capitis De G.*)

This is the most common insect that attacks man. It receives its name from being found on the head, although it sometimes is found on the hairs of the beard. It is parasitic in habits, and belongs to the same order as the bedbug. They puncture the scalp and suck the blood. The nits or eggs adhere very closely to the hairs and are found some distance from the scalp. These eggs hatch in two weeks and are very prolific.

I.

The louse may be combed out of the hair with a fine comb. Kerosene put on the roots of the hair will kill all nits and the adult louse.

II.

Mercurial ointment is very effective.

III.

Vaseline is another that checks this pest by clogging up the breathing pores. Whatever remedy is used, should be kept up every two or three days for at least twenty-one days.

Termites.

(*Termes aavipes Koll.*)

Termites, or white ants, as they are sometimes called, are not really a true ant. They have nests and live together similar to the ants but live on decayed wood and vegetable matter. The workers are white, blind, wingless, sexually undeveloped insects. The winged males and females are produced each spring but their wings are not strongly developed, so they are poor flyers. They usually nest in a hollow stump or other infested material. The winged males and females are blackish in color and resemble the true ants, except the crossviens in the wings. They reproduce yearly in the spring.

I.

If this pest infests a building, the surest way is to tear off the pieces that are infested as they bury themselves in the wood and cannot easily be reached by fumigating.

II.

Wood soaked in creosote is excellent in keeping them away.

III.

The greatest difficulty is finding the nest as they tunnel all through the wood, but fumigating with carbon bisulphide is good if one can reach the seat of trouble.

IV.

Gasoline poured into the burrow will destroy them.

Bacon or Ham Beetle.

(*Dermestes lardaris Linn*)

This insect is about 3-16 in. long and ⅛ in. broad. The lower half of the wing covers are covered with grayish-yellow scales, with several small black spots on the wings, which sometimes form almost an entire band across the beetle. This insect is always recognized by its feeding on bacon, ham, lard and cheese. It especially like the fatty portions of the ham. The adult female beetle begins laying her eggs in the spring on meats or nearby, so that the newly hatched larvae may crawl to the meat. The full grown larva are about 9-16 in. long. When full grown, they bury themselves in meat and cheese, and change to the pupa stage. They stay in this state from 3 to 5 days, according to conditions. These beetles reproduce about every six weeks.

I.

If these beetles are found in the meat, the best remedy is to cut away the infested parts and wash in a weak solution of carbolic acid and water, or the good parts may be sliced and fried, lay the pieces in a stone jar and pour over hot lard and cover.

II.

Some find spraying with benzine to be very effective method for destroying the larvae.

III.

Fumigating smokehouses and storerooms with carbon bisulphide or hydrocyanic acid gas will rid the building of this pest Hydrocyanic acid gas is very dangerous so great care should be taken in handling it.

IV.

The smokehouse should be screened in order to keep it insect proof. The mesh should be fifteen to the inch.

BEAN WEEVIL.

(*Acanthoscelides Bruchus obtectus Say*)

Dried beans that have been stored away for the winter supply are the ones most affected. Many of the beans showing round holes are where the adult weevils have matured, some may contain small grubs, while in the lower part of box and in corners will be found these small weevils, about ⅛ inch in length. They are of a brownish, spotted color. New beans may be infected from a few old beans of last year's crop, or by the eggs being deposited in the beans while on the vine.

Fumigation with carbon bisulphide or carbon tetrachloride is the best treatment and should be applied as soon as beans are gathered. Never plant infested beans.

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Aquatic Life: With Special Reference to Entomostraca.

BY JOSEPH STACK.

The present paper is the result of a zoological survey of Beimiller's Cove, Cedar Point, Ohio, and of numerous ponds and streams in that vicinity, nearly all the work being done on invertebrate forms. The chief problem was on the habitat of Entomostraca and the environic conditions affecting them. The forms most abundant in the cove, and most often observed, belong to the two sub-classes *Phyllopoda* and *Copepoda*. The nauplius stage was considered by itself at all times.

During the summer, several trips were taken to neighboring bodies of water and the data gathered on these trips is included in this survey.

Cedar Point is a peninsula, not over one mile wide at its widest point, extending eastward for seven miles into Lake Erie from the north-central part of Ohio, separating Sandusky Bay on the south from Lake Erie on the north. Cedar Point proper is located at the end of this peninsula and Ohio State University Laboratory is located two miles east of Cedar Point on Beimiller's Cove, at which place most of this survey was made.

Beimiller's Cove is situated in an ideal place for studying aquatic life. It is separated from Lake Erie on the north by Cedar Point, which is one quarter of a mile wide at this place. On the south it is separated from Sandusky Bay by a narrow peninsula about one half mile long which is an extension from the Point proper. The west portion of the Cove cuts into the Point ending in a marsh. The Cove opens into Sandusky Bay on the south-east side. With such aquatic surroundings the opportunity for a comparative study is unlimited, a point that will be considered in the survey.

To obtain more accurate data on the habitat and environic conditions affecting the Entomostraca in Beimiller's Cove, stations were established where different environmental conditions prevailed and these places were subjected to careful study. These stations were visited every day and the day following the visits was spent in the laboratory identifying and determining the specimens collected. On account of the large area of the Cove it required a whole day to make the complete trip to all the stations.

Station I is located in the extreme north-west corner of the Cove and marked by a long pole driven solidly into the bottom at this place. The water is very shallow, 1¾ feet deep. The bottom is covered with decomposed plant life, consisting chiefly of water lily pads and bulrushes. Owing to the shallowness the temperature of the water varies directly with atmospheric changes. As in all shallow water, the temperature remains constant or usually tends to constancy throughout the slight depth according to the changes of air temperature. The shore at this point is covered with ferns and short grasses forming a swampy undergrowth. Owing to this form of vegetation there is little protection from the sun.

Station II is similarly situated near the shore which is swampy and sparsely protected by shade. The water is slightly deeper than at Station I, being 2⅔ feet deep. Other characteristics are similar to Station I. A large water-soaked log extending from the swamp makes a very stable land mark for this station.

Station III is one of the most interesting points studied, being located in the mouth of a sewer channel which carries all the sewage from Cedar Point and empties part of it into the Cove. The remainder is carried, by a deepening of the channel to 4 feet, into Sandusky Bay. Station III is located in the extreme south-west corner of the Cove at the entrance of the sewer channel into the Cove. At this point the water is 3 1-6 feet deep and is extremely turbid, caused by sewage. There is a decided current produced here and continues to the Bay owing to the fact that the channel is several feet deeper than the surrounding water of the Cove. Due to this and to the great force that propels the sewage into the channel, the current is very strong and vegetation is not given a chance to grow as it does in the quiet water of the rest of the Cove. This current produces a fluctuation of forms and numbers at this station. The bottom is covered with a deep black slime. The water is protected from the sun by shrubs and small trees extending from the bank of the peninsula on the south.

Station IV is midway between Station III and the end of the Cove on the south side, being too far from the sewer channel to be noticeably affected by it. The bank slopes gently to a height of about 5 feet on the top of which there is a slight second-growth of trees which furnish considerable shade for this station. The bottom is rather sandy and free from abundant vegetation and is gradually sloping in toward the center of Cove. Depth is 2 feet; marked by tree on peninsula.

Station V is one of the deepest parts of the Cove, 5⅔ feet deep. The bottom is covered with a deep, soft layer of sandy loam on which grows an abundance of vegetation, chiefly *Myriophyllum* and *Ceratopyllum* which grows so rapidly that by August 25th it is impossible to row a small boat through the Cove. These forms first start submerged and later cover the entire surface. This station being located in the center of the Cove is noticeably affected by wind and currents. In early summer, before the vegetation has become too abundant, the water is clear.

Station VI is south-east of Station I on the same side of Cove. The bottom is covered with decomposed plants making a mucky covering over sand. Underbrush covers the shore, back of which is a small wood which furnishes shade to the shore at this station. It is 1⅓ feet deep; marked by dead tree on bank.

Station VII is located about 10 feet south of Laboratory Point in a swampy region, the water being 1¾ feet deep. The bottom is composed of sand covered with muck. The shade is sparse.

Station VIII is midway between Laboratory Point and the end of the peninsula on the south, at the opening of the Cove into Sandusky Bay. This is the deepest part of the Cove, 6½ feet. There is abundant vegetation as at Station V. The bottom is mucky and the wave action quite pronounced. No shade.

Station IX is near the shore, at the extreme east end of the narrow peninsula on the south. The water is shallow at this point being only 1 1-6 feet deep. The bottom is sand covered with scant vegetation. The peninsula ends at this point as a sand bar.

All observations and collecting was done by the aid of a big, heavy, flat bottomed row boat which was 12 feet long and 3 feet wide, having very low sides. It had to be quite large in order to carry the necessary equipment, to give ample room for taking the readings, and for preparing collected material for safe transportation to the laboratory. The heavier the boat the less chance for drifting from the point of operation. Having a flat bottom there was very little chance of rocking and it presented a plain surface on which could be placed bottles, jars, etc. Having low sides, 5 inches above the water surface, it facilitated the work of handling the nets, taking temperature readings and making observations along the bottom.

The carbon dioxide content of the water was determined by titration. On the seat in the stern of the boat was carried a case which contained all the requisites for making the analysis of carbon dioxide content. It contained a small bottle of indicator to which was attached a tube with a spring clamp which kept the bottle air tight and facilitated the using of the indicator. Another bottle similarly equipped contained sodium hydroxide. A test bottle was lowered to the bottom of the Cove by means of a long, stout cord. To the neck of this bottle a weight, heavy enough to submerge it, was attached. To the cork was fastened a stout cord by means of which the water-tight bottle could be opened after it had reached the desired depth. The carbon dioxide content was taken as follows: the test bottle was made as free from air as our means would permit and the stringed-cork tightly inserted. The bottle with weight and cord attached was lowered into the water to the desired depth and the stringed-cork was pulled allowing the water to enter until the bottle was completely filled. Then it was drawn gradually to the surface and corked to keep the air from entering. Before the titration was made the top portion was quickly poured off to obtain more accurate results and 1000 c. c. taken from the remainder. To this a few drops of indicator was added drop by drop and the number of c. c. required to color the solution a delicate pink determined the amount of carbon dioxide present in 1000 c. c. of water. On a following page the results are given. These readings were made only on two trips owing to the amount of time it required to make them and to the fact that the presence of the carbon dioxide was practically constant for the length of time we were working on this problem.

All temperatures were taken by means of an accurately adjusted and tested deep sea thermometer. Four readings were taken at the nine stations every trip; air and water temperature at the surface, water temperature one half distance to the bottom, and on the bottom.

The turbidity was taken by the use of a very simply constructed turbidimiter made of a Mason jar cover in the top of which was the customary porcelain disc. To the sides to this cover were attached three strings which were tied at a point 4 inches above the cover. This method of attachment kept the white porcelain disc parallel to the surface. From the three strings extended a long extension which was used for lowering the cover from the boat. The turbidimiter was lowered in a horizontal position and the depth at which it entirely disappeared from view was noted. It was then slowly raised again and the depth at which it reappeared noted. The mean of these two measurements was taken as the depth of its visibility beneath the surface. This turbidimiter was used at each station.

For collecting purposes towing nets, made of fine silk bolting-cloth were used. These nets were 18 inches long and conical, the base or entrance being 8 inches in diameter and held open by a wooden hoop. Three cords were attached by the same method used on the turbidimiter. The apex or outlet of the net was ½ inch in diameter and to this end was tied a small vial 2 inches long and ½ inch in diameter. On the neck of each vial there was a flange which facilitated the tying on of the net. Fifteen of these collecting vials were used on each trip and were carried in a box specially made for them. New corks were always used and at each station the date, number of towing, and a letter representing the kind of towing was written with water proof ink on each cork which was then inserted into a corresponding vial. See chart number 1 for method of keeping this data.

Field notes were kept in a water-proof covered notebook and the form on the following page was used in recording observations at each station.

Date.................., 1916. Time of day.............. Air temperature.............. Wind: Direction.............. Velocity.............. Water Temperature: Surface.............. ½ distance to bottom............. Bottom.............. Sky.............. Turbidity.............. Carbon dioxide..............per 1000 c. c. Bottom condition..........

The following terms were used for description of:

Wind.		*Sky.*	
Not perceptible	N. P.	Clear	Cl.
Calm	C.	Hazy	H.
Moderate	M.	Cloudy	Cd.
Light Breeze	L. B.	Foggy	F.
Strong Breeze	S. B.		

Plant Life		*Character of Bottom.*	
Abundant	A.	Sandy	Sn.
Sparse	S.	Mucky	My.
Absent	Abs.	Clayey	Cly.

On each trip it was necessary for one man to row the boat and keep notes while the other made the observations. To avoid variations in the readings the same man made all the observations while the other rowed the boat.

We usually started out at 9:30 a. m., and at each station the following procedure was carried out. On arriving at the station a heavy anchor was dropped to the bottom to hold the boat at a fixed point. Then the form for keeping the data, previously described, was filled out. The towings were made as follows: first the tow net with vial attached was weighted and buoyed sufficiently to emerse the net and vial to the desired depth. This was attached to a rope 100 feet long. The boat was then rowed 100 feet and then anchored and the net with vial was gently pulled to the boat. This gave us sample No. 1, horizontal towing at the surface. The cork was marked accordingly and inserted into the vial. A note of vial was made in record book. Owing to the shallow water at some of the stations only the one towing was taken but at other stations where the depth of the water was greater, the surface, one half the distance to the bottom and bottom towings were taken and marked accordingly. The complete trip was generally finished at 3.00 p. m., and the material brought to the laboratory for preserving. Four drops of formaldehyde and two or three of glycerine to each vial served as best preservative. The vials were placed on a special, private table and were not molested. The examination of material was made next day.

FIELD NOTES

CHART I

Date....6-29-16. Time....9:32 A. M. Sky....Hazy.

Station No.	I	II	III	IV	V	VI	VII	VIII	IX
Cent. Temp. at Surface	27.5	27.5	29.	28.	28.	28.5	28.	27.	27.
½ Dist. to Bottom	27.5	27.	29.	28.	28.5	28.5	28.	27.	27.
Bottom	27.5	27.	28.5	28.	26.	28.	28.	26.	27.
Depth	1'9"	2'8"	3'2"	2'	5'8"	1'4"	1'9"	6'2"	1'2"
Time a. m.	9:45	10:00	10:20	10:40	p.m. 1	2	2:15	2:30	3
Wind Direction	N.W.	S.W.	S.W.	S.W.	S.W.	S.W.	S.E.	S.E.	S.E.
Wind Velocity	L.B.	L.B.	L.B.	L.B.	L.B.	L.B.	L.B.	S.B.	S.B.
Turbidity	1'9"	2'8"	8'	2'1"	3'8"	1'8"	1'9"	3'1"	1'2"
Air Temperature	27	27	27	27	26	26	26	26	25
CO_2 Cont. No. c.c. per M.	3	0	20	2	10	0	0	7	2

Vial No.	*Location*
I	Horizontal Towing from station I.
II	Horizontal Towing from station II.
III	Horizontal Towing from station III.
IVa	Horizontal Towing at surface from station IV.
IVb	Horizontal Towing ¼ D. to B. from station IV.

IVc	Horizontal Towing at bottom from station IV.
Va	Horizontal Towing at surface from station V.
Vb	Horizontal Towing ¼ D. to B. from station V.
Vc	Horizontal Towing at bottom from station V.
VIa	Horizontal Towing at surface from station VI.
VIb	Horizontal Towing ¼ D. to B. from station VI.
VIc	Horizontal Towing at bottom from station VI.
VIIa	Horizontal Towing at surface from station VII.
VIIb	Horizontal Towing ¼ D. to B. from station VII.
VIIc	Horizontal Towing at bottom from station VII.
VIIIa	Horizontal Towing at surface from station VIII.
VIIIb	Horizontal Towing ¼ D. to B. from station VIII.
VIIIc	Horizontal Towing at bottom from station VIII.
IXa	Horizontal Towing at surface from station IX.
IXb	Horizontal Towing ¼ D. to B. from station IX.
IXc	Horizontal Towing at bottom from station IX.

A qualitative and quantitative microscopical analysis was made of the contents of each vial. Three slides were made from each sample and the kinds and quantity of forms noted. The average number of each form on three slides was recorded as on Chart II.

6-29-16 CHART II

Vial No.	Bacteria	Algae	Diatoms	Arcella	Nauplius	Bosmina	Cyclops	Cypris	Chydorus	Simocephalus	Daph'a
I	sparse	sparse	0	1	6	12	38	14	12	12	2
II	sparse	sparse	6	3	23	0	5	5	3	0	0
III	abundant	absent	20	0	45	0	9	2	10	0	0
IVa	abundant	absent	2	2	9	4	24	11	0	3	7
IVb	abundant	present	12	8	2	2	14	19	10	8	1
IVc	sparse	present	10	6	5	17	6	3	12	1	0
Va	sparse	present	12	5	41	5	9	0	8	0	0
Vb	sparse	abundant	0	0	7	3	4	14	3	6	2
Vc	sparse	abundant	14	8	1	2	1	10	0	2	0
VIa	sparse	abundant	4	3	48	40	34	18	12	14	3
VIb	abundant	abundant	9	7	2	12	24	16	7	5	0
VIc	sparse	sparse	18	9	7	1	9	4	0	2	0
VIIa	sparse	sparse	0	1	16	1	2	12	8	7	1
VIIb	sparse	sparse	2	0	8	1	3	8	12	3	2
VIIc	absent	abundant	5	2	7	3	0	7	0	0	0
VIIIa	absent	abundant	0	0	5	3	0	6	3	2	0
VIIIb	absent	sparse	0	0	4	2	1	1	0	3	1
VIIIc	sparse	present	7	3	2	4	6	5	3	0	0
IXa	absent	sparse	0	0	2	4	2	0	1	2	0
IXb	absent	sparse	3	6	7	10	7	6	0	5	1
IXc	absent	absent	12	15	0	3	1	12	6	0	3

Chart I represents the data taken on the following days in 1916. June 22, 23, 29. July 7, 13, 21, 24, 26, 28. August 2, 4, 8, 16, 22. On each trip a similar chart was used and at the end of the summer the average temperature, turbidity and carbon dioxide content was calculated. Chart I shows the average at each station. Thus fourteen charts similar to I and II were made, denoting fourteen trips to each station and from the data taken at each station the following conclusions were drawn.

Stations I and II. Very shallow; temperature variable; bottom covered with decomposed plant life. The Entomostraca which feed on plants, desmids, diatoms, etc., were quite abundant. The greater the rainfall the more abundant the Entomostraca at all of the stations. 3 c. c. of carbon dioxide per 1000. No effect on forms found at such a low per cent.

Station III. Comparatively deep. Carbon dioxide content high, 20 c. c. per 1000. Bacterial growth abundant. Numerous Entomostraca in nauplius stage. Adults found more numerous at Station IV where vegetation was more plentiful. The number and genera fluctuated from day to day due to the current from the sewer channel.

Station V. This station was one of the deepest in the Cove and although fewer forms were found here their number and kind were more constant. It was found by taking three horizontal towings that the Entomostraca tend to be uniformly distributed in a horizontal plane having the maximum number about 2 feet below the surface and the minimum at the bottom. The nauplius stage appeared first in the upper waters of the Cove quite near the surface. Increase in population results in extension downward, and the mass becomes most uniformly distributed at its maximum developement. With decline of production there is a relative increase in numbers in the lower waters. Common sunfish (*Eupomotis gibbosus*) were feeding on the surface forms.

Station VI. Located near shore having similar surroundings and environment that existed at Stations I and II. The forms frequently found here were Daphnia, Simocephalus, Chydorus. Sunfish had built their nests at this point and fed upon these forms. It is estimated that one *Daphnia pulex* (female) may have a progeny of 13,000,000,000 in sixty days. It is little wonder then that the Entomostraca form one of the chief foods for fishes. It was also noted that when large numbers of Daphnia occurred and a cloud would shade the rays of the sun these forms would come nearer to the surface and with the passing of the cloud the forms would descend.

At Stations VII, VIII, and IX, which were at the outlet of the Cove all the forms fluctuated owing to the wind currents producing waves. Especially was this true when the wind came from the south or the southeast. On calm days the greater numbers were found near the surface while on windy days they were entirely absent or only a few near the bottom. Very seldom was the nauplius stage found at this station.

At Stations I, II, VII, and IX, the water was shallow and the temperature remained constant or would tend to constancy throughout the slight depth, depending upon atmospheric changes. At these stations the forms were found to be numerous on warm, bright days but very few could be found on cool, dark days; at such times they were more numerous in deeper water where less fluctuations in temperature occurred. Greater fluctuations occurred in the narrow Cove which was also shallower, than in Lake Erie or in the abandoned quarry pond to be described later, both of which were considerably deeper.

This sums up only a very minute portion of such a vast problem and only a few conclusions have been drawn. In addition the following data was collected on trips taken to neighboring bodies of water and also on some other observations made in Beimiller's Cove.

Blue Hole, Castalia.

Blue Hole is located at Castalia, Ohio, which is about six miles southwest from Sandusky, Ohio, close to the Big Four R. R. tracks.

A party of four made observations and collected material from Blue Hole, July 3rd, 1916. We arrived at this place at 10:45 a. m., the weather conditions being ideal. The sky was clear, the sun hot and the wind very perceptible.

The Hole is 80 feet long, 64 wide and about 45 deep; having two small outlets about 3 feet wide, leading from either side. It is surrounded by a narrow path about 2 feet wide and surrounding this there is thick vegetation, 6 inches to 3 feet high. Extending from the bank, out about 2 feet on the top of the water there is a shelf of plant life made up of moss, chāra, algae, spirogyrae, and other forms intermingling.

On this particular day we found the water to be exceedingly clear and blue. This blue color is probably due to the blue-green algae and great amount of sulphur present. The Hole is fed by springs which, on some days, bubble up to the surface. The water is ice cold and very odorous of sulphur. Workmen, who get drinking water there, say that when the springs are bubbling it is impossible to see the bottom owing to the great agitation. The sides and bottom are composed of marl and only a slight growth of vegetation occurring on the sides near the top, was found.

From the two streams leading from the Hole, numerous trout are caught every year but in the Hole itself animal life is very sparse. We could see no fish but found one stickleback underneath the plant shelf. The keeper of the Castalia Fishing Club said that he had seen trout swim across Blue Hole with mouth out of water and then jump on to the land. From these facts we drew the conclusion that there is but very little free oxygen present.

From the shelf which covered the water for about two feet from the shore towards the center, pieces of the shelf, 1 foot long by 6 inches wide, were taken from the Hole and examined. The first piece was taken from a point nearest the center of the Hole. It was made up of moss and algae. On the under surface there were found numerous snail eggs but only a few adult forms. Located in the mat there were *Gammarus* and snails. Very few forms were found on the top of the mat.

The second piece was taken from a point close to the shore and the odor from this piece was very strong of sulphur. Few forms were found on the surface and on the bottom but in the mat the following forms were found: numerous insect larvae, snail eggs, leeches and *Gammarus; Asellus* sparse, and only one earthworm.

The third sample, taken from the mat next to the shore, was made up of chara. In this the *Gammaridae* and *Asellae* were abundant. Also found *Simulium* larvae. In a piece of *Spirogyrae* mat taken from a similar point numerous *Annulates* were found.

A sample of moss taken from the Hole at the upper end had very little life on it, one earthworm being found.

Sample number 5 was taken from near the shore and was made up of mint, moss and other plants and it was found to be sparsely inhabited; a few snails, leeches, and insect larvae. Three pieces of moss, the size of the hand, were taken next and examined and the following were found:

A..............7 Gammaridae.
B..............13 Gammaridae.
C..............14 Gammaridae.

From a piece of chara the same size:

A..............3 Gammaridae.
B..............4 Gammaridae.
C..............4 Gammaridae.

The moss seemed to be the most desirable. The gray colored type which is the larger was found, as a rule, nearest the shore. These *Gammaridae* also live near the surface. Other forms found were earthworms, snails, *Asellus* (few) and *Hydrophilous* beetles (few). In the protected place along the shore a great many *Physa* were found on the algae.

On another lump of moss the size of the hand we found 21 leeches, 5 snails, 2 earthworms, 1 beetle, 10 *Gammaridae*.

From the preceeding data we drew the following conclusions:

1. Life scarce, due to lack of oxygen.

2. *Gammaridae* most numerous of forms found, being most abundant near the surface and in the plant life along the shore.

3. Algae and moss plentiful, furnishing abundant food for plankton.

Towings were taken at the surface (Tw. 1); (Tw. 2) ½ the distance to the bottom and in these the following forms were found:

Tw. 1.
Diatoms (abundant).
Spirogyrae (sparse).
Blue-green algae (abundant).
Roundworm (Nais 1).

All smaller protozoans absent. A few Desmids found.

Tw. 2.
Spirogyrae (sparse).
Cypris..................4.
Annulates...........3.
Insect larvae......2.

On August 3rd. we took the following readings, the carbon dioxide content being taken about 10 feet below the surface:

Reading No. 1..............50 c. c. per M.
Reading No. 2..............60 c. c. per M.
Reading No. 3..............60 c. c. per M.

The depth of the water near the log on the west side is 32 feet. The depth in the depression on the east side is 29 feet.

The temperature at the lower outlet was 41.3 F. The temperature around the shelf where the water is more stagnant than at the outlet was 60.8 degrees F.

BEIMILLER'S COVE, CEDAR POINT.

July 5, 1916.

A strip of shore water 100 feet long and 30 feet wide along the northwest corner of the Cove was examined for aquatic forms. The temperature of the water was 27 degrees C., and this was constant throughout the slight depth of 2 to 3 feet.

The flora found consisted of willows along the shore, *Myriophyllum* and *Ceratophyllum* just below the surface, roots of grasses and trees along the shore, and reeds throughout the space covered.

On the surface of the water along the shore were found adult mayflies and midges while adult *Lepidoptera* were flying over the water. There was an abundance of vegetation near the shore and this accounts for the mucky bottom at the east end of the Cove. Leeches (*Glossiphonia*) were found to be numerous and *Asellus* were abundant.

In the mud and under the surfaces of leaves and in among the roots along the shore the *Gammaridae* were numerous. Also found large egg masses of P*olyzoa*, pupae cases, *Oniscus*, leeches, and snail eggs.

On the reeds which were all growing from a sandier bottom, leeches, water mites, snails, polyzoans and snail eggs were found. On all vegetation in this locality polyzoans were found in abundance. *Gammaridae* most numerous on myriophyllum and algae.

On the bottom along the northeast side of the Cove a few mussels (*Lampsilis*), numerous snails at a depth of 2½ feet; and sunfish nests at 2 to 3 feet were found; also a few crayfish.

The air temperature during the collecting period was 27 degrees C. and the water temperature 25 degrees.

SUNFISH NESTS—BEIMILLER'S COVE.

July 5, 1916.

The sunfish build their nests along the shore in shallow water where the bottom is unusually sandy and free from vegetation.

The nest consists of a saucer-like depression having the bottom lined with small pebbles. These pebbles may be the result of the fanning, described later on, or they may be the result of wave action.

In the process of building the nest the fish clear the desired location by swimming around and around the spot in a very methodical manner; swimming clockwise three or four times then erecting the body and using the tail as a fan or broom to clear away the vegetation and other foreign substances; then they swim counter-clockwise for three or four times and go through the same process of sweeping. At regular intervals, usually after four complete cycles, they dart out to survey the surroundings for enemies, etc.

They are gregarious in their nest building habits. We found anywhere from 6 to 14 in a colony in the Cove.

MARSH POND—KELLEY'S ISLAND.

July 8, 1916.

Large marsh pond located about 75 yards from Lake Erie. Great abundance of vegetation consisting of algae and spirogyrae. The bottom was covered with a deep mud. The following forms were found: beetles, water striders, snails, few *Gammaridae* and tree toads. Back swimming beetles, *Hydrophylidae, Dytiscidae;* numerous crayfish, minnows, frogs amid the vegetation, leeches and *Rhyncophoridae.*

This marsh was formerly a celery bed but now kept moist and marshy by springs and seepage from the lake.

ROCK BOTTOM POND—KELLEY'S ISLAND.

July 8, 1916.

The pond was originally a quarry and has been blasted out at least 14 years ago. It measured 100 feet wide and 120 feet long. Rocky bottomed and rock bound. Turbidity 9 inches. One corner was covered with grass and willow bushes. Abundant algae and spirogyrae around the edge.

On the surface were found water striders, *Gyrinidae,* back swimmers, *Notonectidae,* midgepupae, diptera larvae, fish, turtles, toads, leeches and snails. Also found an Oligocheat (*Lumbriculus*) close to the rocks in spirogyrae.

In a surface towing taken from a point 10 feet from the shore along the bottom the following forms were found:

Cyclops..........75.
Cypris..........26.

Numerous *Colpoda* which resembled *Paramecium* only smaller.

LAKE ERIE AND SANDUSKY BAY FARMS.

July 17, 1916.

Comparison of plankton in Lake with that in Bay.

No. 1 Tw. in Bay.

1. *Ceratium* (numerous).
2. *Nauplius* (numerous).
3. *Cyclops.*
4. *Annulata* (*Stylaria lacustria*).
5. *Rotifera.*
6. *Diatoms* (Asterionella).
7. *Arcella discoidea.*
8. *Bosmina* (few).
9. *Amoeba proteus.*

No. 2 Tw. in Bay.

1. *Bosmina.*
2. *Nauplius* (numerous).
3. *Cypris* skeleton.
4. *Ceratium* (numerous).
5. *Rotifera.*
6. *Peritricha* (*Podophrys*).
7. *Diatoms.*
8. *Daphnia hyaline.*
9. *Cypris.*
10. *Closterium.*

No. 1 Tw. in Lake.

1. *Monostyla.*
2. *Ceratium longicorne.*
3. *Difflugia lobostoma.*
4. *Bosmina striata.*
5. *Nauplius.*
6. *Diatoms* (Asterionella).

No. 2 Tw. in Lake.

1. *Difflugia lobostoma.*
2. *Ceratium.*
3. *Diatom.*
4. *Algae.*
5. (Fish).

From the preceeding comparison we find that the planktonts are more numerous in the Bay than in the Lake and in the Lake they are more numerous a distance out where the shore does not affect the occurrence than they are near shore. For self preservation the planktonts avoid the battering action of the waves along the shore.

Pipe Creek, Sandusky.

July 19, 1916.

Pipe Creek is a typical rock-bottomed stream which begins in a marsh near the Bay and empties back into the marsh. The stream is about 15 feet across and a sewer empties into it at the bridge near the Soldiers' Home, from where we started. The vegetation consisted chiefly of algae which was directly in the stream. Also found live crayfish and many small minnows.

Vegetation covered with *Eucrangonyx* and beetles; damsel fly larvae were also quite abundant; small cat fish, dragon fly larvae, several snails, cat fish fry and the numerous skins of crayfish which had been shed.

Towing No. 1 was taken below the bridge along the shore. The current was moderate; depth about 8 inches; sewer contamination present. Air temperature 32 degree C. Water temperature 32 degrees C. Found *gammarus*, *diatoms*, and *arcella*.

Towing No. 2 was taken from a quiet pool banked off from the main channel by rocks. Found *cyclops, arcella, difflugia* and *diatoms.* Life very sparse.

Towing No. 3 was taken from a quiet pool in the creek below the cemetery, the spot being well shaded. Contamination from all the sewers from the cemetery and below was present at this point. No vegetative forms were present.

1. *Annulata* (*Nais*).
2. *Amoeba proteus.*
3. *Diatoms* (numerous).
4. *Rotifera* (*Brachionus entzii*) numerous.
5. *Paramecium.*
6. *Arcella.*
7. *Euglenoidea* very abundant and this is indicative of sewage contamination; encysted forms abundant also.

More forms found here and the species were more numerous than at the points from which the two preceding towings were taken.

Down about 150 feet the vegetation was chiefly of a chara-like plant. Rapids were located below the second point of collection. In the rapids we found snails (numerous) larvae cases of midges, nematodes, beetles.

From rock on bottom: plannaria, caddice fly cases, bryozoan, snail eggs, fly larvae, egg case of water beetle, leech and hydra.

Air temperature was 30 degree C. and that of the water was 35.

Lake Erie Plankton.

July 27, 1916.

Towing No. 1 at surface.

3 *Vorticella* on blue-green algae (Anabaena Flos-aquae).
2 *Diatoms.*

Towing No. 2. ½ distance to bottom—10 feet.

12 *Nauplius.*
2 *Cyclops.*
1 *Bosmina.*
18 *Vorticella* on *Anabaena Flos-aquae.*

Towing No. 3 taken from the bottom—20 feet.

4 *Daphnia hyalina.*
65 *Cyclops.*
20 *Nauplius.*

There were few forms found at the surface, more numerous at the middle and bottom, greatest number at the bottom. The adult cyclops most numerous at the bottom while the nauplius stage was found to be most abundant ½ distance to the bottom.

Vorticella seemed to be very fond of the blue-green algae, *Anabaena flos-aquae*.

SANDUSKY BAY PLANKTON.

July 27, 1916.

Towing No. 1 at surface.
Cyclops.
Nauplius.
Ceratium (numerous).
Vorticella.
Rotifera (numerous).

Towing No. 2 ½ distance to bottom.
Ceratium.
Cyclops.
Difflugia.
Daphnia kalbergensis.
Nauplius.

Great abundance of animal life throughout Bay.

STARVE ISLAND.

July 25, 1916.

Starve Island is located about 20 miles from Cedar Point and about one mile from Put-in-Bay. The island is made up of about ¾ of an acre of limestone and only a slight amount of vegetation occurs on the northeast corner (Plate II).

This island is the nesting place of both the common and black tern and all ages of the birds were found. The youngest ones were found protecting themselves from the sun's heat by keeping in the shade of rocks. This was also a striking example of protective coloration. Found one garter snake and this was the extent of life on the island.

ABANDONED QUARRY—MARBLEHEAD, OHIO.

July 15, 1916.

Abandoned quarry at Marblehead, three or four years old, a typical rock bottom pond. Observations and reading were taken at three stations. Breezy and very bright sunlight.

Station 1.

Located about 50 feet above dock near the center of the pond. Rocky bottom and only a slight trace of algae. Depth 7 feet, 4 inches.

Temperature.

Surface	28 C.
½ dis. to bottom	27 C.
Bottom	21 C.

Carbon dioxide content.

At surface	1 c. c. per M.
At bottom	7 c. c. " "
2 ft. below surface	5 c. c. " "
7 ft. below surface	5 c. c. " "
½ ft. below surface	3 c. c. " "

No. 1 towing taken from the surface.

No. 2 towing taken from the bottom.

No. 3 sample was taken by pumping from the bottom into a net which was tied at the narrow end or outlet of the pump and then the net was carefully washed.

No. 4 towing taken from the bottom.

Station 2.

Located just off the dock. Depth 10 feet. Turbidity 9 feet.

Temperature.

28 C. at surface.
27 C. ½ distance to bottom.
27 C. at bottom.
No carbon dioxide present at surface.
2 c. c. per M. at bottom.
1½ c. c. per M. 7 feet below surface.
7 c. c. per M. 5 feet below surface.

No. 5 deep towing off dock.
No. 6 surface towing off dock.
No. 7 ½ distance to bottom from dock straight across to other side.
No. 8 surface towing from side to side.

Station 3.

At entrance of undercut from Lake through which undercut the pond is kept supplied with water. This point is supposed to be the deepest part of the pond but sounding proved that the pond was the same depth throughout.

Depth..............7ft. 4in.
Turbidity........7ft. 4in.

Temperature.

28 C. at surface.
28 C. ½ distance to bottom.
27 C. at bottom.

No. 9 deep pond dredging.

Carbon dioxide.

At surface..........1 c. c. per M.
At bottom..........5 c. c. per M.

Sunfish were found in the pond and also one stickleback. These fish had been thrown into the pond by fishermen. In pools, cut off from the main part we found water beetles and water striders. In pools not quite cut off from the shallow pools we found an abundance of algae upon which there were numerous beetles (*Hydrophyllidae*) and many small snails. Given below is a summary of the different towings with forms, quantity and quality found in each towing.

No. 1 Towing.

1. *Bosmina*	1
2. *Diatom*	1

No. 2 Towing at bottom.

1. *Nauplius*	3
2. *Bosmina*	2

No. 4 Towing.

1. *Ceratium longicorne*	24
2. *Nauplius*	3
3. *Cyclops*	5
4. *Bosmina*	11
5. *Daphnia*	4

3. *Nematoda*	1
4. *Ceratium longicorne*	672

No. 3 Towing taken by pumping.

1. *Cypris*	4
2. *Diatoms*	5
3. *Difflugia*	1
4. *Ceratium longicorne*	10

No. 6 Towing.

1. *Bosmina*	11
2. *Nauplius*	9
3. *Ceratium longicorne*	68
4. *Rotifera skeleton*	1

No. 8 Towing.

1. *Cypris*	1
2. *Bosmina*	1
3. *Nematoda*	1

No. 5 Towing.

1. *Cypris*	1
2. *Rotifera*	2
3. *Bosmina*	28
4. *Nauplius*	4
5. *Cyclops*	7
6. *Ceratium longicorne*	80
7. *Difflugia*	3

No. 7 Towing.

1. *Nauplius*	10
2. *Bosmina*	14
3. *Arcella*	8
4. *Cylcops*	2
5. *Vorticella*	7
6. *Ceratium longicorne*	563

Our Birds in November.

BY BROTHER ALPHONSUS, C. S. C.

November is the month when the last of the summer residents and spring migrants depart for their winter homes. Fox Sparrows, Titlarks and Myrtle Warbles, among the migrants, are the last to leave us. And among the summer residents, the Robin, Kingfisher, Bronzed Grackle, Killdeer, Vesper Sparrow, Golden-crowned Kinglet and Logger-head Shrike are the latest to depart. The species that are most frequently seen in November are the Song Sparrow, Goldfinch, Cardinal, Biue Jay, Crow, Downy Woodpecker, Redheaded Woodpecker, White-breasted Nuthatch, Chickadee, Snowbird, Purple Finch and Tree Sparrow. Those that are less frequently observed are the Brown Creeper, Hell Diver, Prairie Horned Lark, and Mourning Dove.

SONG SPARROW
Melospiza melodia

This favorite songster is quite hardy, and remains north in small numbers all winter. In November the bird may be heard calling near its summer haunts along the shores of lakes and streams; and occasionally on bright days, the cheery notes of its song will greet the bird-lover. Not infrequently the pedestrian will startle a

Song Sparrow near the edge of a lake, when the bird will fly across the water.

Goldfinch

Astragalinus tristis

In late autumn the Goldfinches gradually grow fewer and fewer in number, and finally no records will be made by the careful observer for days together. In the first part of the month these birds are found in small flocks, and may be readily known by the characteristic call-notes. By this time the Goldfinches have changed their bright summer plumage for the sober dress of winter.

Blue Jay

Cyanocitta crestata

Hardly less striking in appearance than the Cardinal is the handsome Blue Jay. He gives the observer every opportunity to appreciate the beauty of his blue coat, for the bird often drops to the ground, or perches in a low tree or shrub. Here he almost deafens a person who may be close to him by his harsh call-note. The fine bell-like note of the Jay may be heard at any time of the year, but less often in autumn and winter.

Downy Woodpecker

Dryobates pubesceno

This gentle bird may be seen quite frequently in November and also in winter. Usually alone, the Downy Woodpecker is never noisy like most of the other woodpeckers, but utters its note demurely while working on the bark of our forest or park trees. It would be interesting to know what amount of good one Downy Woodpecker does for our trees in the way of searching in the bark for the larvæ of injurious worms and insects.

White-Breasted Nuthatch

Sitta carolinensis

This is the greatest acrobat among the bird tribe. It is always interesting to watch a Nuthatch climbing up or down the trunk of a tree. Both in woods and among park trees this useful bird may be found in winter or summer at work on the bark. More clever in climbing than the Chickadee, the Nuthatch can get at any part of a branch to examine it and find out whether there are any enemies hidden out of sight.

Crow

Corvus brachyrhynchos

The Crow is an interesting bird at all seasons of the year, but most interesting in the bleak days of late autumn. Then he will enter our groves singly or in small numbers, flying about noiselessly and occasionally cawing. Sometimes great flocks of Crows may be seen feeding in corn fields, where they often rise, fly for a short distance, and then they alight again.

Cardinal

Cardinalis cardinalis

The always striking Cardinal remains with us the year round, and is more common in autumn than at any other season of the year. He makes a beautiful picture perched in a bare apple tree in the orchard. Usually his call-note is first heard before one is aware of the bird's presence. The Cardinal does not whistle in November or during the winter months.

Red-Headed Woodpecker.

Melanerpes erythrocephalus

If you see any Red-headed Woodpeckers in November you may know that we shall have a mild winter. This is an infallible sign. Mr. John Burroughs published recently in the newspapers his opinion that we should have a severe winter, owing to the presence in Michigan of a number of Arctic birds supposed to be found there only in very cold weather. But I think the winter will be a mild one, for the Red-headed Woodpeckers are here in numbers.

Chickadee

Parus atricapillus

At no other time of the year are Chicadees so common as in the month of November. In fact I think they are more in evidence then than any other species of bird. Always confiding and easily approached, they utter their well known notes with snap and vigor. Their disposition suggests smartness, while their trim appearance adds to their attractiveness.

Snowbird

Junco hyemalis

The snowbirds or juncoes are our favorite winter birds. But they are more abundant in late fall than in winter. When the ground is covered with snow, the juncoes seem to retire farther south, and only occasional flocks remain to eke out a scanty living in the snow. Always lively and chatty, the juncoes are a delight to the regular pedestrian.

Tree Sparrow
Spizella monticola

This species is probably the latest arrival of the northern migrants. Similar in plumage and in call-notes to the Field Sparrow, the Tree Sparrow comes to our latitude about the time the former leaves us. For this reason it is not easy to be always sure which species you may find at this particular season. Another drawback in the matter of indentifying the Tree Sparrow, is its scarcity at the time it first appears.

Purple Finch
Carpodams purpurens

Late in autumn and in mild winters Purple Finches may be found in small flocks feeding on weed seeds. They loose their bright spring plumage before November, and are then difficult to distinguish from the English Sparrow. No longer is their sweet strain heard, but by a characteristic call-note, when known to the observer, is the easiest way of indentifying the species.

Notes on Variation in Chicory.

N. M. Grier, Ph. D.

Chicory, (*Cichorim Intybus, L.*), has appeared in this section of the Shenandoah Valley within the past few years. Recently the writer has had opportunity to observe its variation, especially with regard to floral structures.

Flowers. Of the 412 specimens examined from various localities and the frequency of whose rays were plotted, those with 14 were found to be most numerous with a total of 76 cases. The curve of variation based on the data obtained was remarkable normal and free from 'skewness' in every respect. Minor modes were obtained for 13 rays in 64 cases at 15 in 65 cases. The least number of rays found was six, the greatest 22.

It appeared that as a whole, the rays were most numerous on heads obtained where the exposure was an open one, such as the roadside on a level stretch of ground, while they were most numerous in the leading classes of 13, 14, 15 rays when these were taken from hillsides consisting largely of rocky or infertile ground. In about 20 of the 412 specimens the heads were solitary, and usually on elongated branches. Of the total number one was white in color, 2 pink, and the others various shades of blue.

Involucre. 238 of 259 outer involucres possessed 5 bracts, but there were 12 specimens with 6 bracts. The least number obtained here was 4, the greatest was 8. Greater variation was encountered in the inner portion. Here there were 140 cases of 8 bracts, 53 of 7, 47 of 9. Least number obtained was 6, greatest was 10.

With its rather extended distribution, and consisting as it does of a moderate number of floral parts, chicory should make where readily available, convenient laboratory material for the study of variation in classes of Biology. Unopened buds will flower until 2 or 3 days after having been brought into the laboratory.

Hollins College, Hollins, Va.

Our Birds in December.

BY BROTHER ALPHONSUS, C. S. C.

It may be interesting to compare the records made by the writer for two Decembers—one (1918) a mild month; the other (1919) partly a cold month. With most of the species the number records was somewhat larger for December, 1918. On the other hand the Downy Woodpecker had notably more records for December 1919.

The records for the two years under comparison would seem to indicate that a difference in the temperature does not necessarily show there are fewer species found when the weather is cold. All the birds except the Hairy Woodpecker and Screech Owl were seen in both Decembers.

The cold weather in December, 1919, moderated after the middle of the month, and then most of the re cords for the Cardinal and the Purple Finch were made.

DECEMBER 1918.

Hairy Woodpecker, 6, 9, 28.
Downy Woodpecker, 6, 15.

Red-headed Woodpecker, 1, 2, 6, 7, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 22, 23, 30.
Goldfinch, 11, 12, 13.
White-breasted Nuthatch, 1, 3 to 19, 21, 23, 25 to 29.
Blue Jay, 1 to 7, 10 to 13, 15, 17, 18, 19, 29, 30.
Crow, 2, 11, 15, 16, 19, 23, 25, 26, 28, 29, 31.
Chickadee, 3, 5 to 9, 11, 13, 14, 15, 16, 18, 29.
Song Sparrow, 3, 5, 6, 8, 9, 10, 13, 14, 16, 17, 18, 19, 25, 26, 27.
Cardinal, 8, 12, 14, 15, 16, 18, 22, 27, 28.
Snowbird, 1, 6 to 15, 17 to 20, 23, 24, 27, 28, 30.
Tree Sparrow, 5, 6, 9, 14, 15, 17, 18, 23, 26 to 29.
Brown Creeper, 1, 6.
Purple Finch, 7, 25, 27, 28, 30.
Mourning Dove, 26, 27.
Total number of species seen, 15.

DECEMBER, 1919.

Downy Woodpecker, 2, 3, 5, 8, 11, 12, 13, 21, 22, 28.
Red-headed Woodpecker, 2, 5, 7, 8, 9, 12, 14, 16, 17, 19, 20, 21, 26, 27, 31.
Goldfinch, 14.
White-breasted Nuthatch, 1 to 5, 7, 8, 9, 12 to 16, 19, 20, 22, 24, 25, 31.
Blue Jay, 5, 7, 8, 9, 11, 12, 13, 18 to 22, 26, 28, 31.
Crow, 2, 7, 9, 26.
Chickadee, 1 to 5, 8, 12, 16, 17, 20, 21, 25, 27.
Song Sparrow, 1, 2, 3, 9, 12, 14, 25.
Tree Sparrow, 23.
Cardinal, 15, 19, 23, 30.
Snowbird, 1, 2, 3, 6, 7, 11, 16, 26.
Brown Creeper, 9, 27.
Purple Finch, 3, 19, 25.
Mourning Dove, 2.
Screech Owl, 16.
Total number of species seen, 15.

NOTE

Contributions on general and midland natural history will be gladly received. Papers on botany and allied subjects, zoology, geology and physical geography, should be addressed to the editor.

Matters relating to advertisements are to be taken up with the secretary of the University.

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THE EDITOR, Notre Dame, Indiana.

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Notes on Alabama Plants.

BY W. WOLF, O. S. B.

TALINUM.

Dr. Charles Mohr in the Systematic Catalogue of his principal work, the Plant Life of Alabama, which appeared in 1901 as Vol. VI., Contributions from the U. S. National Herbarium, includes *Talinum teretifolium* Pursh as a member of the Alabama Flora. He mentions[1] four counties where the species is definitely known to have been discovered, and indicates its restricted distribution there with the remark "not frequent, local." The counties mentioned lie in two distant sections of the State; the one in the central part of Northern Alabama, the other in the Eastern central part of the State. Three of the four counties, which are adjoining, are located in the former section, viz., Walker, Blount, and Cullman. Special localities are given for Walker and Blount Counties, none for Cullman. In the other section, a single station, Baldrock in Clay County, is mentioned. The elevation of this last being specified as 2200 feet, against 800 for Cullman and 1000 for Blount County.

For the present it is not my purpose to discuss the identity of the plants for the State in general with *Talinum teretifolium* Pursh as I have not had an opportunity of examining specimens from the several localities preserved in the herbarium of the Geological Survey of Alabama. I cannot, however, wholly refrain from touching on the matter in so far as Cullman County is concerned, for I have discovered a species distinct from the *Talinum teretifolium* Pursh though closely related to it. Unfortunately Mohr does not specify a definite locality for Cullman County. The statement of altitude, however, is of some value, for it shows that crests of higher elevation were not the station or stations where

[1] l. c. p. 496. 1901.

the plant was discovered, but that he refers only to the approximate level of that table land which is about 800 feet above sea level.

A second remark of Mohr has an indirect bearing on the question, and seems to support the suspicion that the plant reported from this part of the State is perhaps identical with the *Talinum* of my own discovery, and that it was confounded with Pursh's *Talinum teretifolium.* He credits the discovery of the plant in this locality to the Misses Emily and Mary Mohr. Now these ladies lived in the central part of the county, a mile or so distant from Cullman, and close to the Little River (Eight Mile Creek) where it flows through the premises of St. Bernard College. Not very far east of the College grounds, the banks of the stream,—'river' is a misnomer,—become cliffy, the place being commonly known as "The Cliffs." It is from this station that I secured my plants, and, in my mind, there is little doubt that it is likewise the place where the Misses Mohr made their discovery.

That the plant from this locality might have passed without critical examination as *Talinum teretifolium* is not very surprising; first, because this was considered the only species in the North, as well as in the South Eastern States; secondly, because of the short diagnosis which was considered sufficient by the earlier authors. Pursh's[1] classical diagnosis, "*T. foliis cylindricis carnosis, corymbis terminalibus pedunculatis,*" is such that it applies equally well to any species with terete leaves and a terminal peduncled inflorescence, here termed a corymb, but in reality a cyme.

In Chapman's Flora, formerly the leading manual for the South, no character is mentioned which would be of any use in the present case. In Gray's well known Manual of Botany[2] of the Northern United States, mention is made of one character which proves of value in point of comparison, viz., the varying number of stamens in the species *Talinum teretifolium,* limiting them from 15-20. This limiting of the number of stamens is in strong contrast with that found in the plant which I have discovered in Cullman County, in which the minimum is above forty. This difference, it seems should have aroused suspicion regarding the identity of the plant with *T. teretifolium* Pursh. Too much emphasis, however, must not be laid upon this point, for every practical taxonomist knows that the first statement about a limit, in case of variable characters,

[1] Pursh Fl. Am. Sept. 2; 365. 1814.

[2] A. Gray Man., 5th ed. p. 98.

is not necessarily very reliable, and, not infrequently, must be accepted with caution. Such a character, however, may become very valuable in the course of time if it proves constant under further observation.

Robinson and Fernald's Gray's New Manual confirms the constancy of the limit as stated in Gray's older manual. The same limit—15-20—is mentioned in Small's Flora of the South Eastern United States,[4] but with the restricting remark "usually." It is not clear whether this "usually" refers to an occasionally lower or higher number, but the former seems more probable when we refer to the key, which reads, "stamens less than 25." In Britton's works, the Manual of the Flora of the Northern States,[5] and the Illustrated Flora, the limit is extended both ways, viz., 10-30, against Gray's 15-20. Another good character is mentioned in these works, viz., the length of the style as compared with that of the stamens. This character with that regarding the number of stamens unquestionably makes the plant from the Cliffs on the Little River in Cullman County a species distinct from *Talinum teretifolium* Pursh.

The species is easily recognized by: stamens more than 40; style protruding beyond the stamens about as much as their respective length; petals 9-13 mm. long. It becomes then

Talinum Mengesii, spec. nov.

Type specimen in Herbarium St. Bernard College, no. 1668.

Plant succulent, glabrous, 2-4 dm. tall, perennial by a short horizontal rootstock which is sometimes branched, or the innovations arise from a very short vertical caudex; roots slender, fibrous, Stems tufted, generally few or single, 3-10, or rarely up to 15 cm. high, unbranched for almost the whole length, the one to five branches arising from near the top just below the base of the long wiry peduncle by which the stem is terminated. The branches, from a few to 10 cm. long, are often branched again at their ends from below the secondary peduncles, but these secondary branches generally do not develope beyond the phase of fascicled leaves, in other cases, however, grow to normal size and terminate into peduncles. The leaves are quite numerous but not crowded on the stem and branches, terete, 2-5.5 cm. long, 1.5-3 mm. thick, not

[4] Small's Fl. S. E. U. S. p. 440. 1903.

[5] Brit's. Man. N. U. S. & C. p. 385. 1905.

dilated at the base, the backward prolongation less than 1 mm. long, the apex bluntly pointed. The scape-like peduncles are slender but stiff and wiry, 7-20 m. long; the cyme is open and only occasionally corymbosely branched, but as a rule is umbellate, having generally three branches, which are from a few to 12 cm. long and radiate from below the central flower; the bracts are hardly 2 mm. long, inclusive of the posterior prolongation and are lanceolate-ovate; the pedicels are clavate and 5-10 mm. long. The sepals are 3, 5-4 mm. long about one third as long as the petals, ovate, obtusish. The corolla is rose-purple; the petals are mainly obovate, mucronulate, 9-13 mm. long, closing again after spreading for one day or some hours, withering, and at length, like the sepals, deciduous. Stamens 45-100, or occasionally a few more, but most commonly 50-80; filaments distinct, not adnate to the base of the petals, purple; anthers golden yellow. Style distinctly excerted beyond the stamens about as much as their own average length. Capsule 3-4 mm. high, subglobuse, angled at the sutures, 3-, or sometimes, 4- valved. Seeds 1 mm. wide, black, almost smooth, and slightly shining.

The plant in this station has little chance of holding its place in the far future which it once occupied in the past, namely, on the cliff bank of the Little River. The inhabited locality is already broken up into separated patches, the plant being now replaced by various species which were unable to adapt themselves to the formerly prevailing conditions. *Talinum Mengesii* is a plant content with a scant accumulation of soil on the exposed naked surface of the rock, sometimes establishing itself in such small quantities of soil that it cannot produce a proper rootstock for the first time because of insufficient protection. The accumulating soil is rich in organic matter, but I have seen plants flourishing equally well in pure sand, in a somewhat lower situation about an abandoned stone crushing mill. The plant frequently roots between the decomposing bases of xerophile bryophytes of an upright habit, which form patches on the rocks, from a hand's space to a few square feet, and offer a good protection for the plant's rootstock. In such situations the plant grows with practically no soil. But even in cases of a more upbuilt soil, this is rarely more than 1 cm. deep. Not so content is the plant in as far as light is concerned, for it is dependent on bright open sunshine, and this, under the circumstances of advanced soil conditions is its misfortune in the resulting competition. When the soil is about one cm. deep, sooner or later, accommodation of flowering plants other than *Talinum Mengesii* sets in. The first one which associates with this species is *Alsinopsis glabra* Small (*Alsine glabra* Michx.), yet, at least for the first, without interfering with the flourishing of the *Talinum Mengesii*. Because the former plant is a slender open branched, wiry, and rather short living annual with but a few small leaves, no serious overshading or crowding is effected, and thus both species tolerate one another very well. Yet the appearance of this species is a sign that the time is near at hand when *T. Mengesii* is doomed to give up its habitat. By and by other species, well fitted to form a closer plant association in a still scanty soil, begin to establish themselves with *Talinum Mengesii* and *Alsinopsis glabra*. Among the first of these are *Crotonopsis linearis* Michx., *Sarothra gentianoides* L., *Polygala Curtissii* A. Gray, *Allium microscordion* Small, etc. These are all sun loving plants, but unlike *Talinum Mengesii*, they maintain themselves well in the grassy swales which now establish themselves on the formerly barren rock, whence that species in this time of progression has already been outcrowded.

ARUNDINARIA TECTA (WALT) MUHL.

It is rather universally known that *Arundinaria tecta* like the other North American species *A. macrosperma* Michx. does not as rule flower each succeeding year, but remains sterile for longer or shorter periods, generally producing flowers only at intervals of several or even many years. However, such a uniform conception does not prevail in regard to the arrangement of the inflorescence on the plant, i. e.,—that part of the plant upon which the flowers are borne. The interpretation of the leading manuals of the Eastern flora is responsible for this difference of opinion on the character in question. This is to be regretted the more since it is a case in which the majority of botanists are unable to obtain first hand information through actual observation because of the two factors, namely; the sterility and the restricted habitat of the plant.

Curiously enough the uncertainty arises in the diagnosis found in the descriptions of *Arundinaria tecta* given by the authors of the newer manuals, viz.—Gray's New Manual, Britton's Manual of the Flora of the U. S., and Small's Flora of South-Eastern U. S., while in the older manuals, viz.—Gray's Manual, and Chapman's Flora, the diagnosis of the point in question is far more complete.

For clearness' sake let me give an example: In the fifth edition of Gray's own work, Manual of Botany,[1] that part of the description which relates to the inflorescence reads, "spikelets solitary or in a simple raceme at the summit of the branches or frequently on leafless radical culms." At the end of this text we find the word "*Chapman*" and from this we learn that the foregoing statement is not based on Gray's own observations, but that it is accredited to the authority of Chapman. Thus it might seem that the citation of the diagnosis should have been more justly quoted from Chapman's own work, but let me emphasize the fact that Gray himself is not guilty of the violation attributable to the recent authors whose work sails somewhat under the protection of Gray's authority, since his name is associated with the title of the book. The wording in Chapman's original work, The Flora of the Southern United States,[2] is literally the same and needs no repetition.

Upon Chapman's authentical and precise diagnosis we must assume that the flowers may appear on both parts of the plant, namely, on the branches of the leafy culms and on the distinct radical culms. The text in Robinson and Fernald's Gray's New Manual[3] reads, "panicles of few spikelets on long slender branches." The wording differs from that of the old Manual but it does not interfere in our case, for only the words "on branches" relate to the point in question. A comparison with Chapman's text, as adopted by Gray in his own publication, shows that only a part of the diagnosis has been retained by the authors of the New Manual, i. e., that the inflorescence is borne on the branches. The part relating to the radical culms is entirely discarded.

Consulting leading manuals of another school, we find a statement contrary to the one found in "Gray's New Manual." This, however, is a part of Chapman's diagnosis, the very part which the authors of Gray's New Manual have rejected. The works referred to are, "Britton's Manual of the Flora of the Northern United States and Canada" and Small's "Flora of the Southeastern United States." In Britton's Manual[4] the text reads, "racemes on short leafless culms;" in Small's Flora,[5] "inflorescence borne on short leafless stems."

Thus it is obvious that neither in the so called Gray's New Manual nor in the other two works, Britton's Manual and Small's

[1] l. c. p. 98. [2] l. c. p. 561. 1882.
[3] l. c. p. 171. 1908. [4] l. c. p. 158. 1905. [5] l. c. p. 161. 1903.

Flora is a character found which is not included in Chapman's diagnosis, and to which Asa Gray faithfully adhered in the publication of his own Manual. This only is new and strange, viz., that Chapman's diagnosis has been divided. The authors of the one school made part of his statement their own, while those of the other school were content with the rest of it.

This violation of Chapman's diagnosis becomes more pronounced from the fact that in Britton's Manual,[1] and also in Small's Flora,[2] the retained part is made use of as a specific distinction in connection with the size of the plant, for the key presented with the genus Arundinaria reads:

"Spikelets borne on radical shoots of the year; culms 4 m. tall or less, —1 A. tecta.

Spikelets borne on the old stems; culms 5 m. tall or more,—2 A. macrosperma."

The above citation is from Britton's work and is identical with that found in Small's Flora in regard to *A. tecta*, and almost the same in regard to *A. macrosperma*. But Chapman's full text on this part is; "frequently on leafless radical culms." Now, it is logically not the same to simply state "on radical shoots" in place of "frequently on . . . radical culms." The rejection of the word "frequently" becomes almost a necessity in order to make the character a specific distinction.

Now, although the authors of these recent manuals (Hitchcock is credited with having elaborated the *Gramineæ* in Gray's New Manual, Nash, this same family in Small's Flora) have reached conclusions which led to the discarding of a part of Chapman's diagnosis as a result of actual observations or, examination of herbarium material, this does not justify their rejection of either of the two characters for the very reason that the species is an exceptionally rare object of observation in the flowering state. Furthermore the observation of only one phase is no absolute proof against the other. The contradiction resulting from the method used by these authors is plainly evident, for the author in the New Manual tells that the flowers appear on the branches; while the authors of Britton's Manual and Small's Flora state on the contrary that the flowers are borne on radical shoots. It was the duty of these authors to retain both diagnostic characters and place the responsibility on Chapman, a botanist of sufficient ability to

[1] l. c. p. 158. 1905.

[2] l. c. p. 161. 1903.

make correct observations on such conspicuous characters. In case this should not have satisfied the authors, they could have expressed their doubt in the customary way by placing a question mark after Chapman's statement.

To do justice to Dr. Chapman, in bringing his diagnosis to the test, the results of my own observations are herewith presented. The following short statement is based on observations of the species *Arundinaria tecta* Muhl, and is not, as it might seem, a compilation of the characters of both species, *A. tecta and A. macrosperma.*

The following facts are obtained by observations and collections of plants from a locality where, I am certain, *A. macrosperma* does not occur, namely, about St. Bernard, Cullman County, Northern Alabama. Mohr in his Plant Life of Alabama[1] expressly excludes the table lands in his report on the habitat of *A. tecta* ,but this report is superseded, at least in part, by later discoveries.

According to my observations the inflorescence on *Arundinaria tecta* Muhl is borne on the so called leafless radical culms (2-9 dm. high) of the season and with sheaths terminated by minute blades: on leafly radical culms of the season with blades somewhat dissimilar in size and appearance from those of the vegetative culms, 10 cm.; or less long and 1 cm. or less wide: on radical culms of the season with blades rather similar to those of the vegetative culms; culms and leaf blades of moderate size: on the summit of leafly branched and unbranched culms of the season, similar to the vegetative culms in size and appearance: on the summit of the culm and the end of the branches of leafly branched culms of the season, and of the same habit as moderately branched vegetative culms. Occasionally branched culms of the preceding season were found with profuse flowering branches, which arose from the crowded sheaths of the ultimate branches of the previous year. The leaves in these cases had fallen during the winter.

Spikelets 6.5 cm. long, and also spikelets up to 15-flowered have been observed. (Herb. St. Bernard College, Nos. 445 and 446.)

St. Bernard College,
St. Bernard, Ala.

[1] Pl. L. of Ala. Contrib. U. S. Nat. Herb. 6:389. 1901.

The Biological Significance of Selective Adsorption.

BY JEAN DUFRENOY.

Modern biologists come more and more to view living matter in the light of colloid complexes, of which those constituting nucleo and cytoplasma may be termed "cyto-colloids," whereas those building cell-walls or intercellular spaces may be named "histo-colloids."

Adsorption is a most important property of colloids. Adsorption indeed, is most satisfactorily explained as a concentration of a solute at a surface, and colloids offer much useful surface.

Certain surfaces not only have the power of adsorbing a solute as a whole from solution, but have the power of adsorbing a part of a solute at a greater rate than the other.

That an ion may be thus selectively adsorbed from an electrolyte, concomitant or previous hydrolysis of the electrolyte is of course necessary.

Living matter being colloidal, is possessing selective adsorbing properties, which may tentatively furnish an explanation of the metabolic processes in the living being, and of the migration of solutes into the cells, or of the color reaction of the tissues.

A most convenient biocolloid to experiment on, was furnished to us by the mucous deposits in the thermal springs of Barèges (Pyrénées). These deposits long known as "Barégine" are zooglæ secreted by various Bacteriacea. True Baregine, as defined by us, is a furfuroïd, soluble in xanthogenate reagents, as distinguished from the cell wall proper of the Bacteria, which is made up of nonsoluble chitin-like material. [8, 11.]

1.—Basophilous Adsorption.

Many vegetable histo-colloids have a superior adsorbent capacity for bases, and redden blue litmus, (which is a salt, containing a strong base, while the acid is the red dye itself.)

This reddening is easily observed in the case of Barégine by the following experiments: (1.) Blue litmus which is made to filter through a plug of Barégine, first filters red, and later on filters uncolored. (2) Blue litmus, kept in a glass tube above a plug of Barégine, reddens, and in a few hours loses its color from its contact to the Barégine upwards. In both cases, adsorption is selective at first, and total ultimately.

2.—CONSEQUENCES OF BASOPHILOUS ADSORPTION.

There is a struggle for bases constantly going on between basophilous colloids in the plant and those in the habitat. This is most conveniently studied in the cases of unicellular plants: Iron-bacteria, Diatoms, but it is as important for flowering plants in the field. But even the different parts of the same plants struggle for bases, and this should be studied first.

1.—METACHROMASIA.

Many blue dyes are salts, containing colored base and acid radicals. Either the base or the acid, when free, may be itself a red dye.

Whenever basophilous substances are in contact with these blue salts containing a red free base, they color red, by adsorbing the red base.

The red color displayed by colloids bathing in blue solutions is termed metachromatic.

Therefore, most cases[1] of metachromasia readily explain by selective adsorption, and we actually observed substances which color metachromatically to be basophilous: For instance, such zooglæ in the Barégine, which adsorb Fe or Cu as bases from their salts, also color red by basic blues (Naphtylen blue, Methylen blue.)

The same explanation no doubt holds for cyto-colloids; and the so called "metachromatic granules" in the cells certainly are basophilous gels (or maybe sols). Indeed, metachromatic granules were artificially produced, where metachromasia is the result of selective basophilous adsorption: A drop of a xanthogenate (obtained by dissolving Barégine into CS_2+KOH mixture) being placed in contact with a drop of aqueous solution of naphtylen blue or Polychrome blue, it appears an emulsion of tiny red granules, exactly alike the metachromatic granules in the cells.

Metachromatic granules are conspicuous substances in the cell,

[1] Some cases may result of different colors displayed by the same solute as its solvent changes, as assumed by Moreau.[2] In fact, we found the "insoluble blue acid of the Congo, to yield a red solution in Amylic alcohol.

[2] F. MOREAU, Sur les phéno. de métachromasie: *Bull. Soc. bot. France*, t. 63, p. 72, 1916.

but their significance is still doubtful. They have been demonstrated by Guilliermond and Moreau [15, 19] to be secreted by mitochondria, and, in that respect, it is to be noted that in the Sulfuro-bacteriacea such as *Thiothrix sp.*, free sulfur, in the form of intra-cellular globules, deposits only in contact of or inside of metachromatic granules.

Other substances, such as oxalate of potassium, were often found in cells the content of which had degenerated into a basophilous substance, and the relations of basophilous biccolloids to salts in the cell, demand further investigation. That it may be of biological interest appears from the fact that, while nucleo-chromatine is acidophilous in healthy cells, it shows marked basophily in tumour cells of Pines. [8]

This change may result from an altered proportion between base-adsorbent and acid-adsorbent nucleo compounds, or it may be that bases becoming deficient, the base-requirement of the acid nucleo-compounds is no more satisfied.

2.—Struggle for Bases from Host to Parasite.

Marked basophily is often observed in diseased tissues, due to development of much pectic material. [6]

Basophily is conspicuous in the wood of trees, where it is infected by mistletoe. Which wood was found by Councler to be deficient in Ca, but to be rich in PO_4H_3 and K_2O. Basophilous degenerescence may offer to the parasitized tissue a way to oppose the migration of bases from host to parasite.

3.—Iron Deposing Bacteria.

Adsorption again plays an important rôle in the depositing of iron ore by "iron bacteria."

The phenomena is easily studied in the hottest thermal springs of Barèges ($t° = 42°.8$ cent.) where *Ferro-coccus* were observed at various stages of development.

At first they are free, isolated or actively-dividing, highly refringent and thin-walled globules, imbedded in a basophilous zooglæ. Later on, they crowd as *Staphylo-coccus*, their walls thicken and become impregnated with Iron, (easily precipitated blue by Hydrochloric ferrocyanide or red by Sulfocyanide of Potassium.)

The older *Staphyloccus* ultimately form a thin rusty crust, of which the iron is no more soluble, or at least is not more interchangeable with other bases such as Cu. .

Although biochemical reactions may be efficient in changing the soluble iron salts from the thermal water, into the non-soluble iron hydroxide, the adsorbing effect of the cell walls plays a great rôle: in fact, Fe or Cu ions may be fixed in a few minutes by Barégine, and those parts which fix the metal most energically are also those which show the greatest basophily.

It seems therefore that Fe ions are at first adsorbed from the solutions and then biochemically oxydized.

4. Diatoms.

Building of siliceous skeletons by Diatoms was compared by Cohn to depositing of iron by Iron-bacteria.

Indeed, we found that *Synedra affinis*, growing in the Bassin d'Arcachon, near to rusting iron pieces, had developed a rusty color. Moreover, we were able to grow rusty Diatoms in very weak solutions of Iron sulphates in sea water. These rusty Diatoms yielded Prussian Blue, by treatment with hydrochloride ferrocyanide.

Here again we may turn to adsorption for an explanation; Diatoms possess, inside of their siliceous skeleton, a very thin pectic wall, which may adsorb metallic ions, and which we made even to adsorb Cu.

5.—Struggle for Bases from Soil to Plant.

Most plants are in contact with the soil through the basophilous pectic walls of their root-hairs.

These walls compete for bases with the basophilous compounds in the soil.

Bases may be in excess in soils and then easily obtainable by plants, or they may be strongly fixed by the basophilous complex in the soil, such as humic acids, iron hydorxyde . . . the soil being then termed "acid." Most plants thrive on the former soils, but there are few able to live on "acid soils." The former plants have been demonstrated to possess but feeble adsorbent power towards Ca ions, while the latter have a high competing power for bases. [17.]

3.—Acidophilous Adsorption.

Some colloids, such as the basic gels: oxides of Z, Th, Al, La, Zn, Be, Fe and Cr, or celluloses, adsorb the acid more quickly than the base from dissolved salts. Cellulose is widely distributed in vegetable cell walls, where it is associated to pectic acid. Most cell walls therefore may adsorb basic colors by their pectic membrane, and acid dyes by their cellulos constituents.

Adsorption of acid dyes, such as Congo red, Eosine, Fuchsin . . . is conspicuous in the cell-walls of Sulfuro-bacteriacea, *Thiothrix*. . . . It is even so strong, that a small quantity of *Thiothrix* placed in a solution entirely loses color.

Acidophilous basic gels being widely distributed in the habitat and in histological tissues, may exert an adsorbent effect on the acid ions in the cell, which effect demands investigation.

4. Reactions Accompanying Adsorption.

Thermal waters from Barèges' springs redden blue Congo by warming.

This may be accounted for by supposing that basic gels exist in the thermal waters, which adsorb the acid of Congo red at ordinary temperature, without change in the color, which remains blue; on warming, chemical reaction takes place and a salt of Congo red is formed, a red color appearing. At the same time, an insoluble blue acid of the Congo is precipitated, which may again yield interesting adsorbent effect.

Such reactions have called for the attention of numerous investigators and Wedekind and Rheinboldt conclude that adsorption effect may often precede chemical union, which seems specially true of biochemical reaction as was observed for iron depositing bacteria.

Summary.

1. The compounds, in living cells or tissues, are colloids displaying selective adsorption effect.

The constituents of cell walls and most granules in the cytoplasm are base-adsorbent colloids; they compete for bases, each with the other, and with the basophilous colloids in the habitat.

The constituents of nucleoplasma are generally acid-adsorbent, but may become base adsorbent in diseased cells.

Cellulose, an acid-adsorbent colloid, is widely distributed in plant cells and may exert powerful adsorption towards acids.

2. Adsorption effect may be preliminary to biochemical reaction, as is probably the case for iron depositing bacteria.

3. Competition for bases may result in serious loss of bases in

the habitat, and considerable accumulation of bases in plant tissues.

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Sexual Dimorphism and Some of Its Correlations in the Shells of Certain Species of Najades.

BY N. M. GRIER, PH. D.

I.—INTRODUCTORY.

Before Ortmann's discovery that the sex of Najades could be readily learned from associated peculiarities of gill structure, (4, 5,), systematists had only general information—of the type later to be compared in this paper—from which to identify the sex of a mussel when glochidia were absent. Hazy, (2), and Israel, (3), were able to distinguish the sexes of certain European species by such characters as relative length, height, and inflation. Israel, particularly, found associated with sex, certain colors of the epidermis of the shell. The investigations of these latter writers extended only to 3 species, none of which are closely related to those dealt with in this paper, and their original work never seems to have been followed up. In addition there occur in the papers of American investigators from time to time, scattered references to the sexual dimorphism of certain species based on some morphological feature of the shell. Such, however, are either not concerned with the species we are interested in, or are already summarized by Simpson, (6), or Walker, (8), whose information later will be brought out.

II.—PROBLEM, METHOD, AND MATERIAL.

While pursuing another investigation on the comparative morphological characteristics of certain mussel shells inhabiting the Upper Ohio Drainage and their corresponding ones in Lake Erie, (1) the writer obtained data of the type indicated, which he proposes in this paper to associate as far as possible with the sex of the shells examined.

The material used was Dr. A. E. Ortmann's splendid collection of shells in the Carnegie Museum at Pittsburgh, Pa., and while the most complete account of how these measurements were taken is reserved until the publication of the research spoken of, the method of making them is described to what is believed to be a comprehensible extent in the accompaning table dealing with sexual dimorphism. Here it may suffice to state that the dimensions taken were 7 in number and included the measurement of,

1.—Relative degree of inflation.

2.—Height.

3.—Posterior length of shell.

4.—Anterior length of shell.

5.—Length of posterior hinge line.

6.—Length of anterior hinge line.

7.—Thickness of shell—in this investigation taken just superior to the pallial line in the region directly beneath the umbo

In making these measurements an ordinary metric caliper and rule were used, the values obtained reduced to convenient factors by division into the length, with the exception of that of thickness, which it seemed desirable to compare with the height.

Measurements were made on the following genera and species, viz.,

Fusconija flava, Raf.
Amblema costata, Raf.
Pleurobema obliquum coccineum, Con.
Elliptio dilatatus, Raf.
Symphynota costata, Raf.
Anodonta grandis, Say.
Paraptera fragilis, Raf.
Proptera alata, Say.
Anodontoides ferussacianus, Lea
Eurynia recta latissima, Raf.
Lampsilis luteola, Lam.
Lampilis ovata ventricosa, Lam.

The factors above described having been obtained, it was the practice while making comparisons in the endeavor to associate any of the 7 measured morphological dimensions with the sex of the shell, to compare equal numbers of both sexes of the species. An average was made of the values obtained by calculation for each dimension of the shell, and then this result compared with that similarly obtained from the other sex of the animal. A table (I) showing the averages for each dimension of that sex of each species is appended, and from the comparison of its values, the table on Sexual Dimorphism (II) is obtained.

III.—Results.

(a.) Conclusions.

In more condensed form the results given in the tables may be expressed as follows.

1. Males of Pleurobema, Elliptio, Symphynota, and Proptero possess a greater height and degree of inflation than females and are relatively shorter. The females of Fusconaja, Amblema, Eurynia, L. luteola, and L. ovata show opposite characters in this respect to those of females representing the first four named species. Also in the foregoing, height correlates with the degree of inflation of the shell. Males of Anodonta, Anodontoides while having a greater degree of inflation than females, have a less height.

2. Males of Elliptio, Anodonta, Paraptera, Anodontoides, Eurynia and L. ovata have a relatively greater length of the posterior part of the shell, and consequently less of the anterior. In the remaining shells this condition is reversed.

3. The one outstanding morphological feature associated to preponderating extent with maleness in the Najades dealt with, was the greater length of posterior hinge line, (the anterior seems best developed in the females). These facts correlate with values for anterior and posterior length in ½ the species only.

4. Thickness of shell, as associated with sex, seems to be as equally indifferent as all the other dimensions, (with the exception of those of the hinge lines).

(b.) Remarks.

There is now given from Simpson, (6), Walker, (8), Utterback, (7), all descriptive material of the external morphology of these shells usually held to be associated with the different sexes. As a rule, emphasis is placed on Walker's late work, and it is the writer's desire to show the relation of this material to the results he has obtained.

Utterback believed females of *Fusconaja* and *Symphynota* to possess a greater degree of inflation of the shell. My results check only with the former in this respect. We must pass over the other species listed in the order given (for the reason that there seems to be no accredited descriptive material concerning their Sexual Dimorphism), until we come to *Paraptera*.

Simpson: *Paraptera*. "Female and male much alike, former sometimes a little rhomboid or again it ends in a wide rounded point

TABLE II.

SEXUAL DIMORPHISM IN NAYADES.

(Dextro-sinistral diameter $\frac{DSD}{L}$ or convexity of valve divided by length giving *degree* of *inflqion*)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Pleurobema coccineum	15	27	Fusconajo flava
Elliptia dilatatus	15	19	Amblema plicata
Symphynota costata	5	33	Eurynia recta
Anodonta grandis	8	94	Lampsilis luteola
Paraptera fragilis	5	84	Lampsilis ovata
Proptera alata	6		
Anadontoides ferussacianus	3		

(Dorso-ventral diameter of $\frac{DVD}{L}$ value divided by length giving *relative height.*)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Pleurobema	15	27	Fusconaja
Symphynota	5	19	Amblema
Elliptio	15	8	Anodonta
Proptera	6	5	Paraptera
Eurynia	33	8	Anodontoides
		94	L. luteola
		84	L. ovata

(Distance posterior to extremity $\frac{PD}{L}$ from aline passing through median dorsal plane of valve expressing *relative;degree posterior development shell.*)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Elliptio	15	27	Fusconaja
Anodonta	8	19	Amblema
Paraptera	5	15	Pleurobema
Anodontoides	3	5	Symphynota
Eurynia	33	6	Proptera
L. ovata	84	94	L. luteola

(Distance anterior to extremity $\frac{AD}{L}$ from a line passing through median dorsal plane of valve expressing *relative degree anterior development shell.*)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Fusconaja	27	15	Elliptio
Amblema	19	8	Anodonta
Pleurobema	15	5	Paraptera
Symphynota	5	3	Anadontoides
Proptera	6	33	Eurynia
L. luteola	94	84	L. ovata

(Length of shell compared $\frac{PHL}{L}$ with that of posterior hinge line.)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Fusconaja	27	5	Symphynota
Amblema	19	6	Proptera
Pleurobema	15	5	Paraptera
Elliptio	15		
Anodonta	8		
Anodontoides	3		
Eurynia	33		
L. luteola	94		
L. ovata	84		

(Length of shell compared $\frac{AHL}{L}$ with that of anterior hinge line.)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Symphynota	5	27	Fusconaja
Proptera	6	19	Amblema
Paraptera	5	15	Pleurobema
		15	Elliptio
		8	Anodonta
		3	Anodontoides
		33	Eurynia
		94	L. luteola
		84	L. ovata

(Thickness of shell divided $\frac{TH}{DVD}$ by dorso-ventral diameter.)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Pleurobema	15	27	Fusconaja
Elliptio	8	19	Amblema
Anodonta	8	5	Symphynota
Proptera	6	5	Paraptera
Anodontoides	3	94	L. luteola
Eurynia	33		
L. ovata	84		

about in the median line. Female shell a little fuller and more rounded in the post-basal region." Specimens of Paraptera were not abundant, but if in this species "rhomboidal" may generally imply a greater height compared with the length, there is some agreement on the part of my results. Inflation of the post-basal region was not measured.

Proptera: "Female shell with long rounded marsupial swelling at extreme post-basal part, generally sub-truncate behind. Male shell less full in post basal region, nearly rounded behind." My observations do not agree with calculations from Walker's illustration of this species which shows the female to be relatively higher. They do agree in assigning the female a greater posterior length of shell.

Eurynia: "Male shell drawn out behind and ends in a blunt point about midway up from the base. Female shell has long rounded marsupial swelling, ending in a blunt point ⅔ way up from the base." This data agrees with my measurements, as it may be inferred the male is longer, the marsupial swelling may be in evidence from the inflation of the shell at the point measured.

L. luteola: "Female shell with most decided marsupial swelling; here blunt posterior point is somewhat higher up, ($\frac{3}{5}$), of height than that of male, (about halfway), and is usually more inflated." My results show the female as a higher degree of inflation, and is besides relatively longer.

L. ovata: "Female shell slightly inflated post-basal region," etc. As the recorded dimorphism for this genus is practically the same as for these last 2 species, I need only point out the full accord with my results.

The value of quantitative studies of the morphological characteristics of shells is best appreciated when cases are brought back to mind where new genera and species had to be founded on the anatomy of soft parts alone so great was the superficial resemblance in some cases between what turn out to be entirely different animals. If as a general proposition, it be admitted that the systematist should be able to find in any organism *specific characters* distributed from the most minute anatomy to the coarsest features of morphology, any such convergent phenomena as described above could be eleminated as each species of shell could be expected to vary in morphological characters around its own mean. It is to be hoped that the practice of publishing the more usual dimensions for *both* sexes of shells will be continued, that the ultimate philosophic trend of all Biological Science may have ample data for the consideration of the never-dying and always-puzzling question of the environment.

(c.) Source of Error.

Paucity of material compelled me to use in some species a few shells from Lake Erie, (most were from the Upper Ohio Drainage), although it is in some of the measured shell characteristics, as I expect to show, that the Lake Erie shells differ from those of the

Upper Ohio. I do not feel, however, that the value of my conclusions is greatly impaired thereby, as an equal number of shells of both sexes from Lake Erie was included when this had to be done. Besides the reduction to factors apparently expresses the relative proportion of the part concerned, and, by the law of averages, possibly evens up any great differences.

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TABLE I.

GIVING AVERAGE DIMENSIONS OF MALE AND FEMALE SHELLS.

NO. SPECIMENS	MUSSEL	SEX	DSD/L	DVD/L	PD/L	AD/L	PHL/L	AHL/L	TH./DVD
27	Fusconaja flava	♀	.5294	.7756	.7749	.2315	.4867	.2499	.119
27	Fusconaja flava	♂	.4838	.7710	.7550	.2308	.544	.2001	.1181
19	Amblema plicata	♀	.409	.710	.806	.198	.574	.184	.1398
19	Amblema plicata	♂	.437	.7680	.813	.1892	.565	.184	.1699
15	Pleurobema obliquumcoc	♀	.436	.796	.845	.1552	.594	.1987	.43
15	Pleurobema obliquumcoc	♂	.442	.821	.78	.2145	.575	.1973	.27
15	Elliptio dilatatus	♀	.297	.494	.774	.2115	.509	.1830	.24
15	Elliptio dilatatus	♂	.304	.505	.796	.2026	.544	.1615	.22
5	Symphynota costata	♀	.260	.566	.744	.256	.490	.1924	.24
5	Symphynota costata	♂	.287	.586	.729	.270	.497	.253	.26

8	Anodonto grandis	♀	.372	.567	.716	.277	.418	.216	.061
8	Anodonto grandis	♂	.382	.561	.709	.288	.419	.243	.062
3	Anodontoides ferussac	♀	.373	.517	.763	.306	.472	.242	.40
3	Anodontoides ferussac	♂	.357	.518	.754	.248	.436	.182	.35
5	Paraptera fragilis	♀	.355	.751	.734	.268	.502	.2081	.10
5	Paraptera fragilis	♂	.304	.696	.737	.267	.491	.2215	.16
6	Proptera alata	♀	.361	.775	.684	.315	.539	.219	.34
6	Proptera alata	♂	.373	.825	.708	.292	.561	.2185	.19
33	Eurynia recta	♀	.2740	.412	.774	.2229	.540	.1676	.55
33	Eurynia recta	♂	.2703	.4177	.798	.207	.560	.1616	.28
94	Lampsilis luteola	♀	.4027	.6036	.7603	.2739	.5184	.2478	.38
94	Lampsilis luteola	♂	.3708	.5617	.7319	.2593	.4878	.2191	.38
84	Lampsilis ovata vent.	♀	.4780	.7375	.6885	.3105	.4490	.2314	.39
84	Lampsilis ovata vent.	♂	.4660	.716	.706	.297	.451	.2319	.38

Hollins College, Hollins, Va.

The Prairie Mirage.

BY HOWARD C. BROWN.

Strange is it indeed, that to so many persons who have spent their lives upon the prairie, a mirage is something which is far distant; a thing entirely unrelated to their life. Many persons associate the mirage only with the desert. This seems odd enough when one considers the many beautiful mirages which appear in the prairie skies when a reflected grass area seems only a further extension of the vast, real stretch, which, in great, gentle waves of Titanic magnitude, roll, of a prairie morning, in undulating green, wind responsiveness, under the lifting sun. Few things can inspire one with more sincere thoughts of the greatness of the universe, than can the wide stretches of prairie of our land. And the mirages are interesting to me in that they were often so thoroughly linked, in the past, with the life of the pioneer.

If he loved beauty, the pioneer never ceased to revel in those wondrous reflections. But the mirage was not alone a thing of beauty. If it mirrored an enemy's camp, in time of hostilities, it served a utilitarian purpose. But to those who did not love it for its beauty, and for whom it served no real purpose, still it became an object of wonder, and they never ceased to marvel at the unusual phenomenon.

Mrs. Maude A. Fenton, a member of the California Naturalist Club, is a thorough lover of beauty. For a number of years she lived near Indian Head, Canada. Writing of those years, she said that her most pleasant memories of Canada were centered about her enjoyment of the wild flowers, the northern lights, and the mirages. Speaking of the last mentioned, she says, "Situated some seven miles from Indian Head, was the Squirrel Hill, at the foot of which was a very large spring of water. From it the town of Indian Head had its water piped to the town. One bright, frosty morning in the spring of 1907, we noticed what we thought to be about half a mile away, this hill with all the trees, hollows and the place where the spring was, showing quite plainly. On speaking to others about it, they said, 'Yes, but you saw the hill when the mirage was on, for it is over seven miles away."

"Another time in November, 1908, one bright, clear morning I thought that some one had been moving a house and left it in the corner of the pasture land, about one-fourth of a mile away. Both Mr. Fenton and I were deceived into thinking that it was a real house which had been moved during the night, for we knew that it had not been there the day before. On closer examination we found it to be our neighbor's house some two miles away, to the north-east. It stayed there about two hours, and then gradually faded away, back to the place where it belonged.

"During the same winter, we had the chance of seeing the most beautiful one of all, the Katepwa valley. This valley is situated some fourteen miles from Indian Head, and sixteen miles from where we lived. Lake Katepwa is in the center of this valley, and surrounding it are quite high hills with trees, shrubbery, hollows and roads. Also, a few houses. Snow was on the ground. As we had been there a couple of times it did not take us long to name the place. It looked very natural. This was brought to our view about a mile away. The Hills lay to the south-west of us, the house to the north-east, and the valley north-west, and everything showed right side up. These mirages always occurred in the morning, just about sunrise. We never saw one in the evening."

One of the most interesting references to the prairie mirage which I have yet found, is in J. W. Winkley's "John Brown, the

Hero." He tells about a horseman who had been riding full speed up the creek, one morning in 1856, and who stopped at their cabin door. The horseman brought news that the Ruffians were over the border, upon them again, in strong force. He was a messenger from the Middle River region, and had been dispatched to them by his comrades in distress. His mission was, of course, to secure help. The need was urgent. Then there comes the description of the mirage, "As the speaker drew his narration to a close, all present instinctively turned their eyes in the direction whence he had come: namely, toward the south-east. There a sight met our gaze that riveted us to the spot—a spectacle as marvelous as it was beautiful, and singularly confirmatory of our informer's words. To our utter astonishment we looked directly at that moment into the enemy's camp twenty miles away, though seemingly less than a quarter of that distance. It was one of those peculiar phenomena, rarely seen on the water and less frequently on the land, and more wonderful in the latter case when it does thus appear, because the more perfect and on a grander scale: the mirage."

"The prairie mirage is of wondrous beauty. It is usually in the autumn, when all the atmospheric conditions are favorable, that these strange illusions take place on the prairie ocean. Along the eastern horizon, near sunrise, a narrow belt of silver light appears. As it grows broader the silvery gray of its lower side changes slightly golden. Fleecy clouds above the belt take on a yellow red. The grayish shadows of the dawn lift slowly from the earth. Just before the red disk of the sun peers above the horizon-line, one sees in the sky the landscape of trees, of waving grasses or grain, or rocks and hills, held together as it were by threads of yellow and gray and azure. The earth stands inverted in the air.

"The groundwork of this illusion is grayish, semi-opaque mist; and the objects are seen standing or moving along in it. The feet of animals and of men, the trunks of trees, the rocks and hillocks, are set in this aqueous soil. When the conditions are perfect, objects far beyond the range of vision over the prairie are brought near and into plain view of the beholder.

"That morning was such a time and afforded such a scene. There was the camp of the enemy,—miles away, as has been said,—mirrored perfectly and beautifully on the sky, every feature of it traced with the minuteness of a line-engraving. By the aid of our military field-glass we could see the early risers moving through the campground; the horses standing patiently outside awaiting their morning meal; the positions of the pickets keeping guard; the tent doors flapping in the slight breeze or swaying back and forth as the men made egress or entrance. Even the curling smoke of the newly kindled flame, as it ascended upward, curiously traced itself visibly to the eye."

I was greatly interested in the mirages of which Iowan early settlers have told. And I wanted to know also, how far the mirage could be seen. In answer to my inquiries, Mr. Clement L. Webster, who has for years been collecting pioneer data, writes, "I do not just as this moment recall of my having personally seen one of the mirages in this part of the west (Iowa) but I recall the description which some of the old settlers have given to them, which they saw in the north-central part, and north-west parts of Iowa, in the very early days. As they described them to me, they must have been reflections of the South Dakota prairies. I was very familiar with mirages in the south-west."

One of the most recent mirages of the north-central Iowa region, of which I have any record, was one which was seen at Charles City, Iowa, by Mrs. Mary Dutton. "It was November 29th, 1918, or there about, that I saw this reflection," writes Mrs. Dutton. "I hastily threw a shawl about my shoulders and stood alone in the dingy light of the old attic, in the cold, for one and a half hours, wrapped in awe. I did not realize that time was passing, until my mother became alarmed at my long absence. I found that to view it from the ground gave a distinctly different impression. Our house is on a hill and from the third story window I got the best view. The clouds seemed to change and form different angles when I got up stairs. The heavens, for the entire circle around was beautifully colored with stripings of pink and green, seemed to glow. This alone was most beautiful. At the movies when they run the pictures and adds so that they appear liks kaleidoscopic bits of color or form, and then seem to slide unbidden to position, until the picture desired has materialized, you have an effect which is not unlike that which is witnessed at the beginning of the reflection. All of the arrangements of cloud and color were finally produced, and the almost perfect reflection was displayed. It remained for analysis and comprehension for some time, practically unchanged, making recognition quite certain, and not allowing chance for imagination, in a chance cloud formation. The sun was setting in that great blaze of subdued red, and was farther west than the mirage. The clouds which bore the mirage hung unsuspended to the south and between us and the horizon, which held yet another bank of strangely shaped, gray clouds. As to the details of the mirage, I know that it was the Mississippi bluffs which I saw reflected. There was the main river, the further bank being indistinct, but the bluffs on this side were very plain. And yet towards me from the river, was an inlet or a back water pond, that was very distinct. The shore line of this showed a boulder in the edge of the water."

The Mississippi bluffs are fully one-hundred miles distant from Charles City, where the mirage appeared. The same night that this appeared, I had noticed the wondrous colors of the sky, and had telephoned Mrs. Dutton to watch them. But they were going so very fast, that by the time I got back to my observation post, I did not see the same thing which I had phoned about. Then I was busied, and ceased in my watch. And it was apparently at that time that the real mirage began to shape itself.

There is no river the size of the Mississippi and with the bluffs margining it, any place near Charles City. It is a long way for a reflection to carry, but the vivid description which has been given is one of the most interesting of those which I have thus far found. The atmospheric conditions are such that the mirage might easily appear at that time. Most of the ones described have been in the early morning. This was just as the sun was setting. If the sun had dropped below the horizon, then its last rays might have been spent in illuminating just such a reflection as this. The distinct manner of the reflection considering the distance, is one of the most unusual characters of it.

There is much to be learned about the prairie mirage. Many persons could add information concerning it, which would be of value to the collector of data on our natural phenomena. I have collected here some references which I have had of the mirage. There is much which is now waiting to be collected. The lips of the old settlers yet mumble the stories of the early days. But the mumbling will cease e'er long, and then we will not have the records which we should most carefully have collected. Let us then get to work and secure these records before it is too late. All that deals with the early life of the pioneer is sacred to the memory of the men who live after him. The mirage is only one thing which entered into his life. He was intoxicated at times with the beauty and stunned with the wonder of it. Let us too infuse into our beings some of the wonder and beauty which maintained the pioneer.

Bird Nests Found at Spring Ledge in 1919.

BY FRANK C. EVANS.

I have just completed a record of the bird nests found at Spring Ledge, near Crawfordsville, Indiana, during the past summer, and I thought perhaps the readers of the *American Midland Naturalist* might be interested in the result. I located 146 nests on the grounds, and since the leaves have fallen, have found several others; but these are not included in the record. There were twenty-six species as follows:—

Green Heron	1	Flicker	4
Robin	18	Sparrow Hawk	1
Baltimore Oriole	3	Orchard Oriole	1
House Wren	14	Cuckoo, Yellow-billed	3
Mourning Dove	14	Warbling Vireo	3
Brown Thrasher	3	Catbird	3
Bluebird	6	Chimney Swift	2
Chipping Sparrow	5	Hummingbird	2
Red-headed Woodpecker	2	Meadowlark	6
Purple Martin	38	Maryland Yellow-throat	1
Blue Jay	1	Red-winged Blackbird	3
Kingbird	1	Cedarbird	2
Phoebe	2	Crested Flycatcher	1

I put up sixty-six nesting boxes and shelves—fifty-five boxes and eleven shelves. Twenty-eight boxes were used. Six of the boxes were used twice, and three, three times. Twenty-seven boxes were not used. Eight of these were in the immediate vicinity of a sparrow hawk's nest, which I think account for their not being occupied. Of the eleven shelter shelves, five were used, all by robins.

Our Martin colony was considerably larger this year, and was a source of continual delight throughout the summer. Among our prized nests was a hummingbird's, situated on a limb about six feet above a large spring. If I had been permitted to select the location, I could not have picked a more picturesque spot. It was a perfect jewel of a nest. We watched the mother bird throughout the period of incubation, and especially enjoyed seeing her feed her baby, bird—only one of the two eggs hatched. I also found a perfect humming bird's nest under a tree, which had evidently been blown from the limb; so we really think we had two hummingbirds' nests, but have no record of one of them.

I shall never again permit a sparrow hawk to nest on the grounds. I am sure he drove many birds away, for often I would observe him perched in the top of a tall oak tree, and suddenly dart like an arrow for smaller birds that happened to alight in his vicinity. Besides, none of the nesting boxes near the sparrow hawk's nest were occupied.

We did not locate a cardinal's nest this year, although the grounds were full of them nearly all the time. I know they were nesting nearby, but we were unable to find the nests.

I wish everyone could appreciate the great returns in pleasure and satisfaction in protecting and attracting the song birds to their home grounds Certainly no other investment brings greater returns.

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PLATE I.—FENTON ON THE HACKBERRY STAGE.

East portion of Hackberry Grove Clay Bank, the type exposure of the Hackberry stage. The escarpment here is about 76 feet high, the upper 36 feet being Hackberry shales. The lower 40 feet are of Sheffield age, mostly covered by Hackberry talus.

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The Hackberry Stage of the Upper Devonian.

BY CARROLL LANE FENTON.

I.—INTRODUCTORY.

At what is commonly known as the Hackberry Grove Clay Bank, in section 35, Portland Township, Cerro Gordo County, Iowa, is the type locality of the formation described in this paper. On the right bank of Lime Creek at that point is an escarpment some seventy-five feet in height which is composed throughout its exposed thickness of the rocks of two formations: the Hackberry and the Sheffield.[1] These two formations comprise the "Lime Creek Stage" as defined by Calvin,[2] but it is recognized, and was recognized prior to Calvin's description, that the two formations are distinct.

The nomenclature of these two formations had been considerably involved, as has also been the assignment of geologic age. Hall, in 1858[3] assigned the beds of the Hackberry to the Hamilton Stage, but in a later paper by Hall and Whitfield[4] they were considered as being Chemung. White[5] referred the Hackberry shales to the Hamilton, and H. S. Williams attempted at one time to show that they were of Mississippian age,[6] but later[7] corrected this. C. L. Webster, in 1889,[8] referred the Hackberry to the upper Devonian, but placed the subjacent shales in the Hamilton, but has corrected

[1] Am. Jour. Sci. (4), XLVIII, pp. 355-376.

[2] Ia. Geol. Surv. VII, pp. 161-192.

[3] Geol. of Iowa; Vol. I; pts. 1 and 2.

[4] Twenty-third Ann. Rep't, N. Y. State Cabinet, pp. 225-226.

[5] Rep't of Geol. Surv. of State of Iowa, Vol. 1, pp. 187-188; Vol. 2, pp. 252-253.

[6] Am. Jour. Sci. (3) ,XXV, pp. 97-104.

[7] Loc. Cit., p. 311.

[8] Am. Nat. XXIII, pp. 229-243.

the latter error in later papers. By the Iowa Survey the "Lime Creek" has been consistently and correctly assigned to the upper Devonian. In a recent paper by myself,[1] Webster and I referred the shales below the Hackberry to a possible Genesee time equivalency; in 1919[2] I applied the name Sheffield to these shales, but expressed no opinion as to their age except that they are of the late upper Devonian.

Webster, in 1889,[2] in a paper on the Devonian of Iowa, divided it into three stages, the Corniferous, the Hamilton, and the Hackberry. His Hackberry Group was stated by him to consist of one formation which "is known to attain a thickness of forty-five feet, and is made up, for the greater part, of a yellowish brown argillaceous, and sometimes arenaceous shaley limestone." This formation was stated to be the highest Devonian in the state, and, while the description leaves much to be desired, there is no doubt that Webster's Hackberry Group, as originally described by him, includes all of the Devonian rocks above the blue shale at Hackberry Grove, Rockford, and other localities, and below the Kinderhook.

Prior to 1889 the names "Rockford Shales," "Lime Creek Shales," and "Lime Creek Beds" had been used by various authors. Calvin and Williams used all three interchangeably; Webster used the term "Rockford Shales." This name, however, was preoccupied by another formation, so had to be abandoned.

In 1897[3] Calvin, in his report on the geology of Cerro Gordo County described the shales and limestones above what was then considered to be the Cedar Valley Limestone[4] as the Lime Creek Stage, and this name has been used in the Iowa reports, and is more widely known than the name proposed by Webster. In 1919,[5] I discussed the nomenclature of the two formations in question, attempting to show that: (1) The name "Lime Creek" as used by the Iowa Survey does not equal "Hackberry" as used by Webster and myself; (2) that a new formation name was needed

[1] Am. Mid. Nat. V. p. 214.

[2] See Note 8. The division of the Devonian below the Hackberry into Hamilton and Corniferous was erroneous.

[3] Ia. Geol. Surv. VII., pp. 161-170.

[4] The Nora Limestone of Thomas (Science, N. S., XXXVII, p. 459 was not separated from the Cedar Valley limestones at that time.

[5] Loc. cit. pp. 355-360.

for the shales below the Hackberry, and (3), that the name "Lime Creek" is not only unsuitable, but is preoccupied, and so should be dropped.

Iowa Geological Survey (Published Reports)	Clement L. Webster (Early Papers, 1889)	C. L. Fenton
Lime Creek Stage	Hackberry Group	Hackberry Stage
Owen Substage	Upper Horizon	Owen Substage
Hackberry Substage	Middle Horizon	Cerro Gordo Substage
		Spirifer Zone
	Lower Horizon	Striatula Zone
	Genesee??? Stage	Sheffield Formation

FIG. 1.—CORRELATION OF NOMENCLATURES.

II.—STRATIGRAPHY AND DISTRIBUTION.

There is no point at which a satisfactory section of the Hackberry Stage may be taken. The following section, a compilation giving the maximum thicknesses observed, is here introduced in order to facilitate reference in the following description.

II. A.—GENERAL SECTION OF THE HACKBERRY STAGE.[1]

II.—Owen Substage.

C.—Acervularia Zone.

Calcareous, light gray limestones, containing *Pachyphyllum, Alveolites, Acervularia* (an undescribed species; typical of the zone) *Stromatoporella, Syringostroma,* and other species, corals and Stromatoporoids being the most abundant forms........20

B.—Naticopsis Zone.

Magnesian shales and limestones, and argillaceous dolomitic limestones, usually dark buff or brownish in color. Gastropods the predominating fossils, *Westernia* and *Naticopsis* the predominating genera; *Naticopsis gigantea* H. & W. the most typical species........30

A.—Idiostroma Zone.

Buff, gray-buff, or buff-brown limestones, heavily bedded. Crowded throughout by two species of Stromatoporoids(?) commonly referred to *Idiostroma,* as well as other *Stromatoporoida,* and several species of gastropods........4–6½

I.—Cerro Gordo Substage.

B.—Spirifer Zone.

Yellowish, very calcereous shales, shaley clays, and shaley limestones. Weathers partly to clay, partly to limestone chips. Abundantly fos-

[1] For comparison with Calvin's section in Ia. Geol. Sun. VII., p. 163.

siliferous..20

A.—Striatula Zone.

Calcareous shales and shaley limestones, slightly to very gritty. Weathers partly to a rather gritty clay, partly to chips and nodules, strongly iron stained. Beds indurated at various localities, as at Mason City; at Rockford and Hackberry Grove, bearing large numbers of calcareous concretions in the lower portions. Fossiliferous, the fossils occurring largely as casts..25

Disconformity.

At Rockford the Striatula zone attains a total thickness of above sixteen feet, and is separated into three quite distinct divisions. The lowest of these, about two feet in thickness, does not depend so much upon its fauna as the distinctive feature of a large number of calcareous concretions, containing considerable amounts of pyrite, and occasional crystals of feldspar. Fossils are conspicuous by their general absence, even poorly preserved casts being uncommon.

The second division, (Whitneyi Faunule, Fig. 3), contains the typical Striatula fauna. The less common species of this faunule were described by Webster in a paper in the American Naturalist[1]; the most common ones are: *Schizophoria striatula* (Schloth.), *A. reticularis* (Linn.), *A. hystrix* Hall, and *Spirifer whitneyi* Hall. The total thickness of the faunule is about ten feet.

The third division, (Gypidula faunule, Fig. 3), is, to a considerable extent, a transition between the Striatula and the Spirifer zones. The fauna has lost its typical Striatula aspect, but yet it is sufficiently distinct from that of the Spirifer zone to be placed with the lower division. Among the typical Spirifer zone species appearing in this faunule are those marked by an asterisk in the faunal list. The most interesting of these is a large, undescribed species of *Gypidula*, commonly called *G. comis* (Owen). This form is, in general, rare throughout the formation, but in limited areas of the Gypidula faunule considerable numbers of specimens, usually badly crushed, may be found. I collected a total of thirteen specimens, only two of them good, from an area that could be covered by an ordinary sheet of paper. In the area having a radius of approximately fifteen feet about this find I have collected but four specimens, all fragmentary.

The accompanying diagram will serve to show the division of the Striatula into faunules at the localities studied. The division,

[1] Am. Nat. XXII., pp. 1013-1018.

of course, is by no means so hard and fast as might be inferred from the diagram. The figures refer to the approximate thicknesses in feet.

Hackberry Grove.		Mason City B. &. T. Co.		N. W. States Cem. Co.		Rockford B. &. T. Co.	
		4	Reticularis Faunule.				
		18 20	Fucoid Faunule.	8	Gritty, soft beds; few fossils.	3	Gypidula Faunule.
8	Whitneyi Faunule(?)					12	Whitneyi Faunule
2	Concretionary Bed			½	Fucoid Faunule	2	Concretionary Bed

FIG. 3.—FAUNULES OF THE STRIATULA ZONE.

THE CERRO GORDO SUBSTAGE.

II. B.—THE STRIATULA ZONE.

The lowest division of the Hackberry, that referred to by Webster in his earlier publications as the "Lower beds" and the "Lower Horizon," is the one to which Webster and I have applied the name Striatula zone.[1] The most extensive development of this zone is at the pits of the American Brick and Tile Company and the Mason City Brick and Tile Company (owned and operated by the latter) at Mason City, in Cerro Gordo County, where it attains a thickness of at least twenty-five feet. The lower eighteen to twenty feet are composed of more or less indurated, fairly heavy-bedded strata of coarse, gritty texture, strongly iron stained. These beds contain abundant fucoid remains, the most abundant being a small form one-fourth to one-half inch in diameter. It lies along the bedding planes in tangled, curling masses, and is very characteristic of the lowermost ledges. Further up in the zone a larger, branching form, with a diameter sometimes reaching two and one-half inches, predominates. Both are associated together, but there is a distinct predominance of the small species below, and the large one higher up in the zone. The zone is the Fucoid faunule of Fig. 3.

Above the indurated beds containing fucoids as the principal fossils are six to eight feet of gritty, soft shales and clay-shales

[1] American Midland Naturalist, V., p. 214.

which oxidize to a light yellowish. There are but slight traces of induration, and the oxidization is much more complete than in the lower beds. Fossils are quite common as casts, *Schizophoria striatula* (Schloth.), *Atrypa reticularis* (Linn.), *A. hystrix* Hall, and *Spirifer Whitneyi* Hall being the principal species. This bed composes the Reticularis faunule of Fig. 3.

At the pits of the Western States Cement Company, some three-fourths of a mile to the northwest of the Mason City pits the shales below the Hackberry is being worked for the production of cement. They are overlain by seven to nine feet of the Striatula Zone, which is stripped from the smooth, plastic formation below. The Striatula section, while incomplete in the extreme, nevertheless shows a great difference from that at the Mason City pits. The entire thickness of the indurated strata is represented by less than six inches of hard, shaley limestone, bearing fucoids. Above this are seven or eight feet of material very similar to that described above as constituting the Reticularis faunule, but with very few fossils, and those as very poor casts. Mr. A. P. Potts, of the Mason City Brick and Tile Company tells me that the heavy, indurated beds have virtually disappeared less than three-eighths of a mile north of the Mason City pits. This is an extreme example of the decided local variation that characterizes the upper Devonian of this particular district.

II. C.—The Spirifer Zone.

The most striking, and certainly the most interesting, paleontologically of the divisions of the Hackberry is the Spirifer Zone, which at Hackberry Grove attains a thickness of approximately twenty feet. An exact determination of the boundary between the Spirifer and Striatula zones is made difficult by the talus.

This zone, as developed at Hackberry Grove, is divided into at least three faunules, though their bounds have not been very carefully worked out. The table on the following page gives these faunules, with the distinguishing characters.

The Striatula Zone in the neighborhood of Rockford, and particularly at the brick pits, is composed of much the same yellow, calcareous shales, but with a much lesser tendency towards induration than is to be noted at Hackberry Grove. The development of faunules is more obscure than at Hackberry Grove, and I am inclined to think that there is less parallelism between the

3. Stromatoporella Faunule.	Corals and stromatoporoids at their greatest abundance; *Charactophyllum, Pachyphyllum, Stromatorpoella, Syringostroma* predominating genera. Brachiods gastropods abundant; *Naticopsis* more abundant than in Faunule 2. Pelecypods seemingly at height; Paracyclas predominating species.
2. Hystrix Faunule.	Brachiopods at greatest abundance; *Atrypa, Schizophoria, Strophonella, Douvillina, Spirifer* the predominating genera.
1. Gigantea Faunule	*Naticopsis gigantea* and *Floydia* the dominant gastropods. Brachiopods abundant. Corals much less abundant than in upper two faunules.

FIG. 4.—FAUNULES OF THE SPIRIFER ZONE AT HACKBERRY GROVE.

two localities than I at first supposed.[1] It is certain that the horizon of dominant gástropod development at Rockford is above that of dominant brachiopod development. The upper portions of the zone are not present, so the development of the Stromatoporella faunule, if it was developed, cannot be determined.

Three miles west of Rockford, at a roadside exposure known locally as Bird Hill, the Spirifer consists of two distinct faunal divisions. The lower is made up of compact clay-shales crowded with small fucoids, but without many other fossils; the second is of soft clay-shale similar to that of the Rockford pits, but with a distinctly different fauna. *Lioclema occidens* (H. & W.), common at the Rockford pits, is here almost uncommon, but the smaller bryozoa are to be found in abundance. Rugose corals (*Charactophyllum nanum* (H. & W.), *Zaphrentis solida* H. & W., *Chonophyllum ellipticum* (H. &. W.) are abundant, and on the whole are of a larger size than at Rockford. The general aspect of the brachiopod fauna is different from that at Rockford, though the species are much the same. There is a notable tendency among the *Spirifers* of the *hungerfordi* and *whitneyi* groups to develop wide forms, as *S. whitneyi productus* Fenton.

I think it has been made plain in these descriptions that there are distinct faunal differences in the Spirifer Zone. These faunal differences seem to me to be dependent on locality and local environment rather than upon time. Doubtless stratigraphical position and individual variations are related, but I am inclined to lay the major part of the responsibility to local environment.

[1] Am. Jour. Sci, XLVIII, p. 363.

The difference of the fauna at one point from that at another is far more easily seen in the results of a collecting trip than in a collection or in faunal lists, for the difference is primarily one of numbers of specimens, secondly of variations, and probably last, of species. This last statement cannot, of course, apply to such forms as *Lioclema occidens*, which, while abundant about Rockford is uncommon (relatively, at least) at Bird Hill, and rare at Hackberry.

The Owen Substage.

II. D.—The Idiostroma Zone.

The highest portion of the Hackberry Stage which is in place at Hackberry Grove is composed of four to six and one-half feet of rather heavily bedded limestone, gray, gray-buff, or buff in color, and crowded throughout by two species of Stromatoporoids commonly referred to the genus *Idiostroma*. Associated with the species are several species of *Stromatoporella*, and numerous large specimens of *Naticopsis gigantea* H. & W. At a small exposure south and east of Hackberry Grove the lower portions of this zone contain numerous corals, among them being *Aulopora annectens* Clarke. *Westernia crassa* Webster, and *W. gigantea* Webster have been taken from this zone at Hackberry Grove. The limestones of the *Idiostroma* zone are very distinct, both lithologically and faunally from the underlying Spirifer beds. At all points where they were examined they were characterized by the two slender *Idiostromas*.

II. E.—The Naticopsis Zone.

The type locality for the Hackberry Stage is the Hackberry Grove exposure, and this same exposure furnishes the typical development of the Cerro Gordo Stage. The type locality for the Owen substage, and its upper two zones is the Owen Grove quarry, near Owen Creek, in Portland Township. At that locality there are some thirty feet of dark buff or brownish limestone, shales, shaley limestones, and dolomites overlying the Idiostroma beds, and characterized by their abundant gastropod fauna, in which the species *Naticopsis gigantea* predominates. The three species of *Westernia*, two or three unidentified species of *Ceneostoma*, and *Floydia concentrica* Webster, are among the other gastropods.

II. F.—The Acervularia Zone.

Above the Naticopsis Zone at Owen Grove there is a slope of about twenty feet, on the surface of which are numerous fragments of limestone bearing, among other fossils, a new species of *Acervularia* that has been variously referred to *Acervularia profunda* Hall, and *A. inequalis* H. & W. by various authors. *Pachyphyllum woodmani* (White) is common, in at least three varietal forms; *Strombodes*, *Alveolites*, *Chonophyllum*, and other corals are present. There are several species of gastropods, and pelecypods of the genus *Paracyclas;* brachiopods are relatively uncommon.

In the bed of Hackberry Creek, east of the Hackberry Grove escarpment, there are large amounts of residual material from the Acervularia Zone, and it is here that the best collecting is to be found. Corals are common; stromatoporoids common, but less so than they would be in weathered Spirifer Zone material from Hackberry Grove. *Stromatoporella incrustans* (H. & W.), *S. solidula* (H. &. W.) and several apparently undescribed species are among them. Both corals and Stromatoporoids are frequently pierced by what seem to be borings of a large species of *Cliona*, in no way allied to the *C. Hackberryensis* of the Spirifer zone.

II. G.—Distribution of the Formation.

The accompanying map, made up by C. L. Webster and myself, will serve to show the general distribution of the formation. I am particularly indebted to Mr. Webster for data regarding the Owen Substage and the questionable Hackberry areas in Worth County. His long study of the formation has enabled him to secure much data that I could not, in my brief work, secure.

III.—The Fauna of the Hackberry.

The following list, while far from complete, will serve to give an idea of the fauna in general, and in its stratigraphic relationships. No attempt is made to enumerate all of the undescribed species; those noted are in all cases the most striking or most characteristic ones.

In the foregoing pages considerable mention of various species has been made, and the stratigraphic relations of many forms have been noted. In order, however, to give a staisfactory idea of the bases for division of the formation into substages and zones here described, the following list is divided into three sections: the fossils of the Owen substage, those of the Spirifer zone, and those of the Striatula zone. Even this division, however, fails to give the true distinction between the last two subdivisions; this is apparent only in survey of the results of several days of careful collecting. It is a difference not so much of species as of numbers of species, and numbers of individuals, there being a greater abundance of both in the Spirifer zone.

In the following list, the abbreviation "sp." is used where the species is undetermined; the abbreviation "n. sp." indicates that the species (or variety: "n. var.") is undescribed.

Fossil Species of the Owen Substage.

PLANTAE
"Fucoids," of at least two species, undetermined.
ANIMALES.
Porifera
Cliona sp. or sps. Large boring forms in Alveolites, Acervularia, Pachyphyllum, etc.
Coelenterata
Anthozoa
Heliophyllum sp.
Heliophyllum n. sp.
Chonophyllum ellipticum H. & W.
Chonophyllum sp.
Zaphrentis solida H & W.
Cystiphyllum mundulum H. & W.
Charactophyllum nanum (H. & W.)
Strombodes johanni (H. & W.)
Strombodes johanni multiradiatus (H. & W.)
Acervularia cf. inequalis H. & W.
Acervularia n. sp.
Acervularia n. sp.
Pachyphyllum woodmani (White)
Pachyphyllum woodmani (White) var.
Pachyphyllum crassisostatum Webster
Pachyphyllum crassum Webster
Alveolites rockfordensis H. & W.
Cladopora robusta Rom.?
Aulopora iowensis H. & W.
Aulopora cf. saxivadum H. & W

Aulopora annectens Clarke
Aulopora sp.
Aulopora n. sp.
Syringopora sp.
Hydrozoa (?) (Stromatoporoidea)
Stromatoporella sps.
Stromatoporella solidula (H. & W.)
Stromatoporella incrustans (H. & W.)
Stromatoporella n. s.
Syringostroma planulatum (H. & W.)
Idiostroma n. sp.
Idiostroma n. sp.
Vermes
Spirorbis omphaloides (Goldfuss)
Forms probably belonging to the Tubulifera.
Echinodermata
Various unidentified remains, fragmental, of crinoids.
Molluscoidea
Bryozoa
Hederella alternata (H. & W.)
Hederella sp.
Lioclema? sp.
Brachiopoda
Schizophoria striatula (Schloth.)
Leptostrophia canace (H. & W.)
Strophonella reversa Hall
Productella hallana Walcott.
Atrypa reticularis (Linn.)
Atrypa hystrix Hall
Atrypa hystrix planostulcata Webster
Spirifer orestes H. & W.
Spirifer hungerfordi Hall
Spirifer whitneyi Hall
Mollusca
Pelecypoda
Paracyclas validalinea Webster
Paracyclas sabini White
Paracyclas elliptica Hall
Leptodesma sp.
Gastropoda

Bellerophon sp.
Straparollus cf. cyclostamus Hall
Ceneostoma sps.
Pleurotomaria sp.
Diaphorostoma lineatum (Con.)
Floydia concentrica Webster
Naticopsis gigantea H. & W.
Westernia crassa Webster
Westernia owensis Webster
Westernia gigantea Webster

Fossils of the Spirifer Zone.

PLANTAE
"Fucoids," three or more species.
ANIMALES
Porifera
Cliona hackberryensis Thomas
Cliona sp.
Coelenterata
Anthozoa
Zaphrentis solida H. & W.
Cyathophyllum n. sp.
Charactophyllum nanum (H. & W.)
Heliophyllum cf. scrutarium Clarke & Swartz.
Chonophyllum ellipticum H. & W.
Chonophyllum n. sp.
Strombodes johanni (H. & W.)
Strombodes johanni multiradiatus (H. & W.)
Pachyphyllum woodmani (White)
Pachyphyllum woodmani cf. gregarium Webster
Pachyphyllum crassicostatum Webster
Pachyphyllum ordinatum Webster
Pachyphyllum crassum Webster
Pachyphyllum n. sp.
Macgeea solitaria (H. & W.)
Macgeea parva Webster
Macgeea culmula Webster
Acervularia inequalis H. & W.
Acervularia n. sp.
Acervularia profunda Hall

Alveolites rockfordensis H. & W.
Cladopora cf. robusta Rom.
Cladopora cf. palmata H. & W.
Aulopora iowensis N. & W.
Aulopora saxivadum H. & W.
Aulopora filiformis Billings
Aulopora n. sps.
Syringopora sp.

Hydrozoa (?)
Stromatoporella solidula (H. & W.)
Stromatoporella incrustans (H. & W.)
Actinostroma cf. expansum (H. & W.)
Actinostroma n. sp.
Syringistroma planulatum (H. & W.)

Vermes
Serpularia, sps.
Cornulites, sps.
Spirorbis omphaloides (Goldfuss)
Spirorbis arkonensis Nich.

Echinodermata
Crinodea
Unidentified Crinoid remains; about ten species (Webster).

Echinoidea
Nortonechinus n. s.
Spines of unidentified forms.

Molluscoidea
Bryozoa
Vinella? sp.
Hederella alternata (H. & W.)
Hederella cf. filiformis Nich.
Lioclema occidens (H. & W.)
Lioclema minutissimum Nich.
Fenestella vera Uhlrich
Fenestella sp.
Eridotrypa sps.

Brachiopoda
Crania famelica H. & W.
Crania famelica H. & W. var.
Crania crenistriata Hall
Schizophoria striatula (Schloth.)

Schizophoria striatula impressa (Hall)
Leptostrophia canace (H. & W.)
Leptostrophia perplana nervosa (Hall)
Stropheodonta n. sp. (cf. calvini Miller)
Stropheodonta exilis Calvin(?)
Douvillina, n. sp.
Douvillina arcuata (Hall)
Douvillina arcuata maxima Fenton
Strophonella reversa Hall
Strophonella reversa gravis Fenton
Strophonella reversa hybrida (H. & W.)
Schuchertella prava Hall
Schuchertella prava Hall
Schuchertella sp.
Productella hallana Walcott
Productella truncata Hall
Productella speciosa Hall
Gypidula comis munda (Calvin)
Gypidula cf. comis Owen
Rhynchonella subacuminata Webster
Camarotoechia contracta saxatilis Hall
Rhipidomella cf. penelope Hall
Pugnoides altus (Calvin)
Pugnoides ambiguus (Calvin)
Liorhynchus iris Hall
Liorhynchus sp.
Centronella navicella (Hall)
Cranaena calvini (H. & W.)
Atrypa reticularis (Linn.)
Atrypa reticularis hackberryensis (Webster)
Atrypa reticularis alta Fenton
Atrypa reticularis (Linn.) n. var.
Atrypa hystrix Hall
Atrypa cf. spinosa Hall
Atrypa cf. aspera Hall
Spirifer whitneyi Hall
Spirifer whitneyi rockfordensis Fenton
Spirifer whitneyi gradatus Fenton
Spirifer whitneyi productus Fenton
Spirifer — sp.

Spirifer hungerfordi Hall
Spirifer n. sp.
Spirifer macbrideii Calvin
Spirifer orestes H. & W.
Spirifer substrigosus Webster
Spirifer websteri Fenton
Spirifer cyrtinaformis H. & W.
Spirifer cyrtinaformis helenae Fenton
Cyrtina hamiltonensis recta Hall
Ambocoelia sp.
Reticularia n. sp.
Athyris cf. minutissima Webster

Mollusca

Pelecypoda

Grammysia sp.
Spenotus contractus Hall(?)
Leptodesma sp.
Lucina sp.(?)
Paracyclas sabini White
Paracyclas elliptica Hall
Paracyclas validalinea Webster
Glossites lingualis Hall
Pterinopecten sps.
Aviculopecten sps.

Gastropoda

Bellerophon sp.
Straparollus cyclostamus (Hall)
Straparollus sp.
Platyostoma(?) insolitum Webster
Platyostoma(?) antiquum Webster
Platyostoma(?) modestum Webster
Diaphorostoma cf. ventricosum (Con.)
Cyclonema sp.
Pleurotomaria verticillata Webster
Holopea(?) iowensis Webster
Holopea sps.
Naticopsis gigantea H. & W.
Naticopsis gigantea hackberryensis Webster
Naticopsis gigantea websteri Fenton
Naticopsis magnificentis Webster

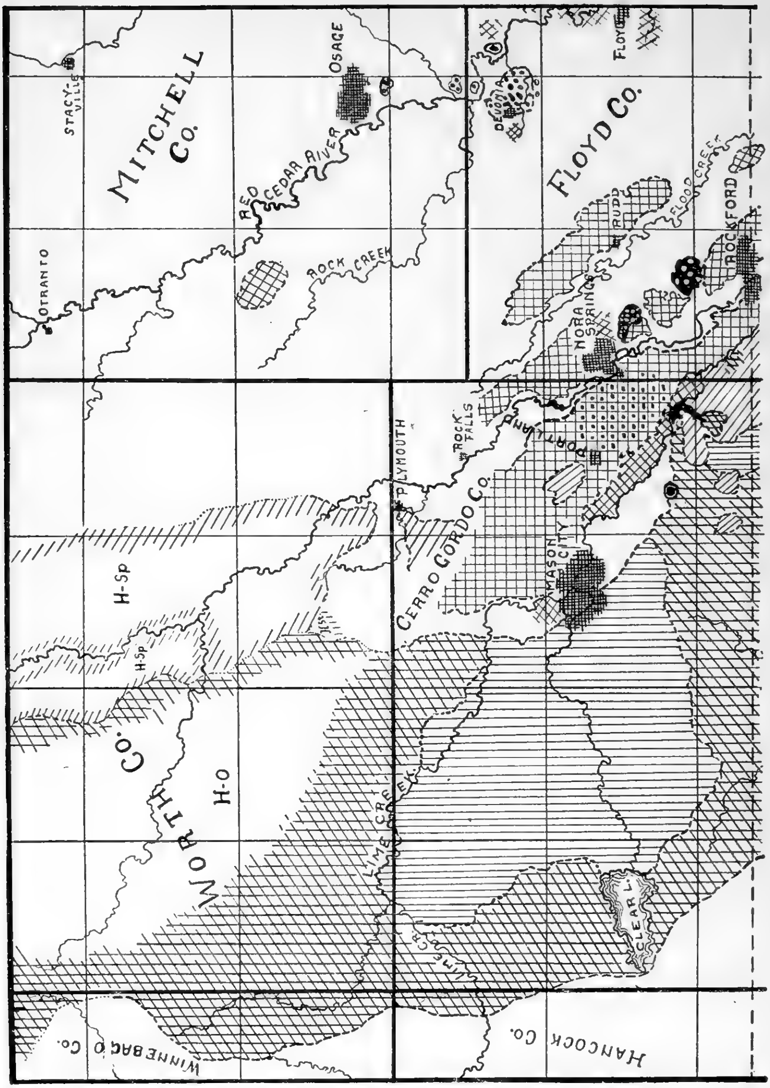
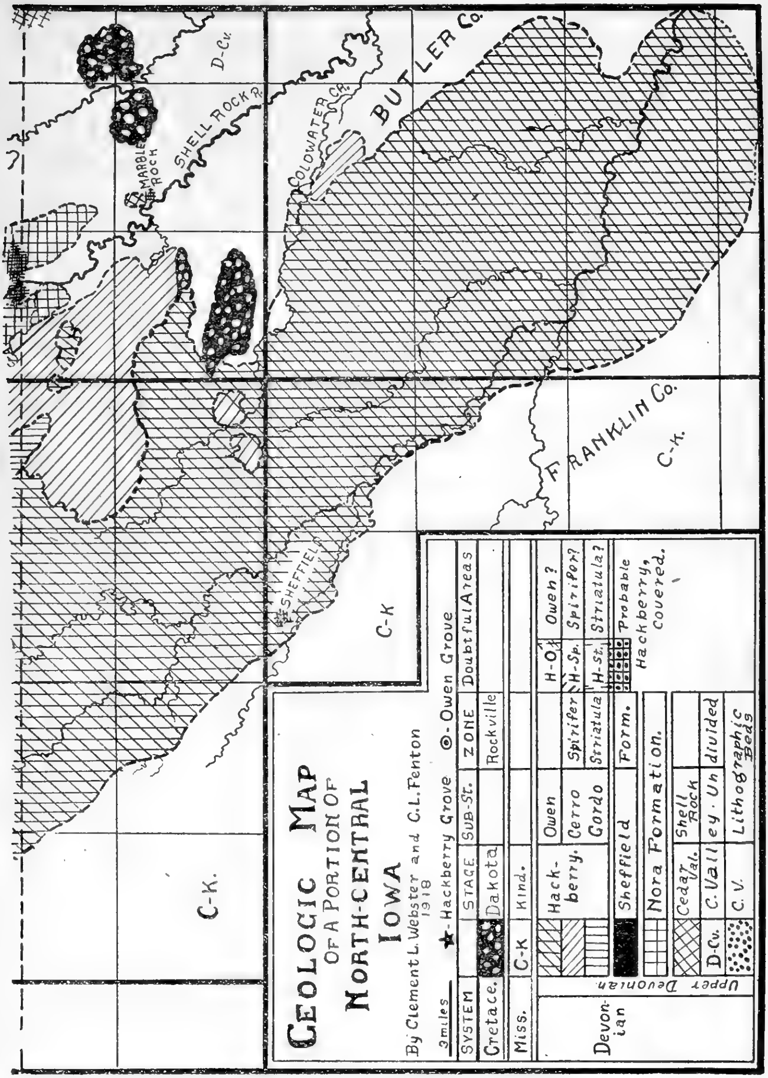


FIG. 2.—Geologic Map Showing Distribution



of the Hackberry Stage, and other Formations.

Floydia concentrica Webster
Floydia concentrica multisinuata Fenton
Loxonema hamiltonensis Hall
Loxonema sps.
Platydesma sp.
Paleotrochus sps.
Cephalopoda
Orthoceras berryx Hall
Orthoceras consortale Hall
Orthoceras sps.
Gomphoceras sps.
Manticoceras pattersoni (Hall)
Vertebrata
Piscea
Ptyctodus calceolus M. & W.
Dinicthys pustulosus Eastman
Diplodus striatus Eastman
Diplodus priscus Eastman
Apsidicthys sp.

FOSSIL SPECIES OF THE STRIATULA ZONE.

PLANTAE
"Fucoids," several species.
ANIMALES
Molluscoidea
Bryozoa
Lioclema occidens (H. & W.)*
Undetermined species.
Brachiopoda
Crania famelica H. & W.*
Leptostrophia canace (H. & W.)*
Douvillina arcuata (Hall)*
Gypidula cf. comis (owen) n. s.*
Centronella navicella (Hall)*
Centronella sp.
Cranaena calvini (H. & W.)?*
Schizophoria striatula (Schloth.)
Atrypa reticularis (Linn.)
Atrypa reticularis alta Fenton?*

* Found in the Gypidula faunule, at Rockford.

Spirifer whitneyi Hall
Spirifer hungerfordi Hall
Athyris minutissima Webster
Mollusca
Pelecypoda
Glossites sp.
Grammysia(?) sp.
Paracyclas sabini White*
Paracyclas validalinea Webster
Gastropoda
Platyostoma mirum Webster
Platyostoma pervetum Webster
Platyostoma sp.
Platyostoma n. sp.
Naticopsis rara Webster
Turbo (?) strigullata Webster
Turbo (?) incerta Webster
Holopea tenuicarinata Webster
Cyclonema brevilineata Webster
Cyclonema subcrenulata Webster

IV.—The Age and Relationships of the Hackberry Stage.

In section I of this paper there is given a summary of the age and equivalency of the Hackberry beds; it is not necessary to review this here. The two important questions are: (1) Is there any described equivalent of the Hackberry Stage? (2) What claims to the rank of stage can be advanced for the formation?

The first question can be answered with a decided negative. Calvin, interpreted the fauna of the Independence Formation of Iowa as the predecessor and direct ancestor of the Hackberry Fauna. This interpretation, however, was based on a very small number of species, and it is doubtful if some of these can be satisfactorily referred to both formations.

Clarke[1] saw a considerable relationship between the Hackberry, Independence, and High Point faunas. His conclusions, however, were drawn, as shown in the table given by him, from but a small fraction of the bryozoan, brachiopod and mulluscan faunas of the Hackberry, the total number of species from the three formations which were included in the table being forty-three. Aside from

[1] Bulletin 16, U. S. G. S.; pp. 74-76.

paleogeographic difficulties, the paleontologic evidence is against rather than in favor of correlation of the Hackberry with the High Point.

If an equivalent for the Hackberry is to be found, it must be looked for in the north and west rather than in the east. The similarity of certain Hackberry species with forms from northwest Canada and from western United States[1] is of interest. Thus certain western forms of *Spirifer whitneyi* Hall are strikingly like the Hackberry form which I have called *S. whitneyi gradatus*. But as yet nothing of sufficient importance to allow for correlation has come up. Therefore, if we except time equivalency, we may state without question that there is no described equivalent of the Hackberry Stage.

But is this formation a stage? Some writers think not; in one publication of the Iowa Survey the formation was referred to as a substage.[2] On the other hand, Calvin, Webster, Thomas, and others have not hesitated to give the Hackberry the rank of stage or group. It is true that if we compare the thickness of the rocks of the Hackberry with that of such formations as the Cedar Valley—to take another Iowa Devonian formation—or with the great thicknesses of some of the eastern formations, it makes but a poor showing. But thickness of sediments does not make a stage, just as it does not make a system. Fossils provide the evidence which can be relied upon.

The great difference of the Hackberry fauna from that of any other described formation has been dwelt upon; that feature is of importance in this connection as well as in correlation. The radical change of the Hadkberry fauna from those preceding it in the Iowa region is also of note. So far as known now, there is not a single fossil species in the Sheffield formation which is found in the Cedar Valley or Nora formations. So far as known, there is not a single species common to the Hackberry and Sheffield formations. The number of species common to the Hackberry and the Cedar Valley is small, and by careful study will become smaller.

On the other hand, if one is to consider the wealth of species, and the wealth of new species, in the Hackberry, the arguments for giving the formation the rank of stage are greatly strengthened. The number of formations in the Paleozoic which can show as

[1] See particularly Kindle; Bulletin 391, U. S. G. S.

[2] Eastman, Ia. Geol. Surv. Vol. XVIII, pp. 45-50.

prolific and as distinct a fauna, with as many forms known from that formation alone, is by no means great. And when it is recollected that the maximum *composite* thickness of the formation is but one hundred feet, and the average thickness very much less, there seems even less reason to call the formation a substage Moreover, if one calls a formation a substage he implies that it is a division of some stage. But since there is no known equivalent of the Hackberry, to what stage might it be referred?

V.—Summary.

1.—The highest, and youngest, position in the Devonian of Iowa is occupied by a formation whose known maximum composite thickness is about one hundred feet.

2.—This formation has been discussed under various formation names. The name *Hackberry*, proposed in 1889, has priority over other names and is more directly suitable to the formation than any other name which has been applied to it. Other names should therefore be regarded as synonyms, and should not be applied to this formation.

3.—The Hackberry formation is distinct, with no described equivalent. It is correctly designated as a stage (or group, as that term is commonly used).

Explanation of Plate

Figs. 1—2. *Atrypa reticularis alta* Fenton. A characteristic Spirifer zone form, found both at Hackberry Grove and Rockford.

Figs. 3—4. *Spirifer whitneyi rockfordensis* Fenton. An erratic form of considerable rarity, which I have found only at Rockford.

Figs. 5—6. *Spirifer whitneyi productus* Fenton. A form of *S. whitneyi* seldom found at Hackberry, sparingly at Rockford, but characteristic of the Bird Hill exposure. Specimen from Rockford.

Figs. 7—10. *Spirifer whitneyi gradatus* Fenton. Rockford, Ia. A form best developed in the Rockford district, in the middle portion of the Spirifer zone.

Figs. 11-17. *Spirifer cyrtinaformis helenae* Fenton. Rockford, Iowa. Specimens showing the slanting area and produced hinge-line which is particularly characteristic of the Bird Hill specimens. Good examples are less common at Rockford, and still less so at Hackberry.

Figs. 18-22. *Strophonella reversa gravis* Fenton. Rockford, Iowa. A form which, although usually best preserved at Rockford, is more characteristic of Hackberry Grove, Gigantea faunule.

Figs. 23-25. *Douvillina arcuata maxima* Fenton. Hackberry Grove, Iowa. A form which is found mainly at Hackberry Grove.

FIG. 27. *Spirifer* websteri Fenton. Rockford, Iowa. A distinct species of the *orestes* group. I originally referred to this form the one shown in Figs. 28-31, but this was incorrect.

FIGS. 26; 28-31. *Spirifer* species undescribed. Rockford, Iowa. Another species of the group of S. orestes H. & W. Spirifer zone; about equally characteristic of Rockford and Hackberry Grove.

EXPLANATION OF PLATE

FIG. 1—2a. *Naticopsis gigantea* Hall and Whitfield. Hackberry Grove, Ia.

FIG. 3. *Naticopsis gigantea* Hall and Whitfield. A large specimen, upper whorls restored. Hackberry Grove, Iowa.

FIG. 4. *Floydia concentrica multisinuata* Fenton. Holotype. Rockford, Iowa.

FIG. 5.—5a. *Floydia concentrica* Webster. Fig. 5; portion of a large specimen. Fig. 5a; cross-section of shell of specimen shown In Fig. 5. Rockford, Iowa.

Figures 1-3 are characteristic Spirifer zone forms from Hackberry Grove. Figures 4-5 show two typical specimens from the upper part of the Spirifer zone at Rockford.

A Consideration of Certain Genera Proposed by Ehrhart.

BY HOMER D. HOUSE

The question of what constitutes proper publication of a genus has received more than a little attention both in codes, proposed, promulgated or adopted, and by individual expression of opinion. A new genus published today without description but merely by the implication or indication of a type species would certainly seem inadequately published. However any code or set or rules which is retroactive is sure to encounter perplexing situations, which lead sooner or later to various evasions or deliberate exceptions.

This article deals with a set of generic names published by Friedrich Ehrhart in 1789 (Beitrage zur Naturkunde und den damit verwandten Wissenschaften, etc. 4: 146-148. 1789). Like many genera published by Rafinesque, Sweet, and several other early writers these genera were published without description, merely by the designation of a previously published species. The frequency with which this sort of generic publication occurs indicates that it must have been at the time regarded as a quite proper method. Many of Necker's genera are now regarded as invalid because no species were indicated, although not a few of them have been more or less commonly recognized and used in floras and manuals up to within a few years ago.

Before passing to a detailed consideration of Ehrhart's genera it may not be out of place to enumerate a few commonly accepted generic names which were published by Rafinesque merely by the citation of a type species. More extended search would doubtless reveal other genera by other authors which belong in the same catagory.

Adlumia Raf.
Scoria (Hicoria) Raf.
Spathyema Raf.
Triadenum Raf.
Achroanthes Raf. (Malaxis Sw.)
Washingtonia Raf. (Osmorhiza Raf.)
Odostemon Raf.
Quamasia Raf.
Leptamnium Raf.
Thalesia Raf.
Leptilon Raf.

The number preceeding each of Ehrhart's names is that of the order in which he published them.

I.—PHAEOCEPHALUM Ehrh. Beitr. 4: 146. 1789.
(Rynchospora Vahl, Enum. 2: 229. 1806)

The type as indicated by Ehrhart, is *Schoenus fuscus* L. *Schoenus corniculatus* Lam. not being regarded as congeneric with this group is not included in the following enumeration of species formerly referred to Rynchospora.

P. album (L)	*Rynchospora alba* (L.) Vahl
P. axillare (Lam.)	*R. axillare* (Lam.) Britton
P. Baldwinii (A. Gray)	*R. Baldwinii* A. Gray
P. brachychaetum (Sauv.)	*R. brachychaeta* Sauv.
P. caducum (Ell.)	*R. caduca* Ell.
P. chapmanii (M. A. Curtis)	*R. chapmanii* M. A. Curtis
P. ciliatum (Michx.)	*R. ciliata* (Michx.) Vahl
P. compressum (Carey)	*R. compressa* Carey
P. Curtissii (Britton).	*R. Curtissii* Britton
P. cymosum (Ell.)	*R. cymosa* Ell.
P. decurrens (Chapm.)	*R. decurrens* Chapm.

P. dodecandrum (Baldw.)	*R. dodecandra* Baldw.
P. distans (Michx.)	*R. distans* (Michx.) Vahl
P. divergens (M. A. Curtis)	*R. divergens* M. A. Curtis
P. Earlei (Britton)	*R. Earlei* Britton
P. fasciculare (Michx.)	*R. fascicularis* (Michx.) Vahl
P. filifolium (Torr.)	*R. filofolia* Torr.
P. fuscoides(Boeckl.)	*R. fuscoides* Boeckl.
P. fuscum (L.)	*Schoenus fuscus* L., *R. fusca* (L.) Ait. f.
P. glomeratum (L.)	*R. glomerata* (L.) Vahl
P. gracilentum (A. Gray)	*R. gracilenta* A. Gray
P. Grayi (Kunth)	*R. Grayi* Kunth
P. inexpansum (Michx.)	*R. inexpansa* (Michx.) Vahl
P. intermedium (Chapm.)	*R. intermedia* (Chapm.) Britton
P. Kneiskernii (Carey)	*R. Kneiskernii* Carey
P. leptorhynchum (C. Wr.)	*R. leptorhyncha* C. Wright
P. microcarpum (Baldw.)	*R. microcarpa* Baldw.
P. milaceum (Lam.)	*R. milacea* (Lam.) A. Gray
P. mixta (Britton)	*R. mixta* Britton
P. palulum (A. Gray)	*R. palula* A. Gray
P. pallidum (M. A. Curtis)	*R. pallida* M. A. Curtis
P. perplexum (Britton)	*R. perplexa* Britton
P. Plankii (Britton)	*R. Plankii* Britton
P. plumosum (Ell.)	*R. plumosa* Ell.
P. proliferum (Small)	*R. prolifera* Small
P. punctatum (Ell.)	*R. punctata* Ell.
P. pusillum (Chapm.)	*R. pusilla* Chapm.; M. A. Curtis
P. rariflorum (Ell.)	*R. rariflora* Ell.
P. solitare (R. M. Harper)	*R. solitaria* R. M. Harper
P. schoenoides (Ell.)	*R. schoenoides* (Ell.) Britton
P. stipitatum (Chapm.)	*R. stipitata* Chapm.
P. Torreyanum (A. Gray)	*R. Torreyana* A. Gray
P. Traceyi (Britton)	*R. Traceyi* Britton.

2.—LEUCOCOMA Ehrh. l. c. p. 146.

The type of this is designated as *Eriophorum alpinum* L. The genus has recently been taken up by Rydberg (*Leucocoma alpina* (L.) Rydb., Rocky Mountain Flora, 108. 1917).

11.—LEIOPHYLLUM Ehrh., l. c.

The type is designated as *Schoenus compressus* L., which is

Scirpus Carices Retz. (*Scirpus compressus* Pers., not Moench).

13.—TIPHOGETON Ehrh., l. c.

The type is designated as *Isnardia palustris* L., and since it is also the type of Isnardia, Tiphogeton becomes a synonym of Isnardia.

14.—HYDROPHILA Ehrh., l. c.

The type is designated as *Tillaea aquatica* L. The same species is made the type of Tilleastrum Britton (Bull. N. Y. Bot. Gard. 3: 1. 1903)

H. aquatica (L.) *Tillaea aquatica* L., *Tillaea simplex* Nutt., *Bulliarda aquatica* DC., *Tilleastrum aquatica* Britton.

H. Drummondii (T. & G.) *Tillaea Drumondii* T. & G., *Tilleastrum Drumondii* Britton.

H. Vaillantii (Willd.) *Tillaea Vaillantii* Willd., *Tilleastrum Vaillantii* Britton.

15.—PRATICOLA Ehrh., l. c.

The type is designated as *Thalictrum simplex* L., native of Europe. The name is not valid unless quite extensive segregation of the genus Thalictrum, as now constituted, should be made.

16.—LIMNAS Ehrh., l. c.

The type is designated as *Ophrys paludosa L.* This has been placed in the genus *Sturmia* Reichb. (1828), which is invalidated by *Sturmia* Hoppe (1799) and *Sturmia* Gaertn. (1805).

The writer has previously pointed out (Torr. Club Bul. 32: 378. 1905) that the type of Orphys L., is *Orphys ovata* L., and that Listera is a generic synonym. The type of Malaxis Sw. (1788) is *M. spicata*, congeneric with our native species now known as *M. monophylla* (L.) Sw., and *M. unifolia* Michx. *Ophrys paludosa* L., was also included by Swartz in Malaxis, and has been reported from Otter Tail County, Minn. and is common in Europe, so that Limnas Ehrh., must be regarded as a synonymous generic name of Malaxis. *M. paludosa* however, differs in certain important characters from our native species, and if seperated from Malaxis, the generic name Limnas would be available for it.

21.—MARISCUS Ehrh., l. c.

The type is designated as *Schoenus mariscus* L. This name dating from Haller, had already been taken up for this type by Zinn (Cat. Hort. Goett. 79. 1757). Cladium P. Br. (1756) being a hyponym, is not recognized in recent floras.

34.—STYPHORRHIZA Ehrh., l. c. p. 147.

The type is designated as *Polygonum viviparum* L., and as a genus is antedated by Bistorta (C. Bauhin) Miller.

37.—HELLEBORINE Ehrh., l. c.

The type is designated as *Serapias latifolia* which is the same as Serapias helleborine L., now recognized as the type of Serapias, so that Helleborine Ehrh, becomes another of the numerous synonyms of Serapias.

41.—TRICHOPHYLLUM Ehrh., l. c.

The type is designated as *Scirpus acicularis* L., so that Elocharis R. Br. (1810) becomes a synonym of Trichophyllum.

T. aciculare (L.)	*Scirpus acicularis* L., *Eleocharis acicularis* R. &. S.
T. acuminatum (Muhl.)	*Eleocharis acuminata* (Muhl.) Nees
T. albidum (Torr.)	*E. albida* Torr.
T. arenicolum (Torr.)	*E. arenicola* Torr.
T. atropurpureum (Retz.)	*E. atropurpurea* (Retz.) Kunth.
T. Baldwinii (Torr.)	*E. Baldwinii* (Torr.) Chapm.
T. bicolor (Chapm.)	*E. bicolor* Chapm.
T. capitatum (L.)	*Schoenus capitatus* L., *Scirpus tenuis* Willd., *Eleocharis tenuis* Schultes, *E. capitata* (L.) R. Br.
T. cellulosum (Torr.)	*E. cellulosa* Torr.
T. Chaetaria (R. & S.)	*E. Chaetaria* R. & S.
T. cylindricum (Buckl.)	*E. cylindrica* Buckl.
T. diandrum (C. Wr.)	*E. diandra* C. Wright
T. elongatum (Chapm.)	*E. elongata* Chapm.
T. Engelmanni (Steud.)	*E. Engelmanni* Steud.
T. intermedium (Muhl.)	*E. intermedia* (Muhl.) Schultes
T. intermedium var. *Habereri* (Fernald)	Var. *Habereri* Fernald
T. interstinctum (Vahl)	*Scirpus interstinctus* Vahl, *Eleocharis interstincta* R. & S.

T. lanceolatum (Fernald)	*E. lanceolata* Fernald
T. maculosum (Vahl)	*E. maculosa* (Vahl) R. Br.
T. monticolum (Fernald)	*E. monticola* Fernald
T. mutatum (L.)	*E. mutata* (L.) R. & S.
T. nodulosum (Roth)	*E. nodulosa* (Roth) Schultes
T. ochreatum (Nees)	*E. ochreata* (Nees) Steud.
T. obtusum (Willd.)	*Scirpus capitatus* Walt., Not L., *Scirpus obtusus* Willd., *Eleocharis obtusa* Schultes.
T. oblivaceum (Torr.)	*E. olivacea* Torr.
T. ovatum (Roth)	*E. ovata* (Roth) R. & S.
T. palustre (L.)	*E. palustris* (L.) R. & S.
Var. *calvum* (Torr.)	
Var. *glaucescens* (Willd.)	
Var. *vigens* (Bailey)	
T. praticolum (Britton)	*E. praticola* Britton
T. proliferum (Torr.)	*E. prolifera* Torr.
T. Ravenelii (Britton)	*E. Ravenelii* Britton
T. Robbinsii (Oakes)	*E. Robbinsii* Oakes
T. rostellatum (Torr.)	*E. Rostellata* Torr.
T. simplex (Ell.)	*Scirpus simplex* Ell., *Eleocharis simplex* A. Dietr. *Eleocharis tortilis* (Link) Schultes.
T. Torreyanum (Boeckl.)	*E. Torreyana* Boeckl.
T. tuberculosum (Michx.)	*E. tuberculosa* (Michx.) R. & S.
T. tricostatum (Torr.)	*E. tricostata* Torr.
T. thermale (Rhydb.)	*E. thermalis* Rydb.
T. viviparum (Kunth)	*E. vivipara* Kunth.

44.—HYPOPITYS Ehrh., l. c.

The type is designated as *Monotropa hypopitys* L. As a generic group this had already been recognized by Adanson in 1763.

45.—CHAMAEMORUS Ehrh., l. c.

The type is designated as *Rubus chamaemorus* L. Some attempts have been made to segregate the genus Rubus, which contains, as is generally known, a number of distinct groups of species. Greene (Leaflets 1: 245. 1906) adopts the genus from Clusius, and it is apparently as worthy of recognition as a segregate of Rubus, as is Rubacer. (Bossekia Neck.) or Oreobatus Rydb, *Chamaemorus chamaemorus* (L.) *Rubus chamaemorus* L. *Rubus nubis* S. F. Gray.

54.—MONANTHIUM Ehrh., l. c. p. 148.

The type is designated as *Pyrola uniflora* L. This is the type also of Moneses Salisb. (1821), and of Bryopthalmum E. Meyer (1839).

Monathium uniflorum (L.) *Pyrola uniflora* L. *Moneses grandiflora* S. F. Gray.

Monathium reticulatum (Nutt.) *Moneses reticulata* Nutt.

66.—HELICTONIA Ehrh., l. c.

The type is designated as *Ophrys spiralis* L., Hence Ibidium, Gryostachys and Spiranthes are all synonyms. It has been pointed out by Niewland (Am. Mid. Nat. 3: 132. 1913) that Bauhin's name for this genus, Triorchis, has been properly published by Petiver in 1764, and is therefore the earliest generic name, since 1753, for this orchidaceous genus which has been so variously designated within the past twenty years. To Doctor Niewland's treatment I would add the following species:

Triorchis vernalis (Engelm. & Gray) *Spiranthes vernalis* Engelm. & Gray, *S. neglecta* Ames, *Gyrorostachys linearis* Rydb., *Ibidium vernale* House.

Triorchis Beckii (Lindl.) *Spiranthes Beckii* Lindl., *S. simplex* A. Gray (not Griseb.), *Gyrostachys simplex* Kuntze, *S. grayi* Ames, *Ibidium Beckii* House. *Triorchis Grayi* Niewul.

Triorchis lacinata (Small) *Gyrostachys lacinata* Small.

Triorchis longilabris (Lindl.) *Spiranthes longilabris* Lindl. *S. brevifolia* Chapm., *Gyrostachys brevifolia* Kuntze.

Triorchis ovalis (Lindl.) *Spiranthes ovalis* Lindl., *S. cernua* var. *parviflora* Chapm. *G. parviflora* Small

Triorchis spiralis (Sw.) *Satyrium spirale* Sw. not *Ibidium spirale* Salisb., *Neottia tortilis* Sw. *Spiranthes tortilis* L. C. Rich, *Ibidium tortile* House.

Triorchis xyridifolia (Small) *Gyrostachys xyridifolia* Small

Triorchis tribola (Small) *Gyrostachys reverchonii* Small *Gyrostachys tribola* Small. *Ibidium trilobum* Small.

76.—CARDIOPHYLLUM Ehrh., l. c.

The type is designated as *Ophrys cordata* L. This is congeneric

Ophrys ovata L, the type of Ophrys, and the name Cardiophyllum takes its place with Listera as a synonym of Ophrys.

78.—Aetopteron Ehrh., l. c.

The type is designated as *Polypodium aculeatum L.* This is the type of Polystichum Roth, and antedates the publication of that fern genus by several years. The species of the United States which should be considered under this name number about eight. A contemporary paper in which these species are transferred to Aetopteron, has been submitted for publication to the American Fern Journal.

86.—Cornilla Ehrh., l. c.

This is but a slight change in spelling of Coronilla L., and the type species, *Coronilla coronata* L., is also here designated as the type of Cornilla Ehrh.

New York State Museum,
Albany, N. Y.

Birds Observed at Notre Dame, Indiana, in the Fall of 1919.

BY BROTHER ALPHONSUS, C. S. C.

NAME OF BIRD	When was it first seen?	About how many were seen?	When was it next seen?	When did it become common?	When was it last seen?	Is it common or rare?	Does it breed near your station?	REMARKS
Blackbird, Red-winged								
Bluebird	Sept. 3	1	Sept. 11	Sept. 25	Oct. 29	Com.	Yes	No records
Bobolink	Sept. 3	1	Sept. 4		Sept. 5	Com.	Yes	
Bobwhite								No records
Cardinal	Oct. 16	1	Oct. 27	Nov. 5	Nov. 16	Com.	Yes	Not widely distributed
Catbird	Sept. 1	3	Sept. 3	Sept. 2	Sept. 24	Com.	Yes	
Cedarbird								No records
Chickadee	Sept. 5	3	Sept. 14	Oct. 7	Nov. 30	Com.	Yes	
Cowbird	Sept. 2	1	Sept. 12	Sept. 17	Oct. 9	Com.	Yes	Many seen Oct. 9.
Creeper, Brown	Sept. 25	1	Oct. 2		Nov. 9	Rare	No	
Crow	Sept. 3	5	Sept. 12	Sept. 15	Nov. 26	Com.	Yes	
Cuckoo, Black-billed								No records
Cuckoo, Yellow-billed								No records (unusual)
Dickcissel								No records
Dove, Mourning	Sept. 1	2	Sept. 3	Sept. 11	Sept. 28	Com.	Yes	Two seen Dec. 2.
Finch, Purple	Oct. 4	1	Oct. 8	Oct. 19	Nov. 28	Com.	No	
Flicker	Sept. 1	4	Sept. 2	Sept. 1	Sept. 28	Com.	Yes	
Flycatcher, Acadian								No records
Flycatcher, Alder								No records (unusual)
Flycatcher, Crested								No records (unusual)
Flycatcher, Least								No records
Goldfinch	Sept. 1	5	Sept. 2	Sept. 1	Nov. 15	Com.	Yes	
Grebe, Pied-billed	Nov. 3	1	Nov. 5		Nov. 6	Com.	No	
Grosbeak, Rose-breasted								No records
Hawk, Red-shouldered								No records
Indigo Bird								No records (unusual)

NAME OF BIRD	When was it first seen?	About how many were seen?	When was it next seen?	When did it become common?	When was it last seen?	Is it common or rare?	Does it breed near your station?	REMARKS
Jay, Blue	Sept. 1	4	Sept. 2	Sept. 1	Nov. 28	Com.	Yes	
Kingbird	Sept. 9	1	Sept. 11		Sept. 11	Rare	Yes	
Kingfisher	Sept. 2	1	Sept. 15		Nov. 20	Rare		Breeds rarely
Killdeer	Sept. 3	3	Sept. 4	Sept. 9	Nov. 14	Com.	Yes	Seven seen Nov. 14
Knight, Golden-crowned	Nov. 6	1	Nov. 7	Nov. 7	Dec. 4	Com.	No	
Knight, Ruby-crowned	Nov. 14	1			Nov. 14	Rare	No	
Lark, Prairie Horned	Nov. 11	2	Nov. 15		Nov. 15	Rare	Yes	Locally distributed
Martin, Purple	Sept. 9	50	Sept. 15	Sept. 9	Sept. 28	Com.	Yes	Sept. 28, latest record
Meadowlark	Sept. 3	5	Sept. 15	Sept. 15	Oct. 24	Com.	Yes	
Nuthatch, White-breasted	Sept. 10	1	Sept. 12	Sept. 10	Nov. 30	Com.	Yes	
Nuthatch, Red-breasted								No records
Oriole, Baltimore								No records
Oriole, Orchard								No records
Oven-bird	Sept. 23	1			Sept. 23	Rare	No	
Owl, Screech	Sept. 23	1	Sept. 24		Sept. 28	Rare	Yes	
Phoebe	Sept. 14	1	Sept. 16		Oct. 21	Rare		Breeds irregularly
Pewee, Wood	Sept. 1	3	Sept. 2	Sept. 1	Sept. 27	Com.	Yes	
Redstart	Sept. 15	4			Sept. 15	Rare	No	
Robin	Sept. 1	10	Sept. 2	Sept. 1	Nov. 1	Com.	Yes	
Sandpiper, Spotted								No records
Sapsucker	Sept. 17	2	Sept. 27		Sept. 27	Rare	No	
Shrike, Loggerhead	Nov. 11	1			Nov. 11	Rare	Yes	Locally distributed
Snowbird	Sept. 23	3	Sept. 24	Sept. 23	Nov. 30	Com.	No	
Sparrow, Chipping	Sept. 11	4	Sept. 12	Sept. 11	Oct. 20	Com.	Yes	
Sparrow, Field	Sept. 3	5	Sept. 11	Sept. 3	Oct. 26	Com.	Yes	
Sparrow, Fox	Nov. 14	1			Nov. 14	Rare	No	
Sparrow, Savanna	Sept. 22	6			Sept. 22	Rare	No	
Sparrow, Song	Sept. 3	5	Sept. 4	Sept. 3	Nov. 29	Com.	Yes	A few stay all winter
Sparrow, Tree	Nov. 7	1	Nov. 10		Nov. 27	Rare	No	
Sparrow, Vesper	Sept. 22	1	Sept. 24		Nov. 11	Com.	Yes	Irregular in autumn

NAME OF BIRD	When was it first seen?	About how many were seen?	When was it next seen?	When did it become common?	When was it last seen?	Is it common or rare?	Does it breed near your station?	REMARKS
Sparrow, White-crowned	Sept. 26	1			Sept. 26	Rare	No	
Sparrow, White-throated	Sept. 16	5	Sept. 17	Sept. 25	Oct. 29	Com.	No	
Swallow, Barn	Sept. 3	1			Sept. 3	Rare	Yes	
Swift, Chimney	Sept. 15	9	Sept. 17	Sept. 15	Oct. 4	Com.	Yes	
Tanager, Scarlet								No records
Thrasher, Brown	Sept. 6	1	Sept. 11	Sept. 16	Sept. 27	Com.	Yes	
Thrush, Gray-cheeked	Oct. 3	1			Oct. 3	Rare	No	Seen in a wet field
Thrush, Hermit	Oct. 8	1	Oct. 10		Oct. 10	Rare	No	
Thrush, Olive-backed	Sept. 11	1	Sept. 15	Sept. 25	Oct. 1	Com.	No	
Titlark	Oct. 5	25			Oct. 5	Rare	No	
Titmouse, Tufted	Oct. 3	1	Oct. 14		Oct. 14	Rare	No	
Towhee	Sept. 11	1	Sept. 12	Oct. 7	Oct. 30	Com.	Yes	
Vireo, Red-eyed	Sept. 16	1			Sept. 16	Rare	Yes	
Vireo, Warbling	Sept. 1	1	Sept. 4		Sept. 16	Rare	Yes	
Vireo, Yellow-throated	Sept. 26	1			Sept. 26	Rare	No	
Warbler, Bay-breasted	Sept. 13	10	Sept. 28		Sept. 28	Com.	No	
Warbler, Black and White								No records (unusual)
Warbler, Black-poll	Sept. 20	1			Sept. 20	Rare	No	
Warbler, Black-throated Green	Sept. 20	1	Sept. 28		Sept. 28	Com.	No	
Warbler, Magnolia	Sept. 20	8	Sept. 28		Sept. 28	Com.	No	
Warbler, Myrtle	Sept. 26	1	Sept. 28	Oct. 3	Oct. 29	Com.	No.	
Warbler, Palm	Sept. 25	2			Sept. 25	Rare	No	
Warbler, Pine	Sept. 8	1	Sept. 22	Sept. 25	Oct. 5	Com.	No	
Woodpecker, Downy	Sept. 1	1	Sept. 3	Sept. 1	Nov. 26	Com.	Yes	
Woodpecker, Hairy	Sept. 3	1	Sept. 6		Oct. 14	Rare	No	
Woodpecker, Red-headed	Sept. 3	5	Sept. 5	Sept. 3	Nov. 28	Com.	Yes	Stays in mild winters
Wren, House	Sept. 5	3	Sept. 10	Sept. 5	Oct. 3	Com.	Yes	
Wren, Winter								No records in 1919
Wren, Carolina								No records in 1919
Yellow-throat, Maryland								No records (unusual)

NOTE

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Variation in Nacreous Color of Certain Species of Naiades Inhabiting the Upper Ohio Drainage and their Corresponding Ones in Lake Erie.

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I.—Introductory and Statement of Problem.

Perhaps the greatest amount of the systematic study of color in any animal group has been given to the birds, where the demand for a more accurate color terminology in describing the hues of plumaages eventually resulted in the Ridgeway Color Standards and Color Nomenclature, (14),—a scientific achievement apparently but little appreciated by others than ornithologists. Other types of animals, such as the Insects and even the Gastropods have been by no means neglected at least from the standpoint of variation in color pattern, but the fresh water mussels, (Naiades), so far as the writer is aware have not been the subject of any but more incidental observation.

One who has formed some acquaintance with any scientific work dealing with color nomenclature, must become impressed with the apparent glittering generalities in the specific description of shells so far as epidermal and nacreous color are concerned, but lest it be thought there exist no justification for this seeming slovliness on the part of the student of the Naiades, it need only be pointed out that in the case of birds at least, they are probably less numerous in collection, species for species, than mussel shells. Moreover, they possess a distinct advantage in that their plumage colors are usually arranged in a definite color pattern, or so associated with sexual or other characters that the ornithologist may well use them more accurately for descriptive purposes, than the conchologist can with the data he even may more laboriously collect. There has thus been a proportionate development of the study of color as one or the other group of naturalists found essential for constructive work.

The writer's interest in the Naiades has been ecological as well as systematic. In other papers, (3, 4, 5,), dealing with the Naiades he has attempted to associate certain morphological features of the shells with the physical conditions under which they lived. A definite change of morphological features was found to parallel changes in physical conditions. Morphological features of shell are to the systematist, descriptive characters, as are also epidermal and nacreous colors. It would therefore be worth while to look for changes in the latter also to complete the idea of parallelism, and if at the same time, some progress could be made toward systematizing the color nomenclature as existing now in the Naiades so much the better—especially if such could be done with regard to any existing accepted scientific terminology, such as that of Ridgeway. With this preliminary hint of the two-fold scope of the observations to be given and the ultimate basis from which it proceeded, we pass to a digest of the literature only with which we are concerned, (the species dealt with in this paper), as it is felt that the citation of even more fragmentary observations about the other species of Naiades can add but little. At the same time, it may be pointed out that in itself the literature cited largely illustrates points which are the basis of conclusions later to be taken.

Wilson and Clark, (18–19), state that *Unio gibbosus* (*Elliptio dilatatus*), and *Lampsilis*, (*Eurynia*) *rectus* have a greater percentage of white nacre going down stream, (Maumee Drainage). Soft water and amount of humic acid in the upper waters may favor a purplish deposit, while colorless forms which occur shortly after limestone beds are reached, may be found where there is an excess of abundance of lime. . . . The rosy hue of *Quadrula coccinea*, (*Pleurobema coccineum*) seems to be of a different nature going down stream . . . the majority of this species from the Maumee are white, few with a rosy nacre. *Quadrula rubiginosa*, (*Fusconaja flava*) for the most part is white, but some are yellowish rosy. In this drainage 2-3 of *Unio gibbosus* are white. *Lampsilis rectus* had a purple nacre in some streams, white in others. In the Kankakee Drainage, (19), upstream, *Quadrula coccinea* was found to be of a delicate pink color, lower down becoming white, while all shells of Elliptio in the upper part of the Kankakee Basin are of a deep purple color. Utterback, (16), found that the nacre of *Elliptio* was darker in upstreams sections fading out toward the mouth confirming Wilson and Clark's observation. He additionally points out that of *Quadrula verrucosa* that the pink nacred shells are confined to southern Missouri; of *Pleurobema obliquum catillus* that in the Gasconade it has a white nacre, while in the Osage River it is pink. Wilson and Clark further, (18), the color of Anodonta grandis is in ½ the cases dark purple, the other half creamy white. There may be added a curious observation of Israels on *Unio crassus*, that the epidermis of females were usually of a gray color, while that of the males were red.

Following the clues given in the foregoing, effort will be made in this paper to throw light on the following problems connected with the color of nacre in species of Naiades dealt with, viz;

I. In those species commonly assigned more than one characteristic nacre color, to determine as far as possible the relative prevalance of each color in all the shells as a whole, and the difference between L. Erie and Upper Ohio shells in this regard.

II. To determine whether any change in nacreous color takes place going down stream, both in the rivers and their tributaries, and to learn whether in any of the species, a particular shade of the described nacre color is peculiar to the bady of water concerned.

III. To associate as far as possible certain shades of the described nacre color with the sex of the animal in each of the species dealt with.

II.—List of Species Used.

LAKE ERIE	UPPER OHIO DRAINAGE
1. Fusconaja flava parvula ,Grier.	*Fusconaja flava, Raf.*
2. Amblema plicata, Say.	*Amblema costata, Raf.*
4. Pleurobema obliquum pauperculum, Simpson.	*Pleurobema obliquum coccineum, Con.*
3. Elliptio dilatatus sterkii, Grier.	*Elliptio dilatatus, Raf.*
5. Syphynota costata eriganensis, Grier	*Symphynota costata, Raf.*
6. Anodonta grandis footiana, Lea.	*Anodonta grandis, Say.*
7. Paraptera alata, Say.	*Paraptera alata, Say.*
7. Paraptera fragilis, Raf.	*Paraptera fragilis, Raf.*
8. Proptera alata, Say.	*Proptera alata, Say.*
9. Anodontoides ferrus-subcylind. Lea.	*Anodontoides ferrussacianus Leo.*
10 Eurynia recta, Lam.	*Eurynia recta latissima, Raf.*
11. Lampsilis luteola rosacea, Dekay.	*Lampsilis luteola, Lam.*
12. Lampsilis ovata conadensis, Lea.	*Lampsilis ovata ventricosa, Lam.*

The accompanying map and list of localities showing the collecting stations will give some idea of their distribution in the Upper

Ohio Drainage and Lake Erie. The material used was collected by Dr. A. E. Ortmann over a number of years, (1903-07), in Western Pennsylvania and Lake Erie, or secured by him in smaller amount as exchanges. Dr. Ortmann, besides suggesting the value of an introductory study to the color problem in Naiades, has done everything in his power to assist the investigation, for which data was obtained at the Carnegie Museum, Pittsburgh. I am also indebted to Dr. W. J. Holland, Director of the Carnegie Museum for the freest use of its facilities in connection.

III.—Physical Conditions and Type of Mussel Fauna.

The type of Mussel Fauna has already been admirably treated in papers by Walker, (17) and Ortmann, (12). These and the physical conditions concerned have already been summarized by the writer elsewhere, (5); the latter are ably given for L. Erie by Jennings (8), and for the Upper Ohio Drainage in the Water Supply papers of the U. S. Geological Survey (6). For sake of convenience, however, the outstanding points concerning the physical conditions are given in the following, contrasting columns.

LAKE ERIE	UPPER OHIO DRAINAGE
Water colder than in Upper Ohio, but with more even regulation of temperature. Currents much less rapid than in streams, less agitated, except by very moderate currents, carrying but little sediment. Bottom pebbles or sand or mixture of these, depending on region of lake, with coarser sediment derived from wear of land. Temperature conditions favor a more uniform production of food, while the water contains more lime.	*Water warmer, but greater extremes of temperature to face. Streams more rapid than current of L. Erie; greater agitation, frequent falls and rapids, short stretches of quiet pools. River carry a load of debris moving quickly over the bottom which consists of mud, glacial fill, cobbles. Food conditions, (due to extreme of temperature), are less stable, even if at times food is more abundant.*

It may be added that L. Erie shells as a whole have been observed to possess brighter (clearer) colors than their fellows of the Upper Ohio Drainage, are exceptionally polished, and otherwise characterized in distinction by their well developed lines of growth. Dr. Walker in a letter to the writer, (1914) suggested that certain depauperate qualities of the L. Erie shells may be due to the chemical quality of the water, pointing out that the influence of brackish water upon fluviatile species is well known. The relation of this fact to the color problem will be dealt with later.

IV.—METHOD.

As previously indicated, the nacreous color of the Naiades does not readily lend itself to the determination of any well defined color pattern. The writer therefore confined his efforts to the tabulation of the nacreous colors of each species of shell by means of comparisons with the standard colors given in the Ridgeway Color Nomenclature. Usually but one color was recorded—that one most impressing the eye with its vividness and preponderance in the nacre. Where the number of shells from a locality was small, sometimes 2-3 colors were recorded, but only if they appeared to be of equal tone in the shell. Such data was later useful in tracing genetic relationship in the sequence of color change. The color or colors judged most to match were then written in figuring books opposite calculations previously made for the morphological features of each shell. Shell were rejected when erosion of the nacre was such that no definite determination of nacre color could be made. As a rule, white as a *color* was not recognized when there existed a fair suspicion that another color was the original one, for scientifically speaking, white is a combination of colors, and usually the writer was able to refer whitish shades to pearl blue and closely similar colors.

Where a large number of shells from one locality were concerned, it was the usual practice to group all the shells of a closely similar nacre color, and compare as a whole with the shades in Ridgeway. By this means, a general or average hue was obtained, not accurate of course for every shell, but very convenient in determining the relative color of the shells at the locality to ones near it, above or below in the particular body of water. As a rule these relative colors were taken from a fairly large number of shells—8 in most cases, although lack of material often completed the use of smaller numbers. Against such treatment, however, was the check of a separate color comparison for each shell.

By means of the method above described, it was possible to determine for each species, a shade of nacre color peculiar to the locality where the shell had been collected, and this being done charts were prepared showing the sequence of color or color changes passing down stream, or the distribution in different parts of the same body of water. This data is presented in Plate III. Even by this process of condensation, a very large number of colors were obtained for each species, making it imperative to simplify further in order that the evidence for the relative prevalence of different nacreous colors in those species where more than one was described, might be rendered more intelligible for report. Just as the systematist for roughly descriptive purposes has picked out a number of the more prominent nacreous colors of each species, the writer, largely following Simpson's Descriptive Catalogue of the Naiades(15), chose from the previously prepared charts, the 5-15 "leading colors" in the nacreous color of each species, to which the large majority of the rest could be assigned. Percentages of these leading colors were then calculated for each species in the bodies of water, drainages, groups of drainages in which they were found, as best seemed to throw light on the problems to be attacked. While all recorded shades in a large number of the species would not conform to this treatment, they represent percentages in the extreme minority. These may be inferred to exist in those species where the table on "Distribution of Colors as a Whole," does not add up to 100%. Strictly speaking, even this comparatively large number of "leading colors" could have been condensed to a smaller number, but a larger number was necessary in order that certain close distinction in the color of nacre for purposes of the investigation might be made, for example, between the color of shells of a river and those of its tributaries. In the discussion of any particular body of water, however, when the latter is considered by itself, the leading colors given represent my reduction to lowest terms. of the colors represented in it.

V.—Results.

Each species is dealt with separately, there first being given in parallel columns,

(a) Descriptive material concerning the nacreous color as taken from Simpson (15).

(b) The equivalent in the writer's opinion of the Simpson colors in terms of the Ridgeway Color Nomenclature.

It is felt that by this arrangement, and the inferences to be drawn from the names of the Ridgeway Colors themselves, it will be possible for the reader to sufficiently understand the terminology used as to convey the principles this paper hopes to make clear. For the sake of even greater clarity, there are also given latterly in the Ridgeway column, the peculiar shades of the Lake Erie shells, although these are, by the convenient arbitracy arrangement adopted, but varieties of the hues given in the tables, on "Distribution of Colors as a Whole in the latter of which, effort is made to throw light on the first problem stated. There then follows tables of percentages giving the relative distribution of colors in the Upper Ohio Drainage as a whole, and separately, its component drainages. The same is done for Lake Erie and its various collecting stations. After remarks largely in explanation of outstanding points of Plate III, (chart illustrating sequence of nacreous color changes; Problem III, the discussion of each species terminates with the evidence for possible association of Sex Correlative Coloration with the nacreous color of the shell.

1.—*Fusconaja flava.*

SIMPSON	RIDGEWAY
White to	Pearl blue, Pale Grayish Blue Violet, Pale Medici Blue
Salmon;	Pale Pinkish Cinnamon, Pale Pinkish Buff, Light Flesh Pink.
Rose tinted.	Light Orange Pink, Light Salmon Orange.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie. (273 shells.)

Pale Pinkish Cinnamon and allied colors	21%
Pale Pinkish Buff and allied colors	13%
Light Orange Pink and allied colors	11%
Pale Grayish Blue Violet and allied colors	25%
Pearl Blue and allied colors	10%

Distribution of Colors as a Whole in Upper Ohio Drainage. (225 shells)

Pale Pinkish Cinnamon and allied colors	27%
Pale Pinkish Buff and allied colors	23%
Light Orange Pink and allied colors	16%
Pale Grayish Blue Violet and allied colors	17%

Distribution of Colors as a Whole in Upper Ohio Tributaries, etc.

	Alle'ny Tribs.	*Alle'ny River*	*Mon'g. Tribs*	*Mon'g. River*	*Ohio Tribs.*	*Ohio River*	*Tusca. River*
Pale Pink. Cinnamon, etc	30%		62%	27%	100%	30%	
Pale Pink. Buff, etc	25%	67%		23%		25%	50%
Light Orange Pink, etc.	20%			50%		20%	
Pale Gray. Blue Violet, etc	13%	33%					50%
Pale Gray Lavender, etc			25%				
Deeper Hermosa Pink						25%	

Distribution of Colors as a Whole in L. Erie. (67 shells).

Pearl Blue and allied colors	18%
Light Flesh Pink and allied colors	18%
Pale Gray. Blue Violet and allied colors	14%

Pale Medici Blue and allied colors	14%
Light Salmon Orange and allied colors	14%

Distribution in L. Erie—localities.

	La Plaisance Bay	*Cedar Paint*	*Presque Isle Bay*
Pearl Blue and allied colors	12%		
Light Salmon Orange and allied colors	25%	67%	14%
Light Gray. Blue Viol. and allied colors	50%		33%
Medici Blue and allied colors		33%	
Light Flesh Pink and allied colors			33%
Light Buff			8%

Deductions from Tables of Percentages and Plate III:

It will be immediately noted that bluish colors are more prominent in L. Erie than in the Upper Ohio Drainage. Reddish colors also tend to have lighter hues in the former. Colors of a buffy or orange tone rather than pinkish, are most abundant in rivers, where grayish colors also seem to predominate. The intensity of the nacre color seems to diminish in the river especially going down stream. Exceptions to this are in the minority.

In the Upper Ohio Drainage:

In Crooked Creek, Creekside, the shells are mainly light grayish blue violet, but lower down at Rosston, are of a light salmon, fading at a near station on Allegheny River, Kelly, to pale salmon. A progressive fading out may be traced down the latter stream, as well as in a tributary of the Monongheła, Dunkard Creek. The shells of the Monongahela at this point are much like those of Dunkard Cr. but not as red, (pale pinkish cinnamon). As the Ohio is approached, the nacre becomes yellowish, (pale pinkish buff), and finally fades to grayish hues. In 10 mi. Cr. at Amity, the shells take on a grayish lilac hue, but at Clarksville this becomes considerably lightened to reddish colors. In Raccoon Cr. this species has a nacre color of reddish pink, at the nearest collecting point in Ohio it has a yellow tinge.

In Lake Erie:

Presque Isle is characterized by greater proportions of salmon colors. La Plaisance Bay by those of a bluish caste, Cedar Point, orange. In this, as well as other species, different parts of the

* I found no strickly pure white in this species. It seemed practically negligible or is represented in the lighter allied colors of Pale Grayish Blue Violet.

same collecting locality—such as the various stations at Presque Isle, are apt to show a peculiarly distinctive nacreous color.

Observation on Sex Correlative Coloration as Associated with Nacreous Color. * *(27 Shells).*

Blues and Allied colors are twice as numerous in males than in females. Females appear to have the more vivid pinks, while those males even approximating the latter colors have reddish hues.

2.—*Amblema Plicata*

In this species, particular attention was paid to the prevailing hue of the iridescence at the posterior end, as the rest of the shell is whitish. The rusty spots common in this species were ignored.

SIMPSON	RIDGEWAY
Iridescence—Bluish	Pearl Blue, Grayish Lavender, Pale Verbena Violet Pale Vinaceous, Pale Salmon, White.

Distribution of Colors as a Whole in Upper Ohio Drainage and Lake Erie. (185 shells).

Pearl Blue and allied colors	44%
Grayish Lavender and allied colors	22%
Pale Vinaceous and allied colors	30%
White	4%

Distribution of Colors as a Whole in Upper Ohio Drainage (107 shells).

Pearl Blue and allied colors	45%
Grayish Lavender and allied colors	19%
Pale Vinaceous and allied colors	36%

Distribution of Colors as a Whole in Upper Ohio Tributaries, etc.

	Alle'ny Tribs.	*Alle'ny River*	*Beaver Tribs.*	*Beaver River*	*Ohio River*
Pearl Blue and allied colors	50%	55%	20%	50%	33%
Gray. Lavender and allied colors	18%	22%	23%		
Pale Vinaceous and allied colors	33%	22%	55%	50%	66%

Distribution of Colors as a Whole in L. Erie. (78 shells).

Pearl Blue and allied colors	50%
Pale Verbena Violet and allied colors	33%
Gray, Lavender and allied colors	11%
Pale Salmon	6%

* The small number of shells on which this and similar observations for other species is due to the fact that most of the shells were collected before Ortmann's discovery that the sex of these animals is readily determined from cell structure.

Distribution in Lake Erie—Localities.

	Presque Isle Bay	Cedar Point	La Plaisance Bay
Pearl Blue and allied colors	57%	100%	20%
Pale Ver. Violet and allied colors	37%		
Light Pink. Viol. and allied colors			80%
Pale Salmon and allied colors	6%		

Deductions from Tables of Percentages and Plate III.

Pearl blue is most largely represented in Lake Erie. Colors in the Upper Ohio tend to be grayish in nature, those corresponding in L. Erie, more of a violet.

In the Upper Ohio Drainage:

Pearl blue is more prominent in the Allegheny River than in its tributaries, and is more abundant in the Beaver than in the Allegheny. The nacreous color apparently tends to acquire deeper tones in the lower stretches of both the Allegheny and the Shenago. Altho' pearl blue is recorded at its lowest station, grayish lavender would be a composite shade characterizing shells from French Creek, where the pale verbena violet of the upper stretches fades to pearl blue lower down. A similar fading is seen in the Shenango, whose shells are more of a blue compared with its sister river, the Mahoning, where they tend to take on a lilac tinge. Perhaps shells really coming from the Mahoning were the ones of this species obtained in the Beaver River. In Slippery Rock Creek, the shells are pearl blue, in the Ohio River, pale grayish vinaceous.

In Lake Erie:

A bluish violet color characterizes the shells obtained at Cedar Point. This shade accompanied by pinkish violet is distinctive for Presque Isle, while pinkish violets are in the great majority at La Plaisance Bay. Examination of Pl. III shows more fully the variability at Presque Isle.

Observation on Sex Correlative Coloration as Associated with Nacreous Color. (19 shells).

Females appear to be prevailingly pearl blue, while the males are characterized by pale vinaceous colors. The amount of grayish lavender represented is equivalent in both.

3.—*Elliptio dilatatus*

SIMPSON	RIDGEWAY
Deep purple.	Light Vinaceous Lilac, Light Vinaceous Purple, Deep Vinaceous, Deep Vinaceous

	Lavender, Deep Vinaceous Gray, Dark Vinaceous Gray.
Salmon, Straw colored	Pale Ochraceous Buff.
White*	Pearl Blue, white.

Distribution of Colors as a Whole in Upper Ohio Drainage and Lake Erie. (561 shells).

Pearl Blue with allied colors	18%
Light Vinaceous Lilac and allied colors	28%
Light Vinaceous Purple and allied colors	27%
Deep Vinaceous Gray and allied colors	20%
Pale Ochraceous Buff and allied colors	05%

Distribution of Colors as a Whole in Upper Ohio Drainage (509 shells).

Pearl Blue and allied colors	11%
Light Vinaceous Lilac and allied colors	22%
Light Vinaceous Purple and allied colors	25%
Purple Drab and allied colors	12%
Pale Ochraceous Buff and allied colors	6%

Distribution of Colors in Upper Ohio Tributaries, etc.

	Alle'ny Tribs.	*Alle'ny River*	*Mon'g Tribs.*	*Mon'g River*	*Ohio Tribs.*	*Ohio River*	*Beaver Tribs.*	*Beaver River*
Pearl Blue, etc.	9%	11%	13%		14%	6%	14%	6%
Light Vin. Lilac, etc.	17%	42%	27%	33%	41%	56%	21%	39%
Light Vin. Purple, etc.	37%	35%	14%	60%	36%	30%	50%	11%
Light Purple Drab	7%	12%	46%	3%	6%		10%	24%

Distribution of Colors as a Whole in L. Erie. (52 shells).

Light Vinaceous Purple and allied colors	27%
Deep Vinaceous Lavender and allied colors	30%
Deep Vinaceous Gray and allied colors	23%
Dark Vinaceous Gray and allied colors	18%

Distribution in Lake Erie—Localities.

	Presque Isle	*La Plaisance Bay*
Light Vinaceous Purple	20%	20%
Deep Vinaceous Lavender	36%	10%
Deep Vinaceous Gray	36%	50%
Dark Vinaceous Gray	10%	20%

Deductions from Tables of Percentages and Pl. III.

Although pearl blue is represented in L. Erie, the percentage seems small. The colors of the Upper Ohio Drainage seem to be more of a purple lilac, while those of L. Erie are more of a lavender gray. There is at least a distinct lightening of nacreous color in Lake Erie.

*White was found to occur less than 1% in all the shells examined.

In the Upper Ohio Drainage:

As a general thing the colors are lighter in the rivers than in the tributaries. This species is exceedingly variable with regard to nacre color. A general tendency to lighten in color may be observed coming down the Allegheny thus confirming Wilson and Clark's and Utterback's observations. It is true, however that at certain stations it appears to darken, but this result is from a small number of shells. Such apparently also occurs in French Creek, but the shells of the Allegheny are lighter than those of French Creek at the nearest collecting point. Pearl blue is largely limited to the Allegheny River and its tributaries. Nacreous colors, are lighter in the Monogahela than in its tributary, the Cheat. They also tend to lighten in the Ohio River, but in the Shenango at the headwaters they are deep vinaceous, (reddish purple), in hue, lower down becoming more purplish. Characteristic Stream Colors appear to be,

Purple drab for Potato Cr.

Light Purple Drab for Sandy Cr.

Vinaceous colors for Cheat River.

Light Vinaceous Purple drab in Neshannock Cr.

Light reddish to light purples in the Mahoning, lower down becoming purplish lilac to slate purple.

Vinaceous Gray is characteristic of the Ohio.

In Lake Erie:

Presque Isle stands out for its large amount of reddish purple shades, while La Plaisance Bay has grayish purple ones. The great variability of Presque Isle shells may again be noted. Those from other L. Erie localities than those given in L. Erie are so small that *percentages* are not given.

In Chautauqua Lake the shells appear to be mainly white.

Observation on Sex Correlative Coloration, etc. (15 shells).

More males have a pearl blue nacre than females. They also have a larger percentage of lilac shades. Females seem to be characterized by a deeper purple color, and a greater number of lilac shades.

4.—*Pleurobema obliquum coccineum*

SIMPSON	RIDGEWAY
Rose-Pink	Pale Vinaceous Pink, Light Ochraceous Salmon, Orange Pink.
Whitish-red*	Pearl Blue, Venetian Pink, Light Pearl Blue, Burn Blue

* Pure whites appear to be negligible among the shells I examined.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie. (263 shells).

Pearl Blue and allied colors	44%
Pale Vinaceous Pink and allied colors	18%
Venetian Pink and allied colors	20%
Light Ochraceous Salmon and allied colors	8%

Distribution of Colors in Upper Ohio Drainage (247 shells).

Pearl Blue with allied colors	48%
Venetian Pink with allied colors	30%
Pale Vinaceous Pink and allied colors	14%
Light Ochraceous Salmon and allied colors	8%

Distribution of Colors in Upper Ohio Tributaries etc.

	Alle'ny Tribs.	*Alle'ny River*	*Beaver Tribs.*	*Beaver River*
Pearl Blue and allied colors	63%	27%	30%	46%
Venetian Pink and allied colors	10%	33%	31%	38%
Pale Vinaceous Pink and all col	7%	19%	13%	
Light Ochraceous Salmon & all col	14%	11%	20%	15%

Distribution of Colors as a Whole in L. Erie.

Pale Vinaceous Pink and allied colors	45%
Burn Blue and allied colors	33%
Orange Pink and allied colors	16%
Light Pearl Blue and allied colors	4%

Distribution in L. Erie—Localities.

	Presque Isle Bay	*La Plaisance Bay*
Pale Vinaceous Pink, etc.	66%	
Burn Blue, etc.		88%
Orange Pink, etc.	14%	
Light Pearl Blue, etc.	11%	

Deductions from Tables of Percentages and Pl. III.

Pearl blue as such is more abundant in the Upper Ohio Drainage, but to explain this apparent discrepancy to the tendencies already observed, it may be pointed out that there are larger percentages of *bluish* colors in L. Erie than in the Upper Ohio, furthermore the more or less lilac shades of L. Erie shells show admixture with bluish tints.

In the Upper Ohio Drainage:

Pearl blues are found to greater extent in the rivers than in their tributaries, where the colors are pink and reddish. Fading out tendencies are observed in the Allegheny River and French Creek. At the nearest station to the Allegheny River in French Creek they are pinkish, while in the Allegheny itself they are grayish blue.

Characteristic stream colors appear to be,

Pearl blue in the Loyalhanna, altho' a few are pink.

Pinks and blues are apparently equal in the Shenango, altho' these colors are seen to merge to a light grayish blue violet, the pinks fading out.

Pale flesh color in the Pymatuning with a scattering of deeper blues, (Plumbago blue).

Pinks and blues seem equally distributed in Neshannock Creek.

Pinkish colors in Slippery Rock Creek.

In L. Erie

Lilac colors are characteristic at Presque Isle, Burn Blue at La Plaisance Bay.

Observation on Sex Correlative Coloration, etc. (15 shells).

Males possess more pearl blues, less salmon colors, and a tendency toward lilac colors not found in females. The latter have a preponderance of vivid pinks.

5.—*Symphynota (Lasmigona) costata.*

Here closest attention was paid to the color of the nacre in the umbonal cavity, as apparently being the most variable.

SIMPSON	RIDGEWAY
Whitish*	Pearl Blue
Straw colored	Pale Pinkish Buff, Pale Ochraceous Buff.
	Sea-shell Pink, Pale Ochraceous Salmon
	Light Buff, Pale Pinkish Buff.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie. (68 shells).

Pale Pinkish Buff, etc.	27%
Pale Ochraceous Buff, etc.	23%
Sea shell Pink, etc.	16%
Pearl Blue	16%

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie. (47 shells.)

Pale Pinkish Buff, etc.	36%
Pearl Blue, etc.	23%
Sea Shell Pink, etc.	17%
Pale Pinkish Cinnamon, etc.	10%
Pale Grayish Vinaceous	4%
Pinkish Buff	10%

*"Whitish" practically negligible in any part of the shell. Pearl Blue is probably the real shade.

Distribution of Colors in Upper Ohio Tributaries, etc.

	Allegheny Tribs.	*Allegheny River*	*Beaver Tribs.*
Pale Pinkish Buff, etc.	10%	17%	28%
Pearl Blue, etc.	20%	8%	14%
Sea Shell Pink, etc.	10%	17%	8%
Pale Pink Cinnamon, etc.	15%	17%	14%
Pinkish Buff, etc.	10%	8%	
Pale Salmon, etc.	10%		21%
Pale Ochraceous Buff	10%		21%
Ochraceous Buff	10%		
Light Grayish Blue Violet, etc.		8%	
Pale Grayish Vinaceous, etc.		8%	
Salmon Buff		8%	

Distribution of Colors as a Whole in L. Erie. (21 shells).

Pale Ochraceous Buff, etc.	34%
Pale Ochraceous Salmon, etc.	38%
Light Buff, etc.	9%
Pale Pinkish Buff, etc.	19%

Distribution in L. Erie—Localities

	Presque Isle	*La Plaisance Bay*
Pale Ochraceous Buff, etc.	33%	
Pale Ochraceous Salmon, etc.	33%	
Light Buff, etc.		50%
Pale Pinkish Buff, etc.	11%	
Pale Salmon, etc.	11%	50%
Pale Cinnamon Pink, etc.	11%	
Pinkish Buff, etc.	11%	

Deductions from Tables of Percentages and Pl. III.

As previously noted, the greatest attention was paid in this species to the color of the umbonal cavity. Shell for shell, the blues seemed deeper in the rest of the nacre in L. Erie. altho' more pearl blue as a color of the umbonal cavity is reported from the Upper Ohio. Buff and salmon colors preponderate in L. Erie, where in the Upper Ohio, the colors may be pearl blue or pinkish.

In the Upper Ohio Drainage:

Shells lose their buff colors and become pink going down the Allegheny. This also occurs in French Creek, and seems to be the case also in the Monongahela River and possibly in the Shenango. As a general rule there seemed to be more purely pearl blue in the Allegheny Tribs. than in the river itself. Other characteristic stream colors, besides those shown on Pl. IIII are,

Ochraceous Buff in Quemahoning Cr.

Pale Pinkish Buff in French Cr.
Pale Pinkish Buff in Mahoning River.
Sea-shell Pink in Racoon Cr.

In Lake Erie:

Presque Isle apparently has a larger proportion of Salmon colors than La Plaisance Bay.

Observation on Sex Correlative Coloration, etc. (5 shells).

Pearl Blue preponderates in males.
Females have redder colors, with a large proportion of Buff.

6.—*Anodonta grandis.*

SIMPSON	RIDGEWAY.
Bluish White	Pearl Blue, Pale Grayish Blue Violet
Tinted with Purple	Vinaceous Pink, Pale Aniline Lilac.
Cream Color	Pale Pinkish Buff.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie. (119 shells).

Pearl Blue, etc.	40%
Pale Grayish Blue Violet	15%
Pale Pinkish Buff	33%
Vinaceous Pink	5%

Distribution of Colors as a Whole in Upper Ohio Drainage. (97 shells.)

Pearl Blue, etc.	46%
Pale Grayish Blue Violet, etc.	24%
Pale Pinkish Buff, etc.	8%
Vinaceous Pink, etc.	10%

Distribution in Upper Ohio Tributaries.

	Allegheng Tribs.	*Beaver Tribs.*	*Mgnong. River*	*Tuscarawas River*
Pearl Blue, etc.	43%	25%	100%	100%
Pale Grayish Blue Violet, etc.	33%	50%		
Pale Pinkish Buff, etc.	21%	25%		

Distribution of Colors as a Whole in L. Erie. (22 shells.)

Pearl Blue, etc.	55%
Pale Pinkish Buff, etc.	15%
Pale Grayish Blue Violet, etc.	20%
Pale Aniline Lilac, etc.	10%

Deduction from Tables of Percentages and Pl. IIII.

Pearl blue has a proportionally larger representation in L. Erie than in the Upper Ohio. L. Erie has additionally more pinkish and buff colors. Lavenders and grays predominate in the Upper Ohio Drainage.

In the Upper Ohio Drainage:

In the headwaters of French Creek this shell is pearl blue, lower down becoming pale grayish blue violet. In the Shenango, it fades out from a pale pinkish cinnamon color in upstream regions to pale grayish blue violet downstream. Fading out is also observed in the Crooked Creek Drainage. Characteristic stream colors are,

Sea-shell pink in the Mahoning. Pearl blue in Slippery Rock and Racoon Creeks, Vinaceous pink in Sugar Creek, Pearl Blue in Tuscarawas River, Pale Grayish Blue Violet in the Maumee Drainage.

Shells from Conneaut Lake resemble those of L. Erie to some extent in possessing a light pinkish lilac hue.

In L. Erie:

Characteristic hues as shown.

Observation on Sex Correlative Coloration, etc. (8 shells).

Males have a pearl blue or cream color.

Females—pale grayish blue violet or pinkish.

7.—*Paraptera fragilis*

SIMPSON	RIDGEWAY
Faint Purplish	Pale Pinkish Lilac, Pale Congo Pink
Bluish	Pearl Blue.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie. (58 shells).

Pearl Blue, etc.	20%
Pale Pinkish Lilac, etc.	50%
Pale Congo Pink, etc.	30%

Distribution of Colors as a Whole in the Upper Ohio Drainage (28 shells).

Pearl Blue, etc.	20%
Pale Pinkish Lilac, etc.	40%
Pale Congo Pink, etc.	40%

Distribution in Upper Ohio Tribs., etc.

	Allegheny River	*Ohio River*
Pearl Blue, etc.	10%	15%
Pale Pinkish Lilac, etc.		55%
Pale Congo Pink, etc.	90%	30%

Distribution of Colors as a Whole in L. Erie (30 shells).

Pearl Blue, etc.	33%
Pale Pinkish Lilac, etc.	41%
Pale Congo Pink, etc.	20%

Distribution in L. Erie—Localities.

	Presque Isle	*La Plaisance Bay*
Pearl Blue, etc.	30%	16%
Pale Pinkish Lilac, etc.	50%	50%
Pale Congo Pink, etc.	13%	33%

Deductions from Tables of Percentages and Plate III.

There is a greater percentage of pearl blue in L. Erie, and there are more reddish shells in the Upper Ohio Drainage.

In the Upper Ohio Drainage:

Less Pearl Blue and more of the reddish colors are present in the Allegheny River. Shades tending toward purplish predominate in the Ohio. Shells of this species lighten in color going down the Allegheny and Ohio, at least in the upper stretches of the latter.

In Lake Erie:

Presque Isle possesses more pearl blues and less pink than La Plaisance Bay.

Observation on Sex Correlative Coloration, etc. (5 shells).

The males appear to have lighter lilac and pinkish shades.

8.—*Proptera alata*

SIMPSON	RIDGEWAY
Coppery purple.	Hydrangea Pink, Light Pinkish Lilac, Light Purplish Vinaceous, Light Russet Vinaceous, Light Purplish Lilac.

Distribution of Color in Upper Ohio Drainage and Lake Erie as a Whole. (55 shells).

Hydrangea Pink, etc.	27%
Light Pinkish Lilac, etc.	34%
Light Purplish Vinaceous, etc.	21%
Light Russet Vinaceous, etc.	16%

Distribution of Colors as a Whole in Upper Ohio Drainage. (24 shells).

Hydrangea Pink, etc.	27%
Light Purplish Vinaceous, etc.	46%
Light Russet Vinaceous, etc.	24%
Light Pinkish Lilac	3%

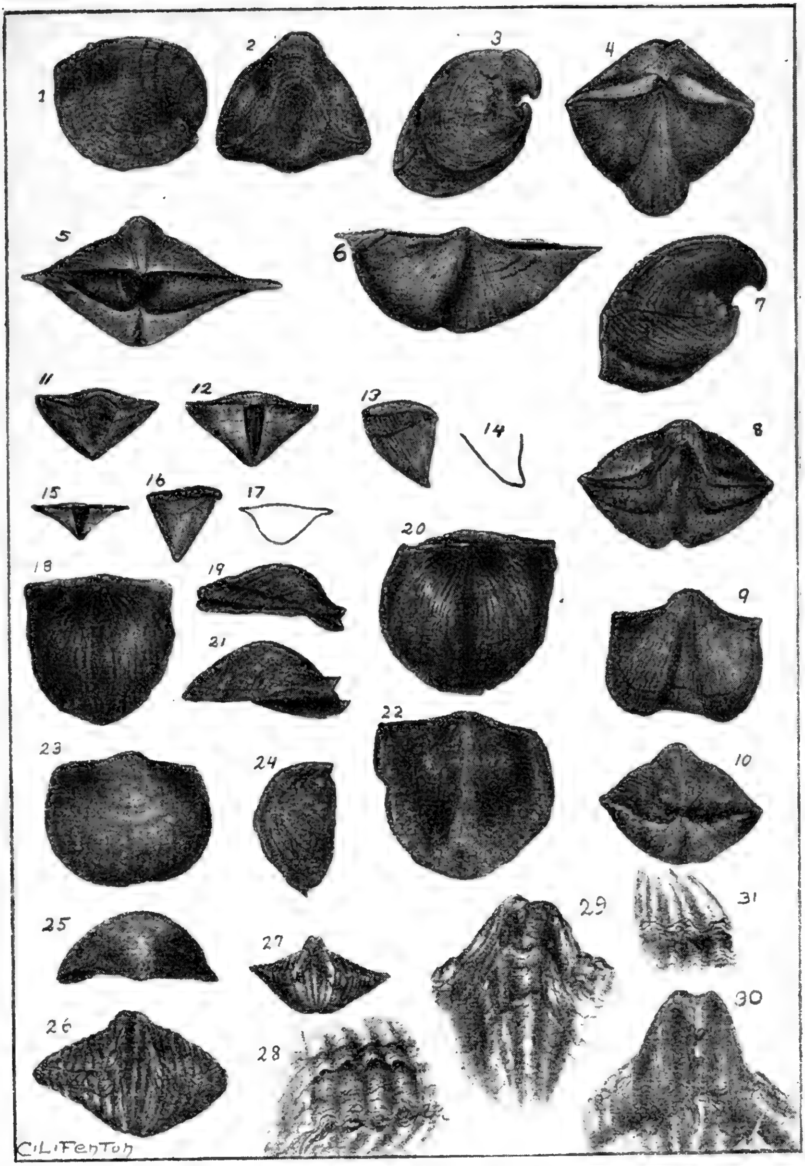


PLATE II.—FENTON ON THE HACKBERRY STAGE.

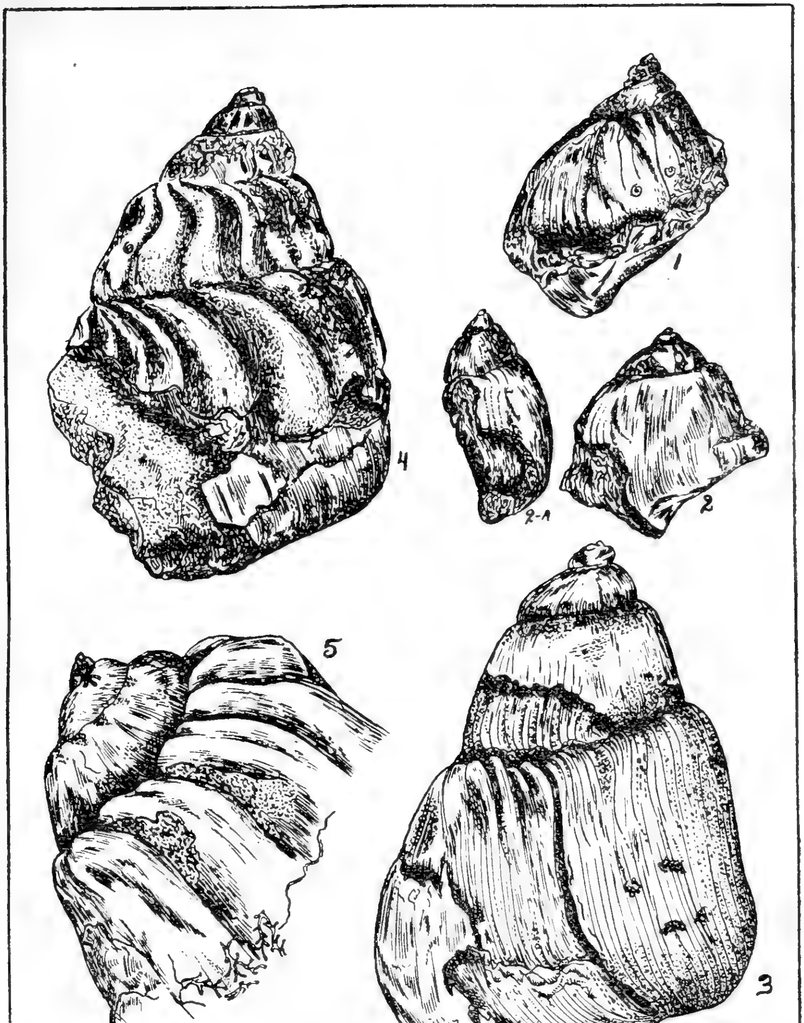
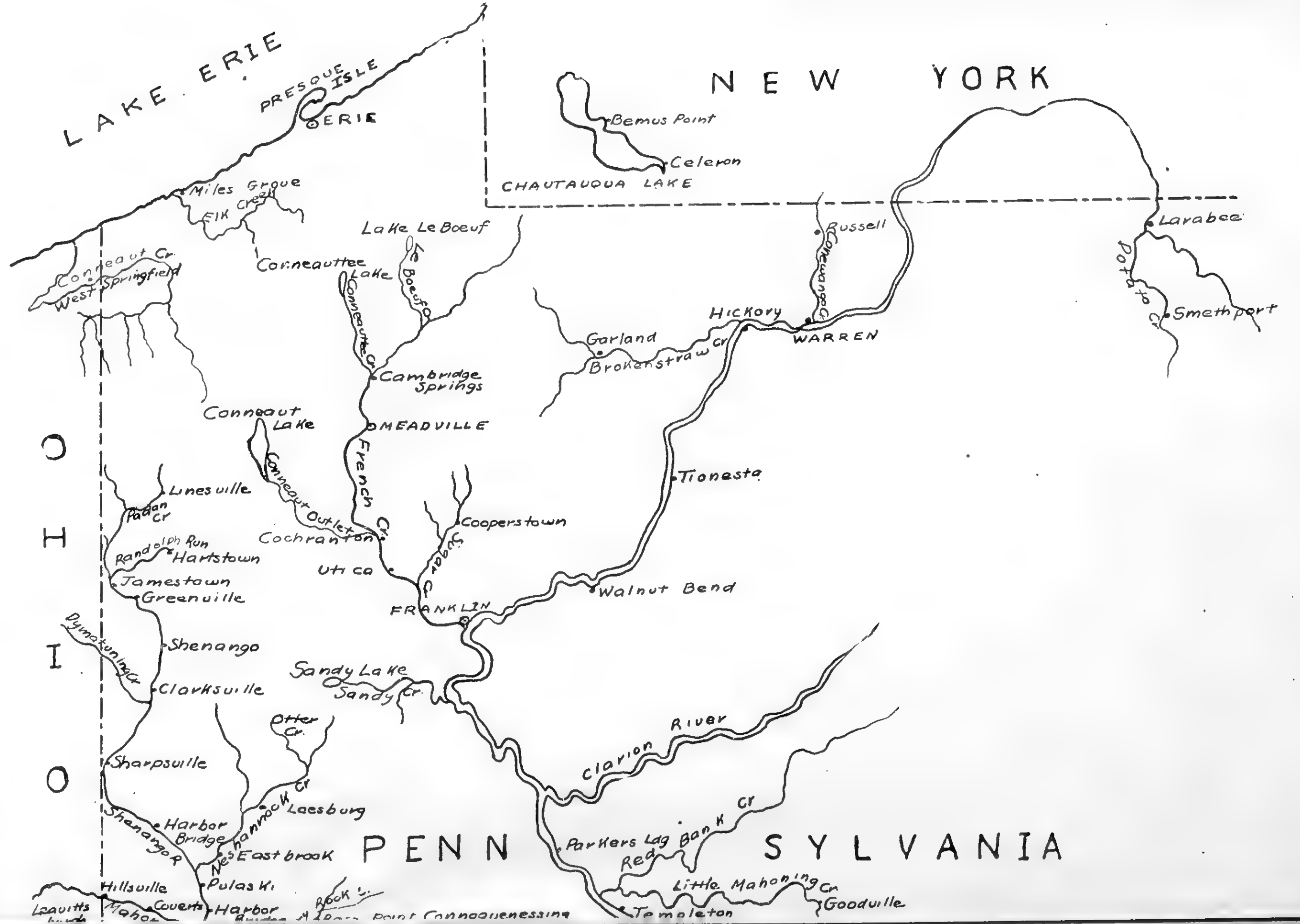


PLATE III.—FENTON ON THE HACKBERRY STAGE


LAKE ERIE
PRESQUE ISLE
ERIE
NEW YORK
Bemus Point
Celeron
CHAUTAUQUA LAKE
Larabee
Potato Cr
Smethport
Russell
Conewango Cr
Hickory
WARREN
Garland
Brokenstraw Cr
Miles Grove
Elk Creek
Conneaut Cr
West Springfield
Conneauttee
Lake Le Boeuf
Le Boeuf Cr
Conneauttee Lake
Conneauttee Cr
Cambridge Springs
MEADVILLE
Conneaut Lake
Conneaut Outlet
French Cr
Cochranton
Utica
Cooperstown
Sugar Cr
FRANKLIN
Tionesta
Walnut Bend
Linesville
Padan Cr
Randolph Run
Hartstown
Jamestown
Greenville
Shenango
Dymatuning Cr
Clarksville
Sandy Lake
Sandy Cr
Otter Cr
Sharpsville
Neshannock Cr
Laesburg
Harbor Bridge
Shenango R
Eastbrook
Pulaski
Hillsville
Coverts
Harbor
Leavitts
Mahon
Rock
Point
Connoquenessing
Clarion River
Parkers Lag
Red Bank Cr
Little Mahoning Cr
Goodville
Templeton
OHIO
PENN SYLVANIA

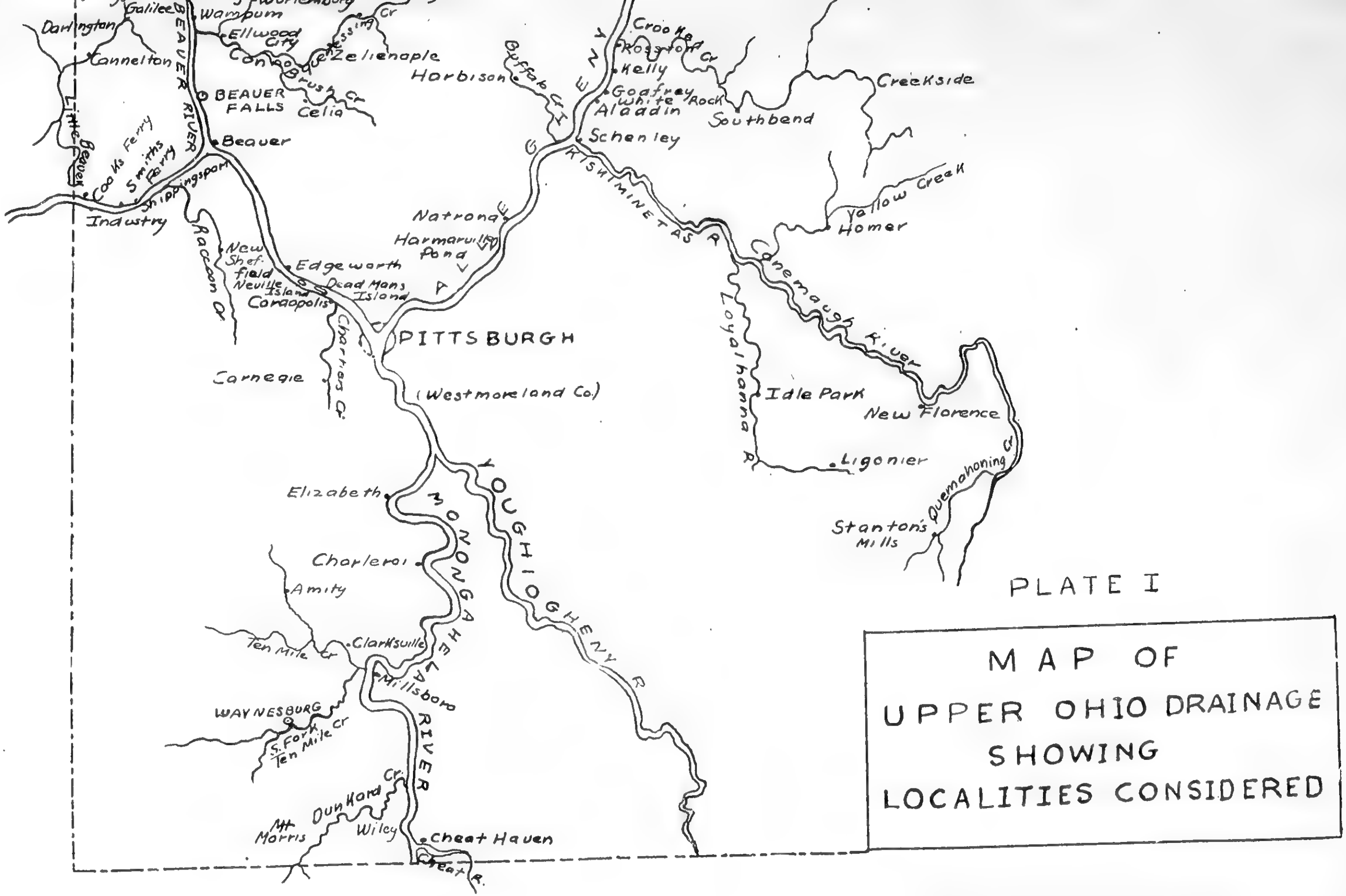


PLATE I.—GRIER ON VARIATION IN NACREOUS COLOR OF CERTAIN SPECIES OF NAIADES.

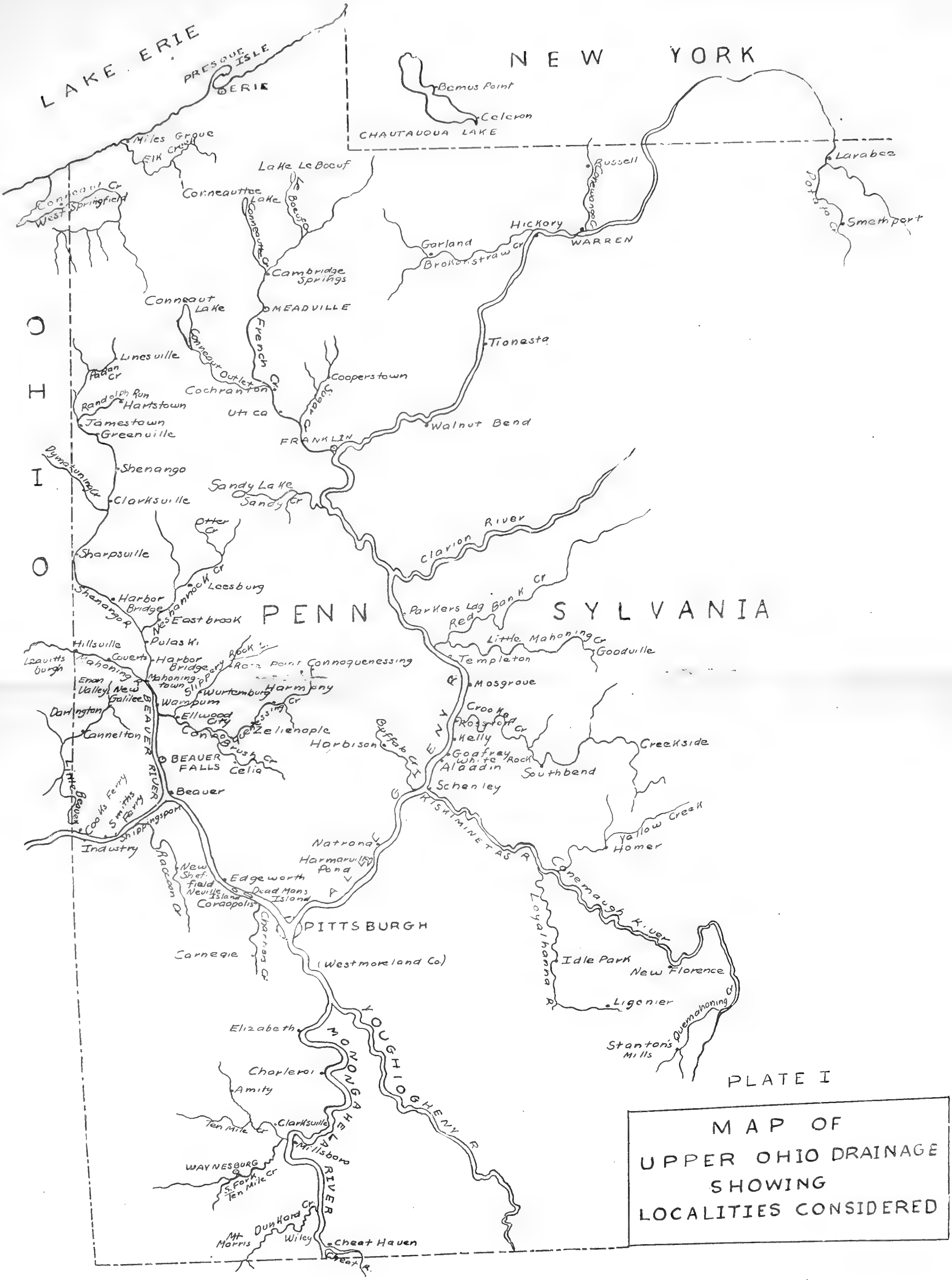


PLATE I.—GRIER ON VARIATION IN NACREOUS COLOR OF CERTAIN SPECIES OF NAIADES.

n.

Distribution in Upper Ohio Tributaries.

	Alle'ny Riv.	*Monong. Riv.*	*Ohio Riv.*
Light Purplish Vinaceous, etc.	60%	60%	33%
Light Russet Vinaceous, etc.	30%	40%	33%
Hydrangea Pink, etc.	10%		33%

Distribution of Colors as a Whole in L. Erie (31 shells).

Hydrangea Pink, etc.	25%
Light Purplish Lilac, etc.	50%
Grayish Vinaceous, etc.	25%

Distribution in L. Erie—Localities.

	La Plaisance Bay	*Cedar Point*	*Presque Isle*
Hydrangea Pink, etc.	67%	16%	12%
Light Purplish Vinaceous, etc.	33%	11%	44%
Light Purplish Lilac, etc.		58%	44%

Deductions from Tables of Percentages and Pl. III.

Lake Erie shells appear to be of a more uniform lilac hue, while there is a greater proportion of pinks and purples in the Upper Ohio Drainage.

In the Upper Ohio Drainage:

The nacreous color seems to be lighter in the Ohio than either the Allegheny or the Monongahela. Coppery purple, (Light Russet Vinaceous), is most prominent in the Monongahela. A tendency to lighten going down stream is seen in the Allegheny.

In Lake Erie:

La Plaisance Bay stands out for a greater proportion of pinks, Cedar Point for Lilac purple, and Presque Isle for dark purple colors.

Observation on Sex Correlative Coloration, etc. (6 shells).

Males—pinkish or lilac.

Females—purple or russet.

9.—*Anodontoides ferrussacianus.*

Here the general tone of the nacre color—not merely the iridescence—was considered.

SIMPSON	RIDGEWAY
Bluish-white	Lavender, Grayish Blue Violet, Pale Grayish Blue Violet
Bluish	Pearl Blue, Pale Aniline Lilac.

Distribution of Colors as a Whole in the Upper Ohio Drainage and Lake Erie. (69 shells).

Pale Aniline Lilac, etc.	26%

Pearl Blue, etc.	25%
Lavender, etc.	23%
Grayish Blue Violet, etc.	22%

Distribution of Colors as a Whole in the Upper Ohio Drainage. (45 shells).

Pearl Blue, etc.	23%
Pale Aniline Lilac, etc.	20%
Lavender, etc.	22%
Light Grayish Blue Violet, etc.	28%

Distribution of Colors in the Upper Ohio Tribs., etc.

	Allegheny Tribs.	*Beaver Tribs.*
Pearl Blue, etc.	14%	20%
Pale Aniline Lilac, etc.	57%	15%
Lavender, etc.		25%
Light Grayish Blue Violet, etc.	29%	40%

Distribution of Colors as a Whole in Lake Erie. (24 shells)

Pale Aniline Lilac, etc.	31%
Pearl Blue, etc.	25%
Pale Grayish Blue Violet, etc.	19%
Lavender, etc.	25%

Distribution in L. Erie—Localities.

	Presque River	*Maumee River*	*Conneaut Creek*
Pale Aniline Lilac, etc.	33%	25%	28%
Pale Blue, etc.	25%	25%	14%
Pale Grayish Blue Violet, etc.	23%	20%	43%
Lavender, etc.	15%	25%	14%

Deductions from Tables of Percentages and Pl. III.

There are more pearl blue, lilac and their related colors in L Erie than in the Upper Ohio Drainage, but there are less of a lavender hue.

In the Upper Ohio Drainage:

Lilac colors appear to predominate in the Allegheny Tributaries as against lavender in the Beaver Tribs. Conneaut Creek draining into L. Erie possesses more pearl blue shells than either the Beaver, Shenango, or Allegheny Rivers. Descending French Creek, the nacre of the species appears to lighten. Pale grayish Blue Violet is characteristic of the French Creek, while Pearl Blue is more typical of the Shenango.

In Lake Erie:

Presque Isle stands out for lilac colors; the Maumee River which drains into it, possesses a great deal of lavender.

Observation on Sex Correlative Coloration, etc. (3 shells).

Males tend toward lavender colors, females blue. In this species, as well as a few others dealt with, the numbers used hardly justify any definite conclusion as to the association of nacreous color with the sex of the animal.

10.—*Eurynia recta.*

SIMPSON	RIDGEWAY
Purple	Light Pinkish Lilac, Light Purplish Vinaceous, Pale Congo Pink.
Bluish White	Pearl Blue
Whitish	White

Distribution of Colors as a Whole in the Upper Ohio Drainage and Lake Erie. (54 shells).

Pearl Blue, etc.	33%
White, etc.	21%
Light Pinkish Lilac, etc.	30%
Light Purplish Vinaceous, etc.	15%

Distribution of Colors as a Whole in the Upper Ohio Drainage (33 shells).

Pearl Blue, etc.	32%
White, etc.	24%
Light Pinkish Lilac, etc.	23%
Light Purplish Vinaceous, etc.	21%

Distribution of Colors in Upper Ohio Tributaries, etc.

	Alleghney Tribs.	*Alleghney River*	*Ohio River*	*Tuscarawas River*
Pearl Blue, etc.	34%	31%	36%	60%
White, etc.	16%	24%	36%	
Light Pinkish Lilac, etc.	37%	20%	16%	20%
Light Purplish Vinaceous, etc.	17%	25%	12%	20%

Distribution of Colors as a Whole in Lake Erie. (21 shells).

Pearl Blue, etc.	39%
Light Pinkish Lilac, etc.	30%
Light Purplish Vinaceous, etc.	21%
Pale Congo Pink, etc.	12%

Distribution in Lake Erie—Localities.

	Cedar Point	*Pesque Isle*
Pearl Blue, etc.	50%	36%
Light Pinkish Lilac, etc.	33%	34%
Light Purplish Vinaceous, etc.	17%	20%
Pale Congo Pink, etc.		10%

Deductions from Tables of Percentages and Pl. III.

A greater amount of Pearl blue and light purple exists in Lake

Erie. White, in any abundance, is found most in the Upper Ohio Drainage.

In the Upper Ohio Drainage:

Pinkish colors predominate in the Allegheny Tributaries, white pearl blue in the river. The Ohio and Tuscarawas Rivers show the greatest percentage of Pearl Blue. A fading out is seen descending the Allegheny. Characteristic stream colors are,

Light Pinkish Lilac in the Allegheny. White in the Ohio.

In Lake Erie:

Where Cedar Point possesses more pearl blue, Presque Isle has more pinkish and purplish colors.

In Chautauqua Lake the prevailing color is a vinaceous pink.

Observation on Sex Correlative Coloration, etc. (*33 shells*).

The nacre of the males seems to be prevailingly purplish; that of the females, pinkish. Pearl Blue is about evenly represented in both sexes.

11.—*Lampsilis luteola*

SIMPSON	RIDGEWAY.
Blue	Pearl Blue
Bluish White	Pale Grayish Blue Violet, White
Straw Colored, Pink	Light Pinkish Lilac, Pale Rhodonite Pink.

Distribution of Colors as a Whole in the Upper Lhio Drainage and Lake Erie (289 shells).

Light Pinkish Lilac, etc	35%
Pearl Blue, etc	13%
White, etc	17%
Pale Grayish Blue Violet, etc	35%

Distribution of Colors as a Whole in Upper Lhio Drainage (187 shells).

Light Pinkish Lilac, etc	30%
White, etc	14%
Pearl Blue, etc	24%
Pale Grayish Blue Violet, etc	35%

Distributixn in Upper Lhio Tribs., etc.

	Alle'ny Tribs.	*Alle'ny River*	*Monong. Tribs.*	*Monong River*	*Ohio River*	*Beaver Drainage*
Light Pinkish Lilac, etc	43%	40%	50%	60%	50%	42%
Pale Grayish Blue Violet, etc	14%	30%	50%			31%
Pearl Blue, etc	16%	30%			15%	13%
White, etc	27%			40%	35%	14%

Distribution of Colors as a Whole in Lake Erie (111 shells).

Pearl Blue, etc.	41%
White, etc.	20%
Light Pinkish Lilac, etc.	27%
Pale Rhodonite Pink, etc.	12%

Distribution in Lake Erie—Localities.

	La Plaisance Bay	*Cedar Point*	*Presque Isle*	*Maumee Drainage*
Pearl Blue, etc.	10%	20%	23%	20%
White, etc.	33%	3%	20%	16%
Light Pinkish Lilac	50%	25%	35%	33%
Pale Rhodonite Pink, etc.	7%	47%	32%	31%

Deductions from Tables of Percentages and Pl. III.

Pearl Blue as well as white is more abundant in L. Erie, but the Upper Ohio has more shades of Light Pinkish Lilac. Pink, however, is a color comprised to large extent in Lake Erie shells, while pale grayish blue violet is largely represented in the Ohio.

In the Upper Ohio Drainage:

Pinkish colors predominate in the Allegheny Tribs., but blues in the rivers.

There is less pink in the Ohio than in the Monongahela, while white is not present in the tributaries of the latter. Pale Grayish Blue Violet seems characteristic of the Beaver Tribs. as a whole, while there is less pearl blue in the Ohio than in the Allegheny, but more white. A fading out is seen going down stream in the Allegheny, Monongahela, and Shenango Rivers as well as in the French Creek. Characteristic stream colors are;

Light Pinkish Lilac to Pearl Blue in the Allegheny, Pale Grayish Blue Violet in French Creek, white with a Light Pinkish Lilac tinge in Conewango Creek.

In Lake Erie:

Light Pinkish Lilac predominates at La Plaisance Bay, while a Lighter Pink represents Cedar Point. Presque Isle is apparently between the two with regard to color, in this respect resembling the Maumee Drainage. In this as well as in other species, characteristic colors not mentioned for any given locality are obtained from Pl. III.

Pale Persian Lilac is a typical color for shells from Conneaut Lake, while a more pinkish variety of this—pale pinkish lilac—is characteristic of Chautauqua Lake.* Greater uniformity of nacre color was found in this than in any other species, a fact somewhat associating itself with the ubiquitous distribution of the species.

Observation on Sex Correlative Coloration, etc. (94 shells).

Males—Pinkish lilac, and apparently a greater proportion of white.

Females—Pale grayish blue violet—slightly more pearl blue.

12.—*Lampsilis ovata*

SIMPSON	RIDGEWAY
Silvery	White
Bluish white	Pearl blue, Pale Grayish Blue Violet
Pink	Light Pinkish Lilac, Pale Purplish Vinaceous.

Distribution of Colors as a Whole in the Upper Ohio Drainage and Lake Erie. (214 shells).

Pearl Blue, etc	20%
White, etc	20%
Light Pinkish Lilac, etc	30%
Pale Grayish Blue Violet, etc	11%
Pale Purplish Vinaceous, etc	19%

Distribution of Colors as a Whole in Upper Ohio Drainage. (188 shells).

Pearl Blue, etc	19%
Light Pinkish Lilac, etc	25%
White, etc	19%
Pale Grayish Blue Violet, etc	19%
Pale Purplish Vinaceous, etc	18%

Distribution in Upper Ohio Tribs., etc.

	Alle'ny Tribs.	*Alle'ny River*	*Ohio River*	*Ohio Tribs.*	*Beaver River*	*Beaver Tribs.*
Pearl Blue, etc	20%	22%	14%	10%	35%	22%
Light Pinkish Lilac, etc	25%	24%	34%	41%	4%	40%
White	20%	22%	25%	13%	16%	16%
Pale Grayish Blue Violet, etc	17%	15%	12%	25%	16%	15%
Purplish Vinaceous, etc	18%	17%	15%	11%	19%	7%

Distribution of Colors as a Whole in L. Erie, (26 shells).

Pearl Blue, etc	24%
Light Pinkish Lilac, etc	23%
White, etc	22%

* My observations on all lake specimens of this species correspond with those of Baker concerning it in Oneida Lake, N. Y. Baker, F. C., The Relation of Mollusks to Fish in Oneida Lake, Tech. Pub. No. 4. N. Y. State College of Forestry, Syracuse, 1916. p. 41.

Pale Grayish Blue Violet, etc	13%
Pale Purplish Vinaceous, etc	17%

Distribution in Lake Erie—Localities, and Chautauqua Lake.

	La Plaisance Bay	*Cedar Point*	*Presque Isle*	*Chautauqua Lake*
Pearl Blue, etc	25%	24%	25%	40%
Light Pinkish Lilac, etc	25%	32%	42%	35%
Pale Pinkish Vinaceous, etc	37%	33%	13%	25%
Pale Grayish Blue Violet, etc	12%	11%	20%	

Deductions from Tables of Percentages and Pl. III.

Pearl Blue and White are most abundant in L. Erie and there is less Pinkish Lilac or Purplish colors, as well as more Pale Grayish Blue Violet are most peculiar to the Upper Ohio drainage.

In the Upper Ohio Drainage:

The rivers have more Pearl Blue and White than the tribs. but less Light Pinkish Lilac and less Pale Grayish Blue Violet. General shades of Pinks and Pearl Blues are about evenly distributed throughout this drainage. About the same percentage of blues exists in the Allegheny and Beaver Drainages, while White is most abundant in the Ohio,—apparently an outstanding exception to the general rule. Fading is seen going down stream in the Allegheny, Ohio, Shenango, and Little Beaver Rivers. Characteristic stream colors are best indicated in Pl. III.

In Lake Erie:

Hère white and pearl blues are practically equivalent. Most of the Light Pinkish Lilac colors are at Presque Isle Bay; Pale Purplish Vinaceous in La Plaisance Bay; while Cedar Point has more purplish colors than Presque Isle, it has less than La Plaisance Bay.

Pearl Blue predominates in Chatauqua Lake.

Observation on Sex. Correlative Coloration, etc. (84 shells).

Males may either be white, pinkish lilac or pearl blue.

Females are purplish vinaceous.

VI.—Conclusions.

1. In certain species, (as may be inferred from the table dealing with the distribution of colors as a whole), there exists a wider range of variation of nacreous color than is indicated by standard specific descriptions.

2. In practically all the species dealt with, a change in nacreous color is observed going down stream from the headwaters to the

mouth. The usual tendency is for the nacreous color to considerably lighten or become bluish.

3. The shells of L. Erie have a greater proportion of blues among them than the corresponding shells in the Upper Ohio Drainage. and Maumee Drainages. The shells of Conneaut and Chautauqua Lakes have the same relation.

Other conclusions, not however as completely substantiated as those given above, but still so evident from the present data as to deserve mention are:

1 Each drainage leaves its own imprint on the shells collected from it in the form at least of an associated peculiar tone of nacre color. (This has already been observed with regard to other physical characters). While the same "relative colors" may be present in different drainages, these are usually distinguished when necessary by varying proportions of other colors.

2. As a rule, the color distinction may be carried so far as to say tentatively at least, that certain shades of nacre color are characteristic of certain localities in a given body of water. While as observed in the chart, this is best observed in the case of Presque Isle shells, ample verification is obtainable in shells from the Upper Ohio Drainage.

3. So far as we may consider results obtained from a small number of shells in many cases, sex correlative coloration seems to be associated with nacre color.

VIII.—Suggestions as to Causes of Facts.

Introductory remarks embody the writers' comments on the first of these conclusions. Any plausible explanation of the second would seem to be found in the physical and chemical conditions under which the shells live. A summary of the physical and chemical conditions present in the Upper Ohio Drainage and L. Erie has been given. Perhaps that physical condition most applying to the problem of nacreous color is the warmer temperature of the water in the former, for it has been seen that as a rule, Upper Ohio shells possess more pigment than those of L. Erie. Pigment is the result of chemical reaction, and chemical reactions in general are increased by the amount of heat.

Wilson and Clark, (18, 19) were inclined to associate with the fading out of the nacreous color of *Elliptio* an abundance of lime, and, (conversely), the want of humic acid in the lower stretches of the stream." Humic acid" seems to be an indefinite chemical term applied to several acid compounds having their origin in the decay of vegetable matter. It is commonly supposed to impart its straw colored to deeper hues to the streams in which it is found. Such a stream is the Shenango R. fed by Pymatuning Creek which in turn drains a swamp. For the reason that forests with their residual humus are, under present conditions at least, most abundant near the headwaters of streams, it may be reasonably supposed that Humic Acid, if any, is most abundant there. As an acid, it must tend to be neutralized later in those streams having an abundance of lime, ($CaCO_3$), and consequently disappear, for analyses of the water in various parts of the Upper Drainage where the shells were collected (6,10), show that there is an increase in the amount of lime present and alkalinity in general going down stream, with a converse reduction, it may be assumed, of any acidity. Faussek, (2), in studies with marine pelecypods came to the conclusion that water containing acid promoted the formation of pigment, while he believed that light played no part in this process. List, (11), another observer was inclined to credit the importance of light as a factor in pigment formation. As the headwaters are freer from silt than those of the lower stretches, we have according to these investigators, more ideal conditions for the production of pigment there than further down stream, where as a matter of fact it is less abundant. In this behaviour of nacreous color of Najades in upstream regions we have a rough analogue to that of the reaction of litmus to acids snd alkalies. Further, the water of L. Erie differs from that of the Upper Ohio Drainage and its lower regions in possessing a greater amount of lime and general alkalinity, especially to note after any humic acid entering the lake has been neutralized. L. Erie waters also contain certain chemicals such as magnesium sulfate and chloride, which are not found, at least in similar quantity, in the Upper Ohio Drainage. Now L. Erie shells have been found to have greater percentages of Blue. This corresponds with the reaction of litmus toward alkaline solutions.

A second analogous example and one more closely related to the factors concerned in the case is the behavior of iron compounds toward CO_2 (13). It is known that Humic Acid attacks the iron oxides, (Fe_2O_3) which color soil red or yellow, and reduces these compounds to ferrous oxide. Ferrous oxide then unites with the CO_2 omnipresent in soil water, forming ferrous carbonate, a colorless compound. As the result of these interactions the ground beneath humus deposits is usually found bleached. Clays, originally red or yellow, may become black, green or blue from the organic matter contained and from the effects of this process. When clay is burned, the organic matter and ferrous carbonate contained is oxidized, and red brick is formed for whose red color the iron oxide is responsible. Now analyses of the shells of 4 common species of Najades furnished through the courtesy of the Commissioner of Fisheries, Washington, D. C., show that the differences in composition between them is greatest and most marked in the content of organic matter, iron, alumina and phosphoric acid. The first three of these are important constituents of soil, and are known to be responsible for the colors of many minerals. The greater rapidity of current, rapids, etc., of the headwaters of streams makes for their greater oxygenation, and this available oxygen may so react with these minerals of the shell as to produce the deeper colors characteristic of the headwaters in a fashion corresponding to the processes described. Further down stream, silt and slow moving waters as well as other conditions may tend to inhibit the oxidative process, and, similarly there may follow a greater inclusion of organic matter in the shell, possibly from the silt itself, resulting in other than the red or yellowish colors allied to iron oxide. A relatively similar situation is found in L. Erie, which has less silt but lighter colored shells. The lighter colors of L. Erie shells may be closest related to the degree of alkalinity of the water. As the natural conditions of the Upper Ohio Drainage are also largely similar to those of the streams draining into L. Erie, a similar explanation may be assumed for their colors. Another alternative hardly consistent with the above facts is that the concentration of humic acid toward the mouth of the stream becomes sufficient to bleach or lighten the colors whose basis is iron. The improbability of this latter becomes clearer when it be remembered that lime also increases in amount going down stream. A more reasonable explanation is that CO_2 whether of the soil water or released from combination by the interaction of humic acid and lime, attacks the ferric or ferrous oxide, already present in the shells and produces ferrous carbonate, which colorless compound may be responsible for the lightening of hues observed. Such an explanation at least embraces most of the physical and chemical conditions known, and is certainly applicable to the many curious facts concerning the nacreous color known to experienced collectors. With regard to the part iron plays in the coloration of the shells of these animals, it is suggestively recalled that it is the basis of many animal and plant pigments such as haemoglobin, bilirubin, chlorophyll, etc.

Speculations here may be unbridled as in other fields and the only thing to qualify it is experimental proof. It may be noted that in many organisms strong production of pigment has been considered evidence of progressive metabolism and sometimes associated with "femaleness" in particular. In other organisms beside the Mollusca it has been also associated with amount of oxygen present, and under the physical conditions the waters of the Upper Ohio are as a whole better oxygenated than those of L. Erie. Some of the observations bear out in part observations on another group of the Mollusca, the Chitons, where Crozier, (1) has found a more brilliant coloring of the soft parts associated with the "female" condition, believing it merely to be the result of a "metabolic accident." From the evidence given, there may be reason to state that the nacreous "ground color" of shells, from which all colors are produced by modification, is a Pearl Blue or "whitish" hue. Dr. A. E. Ortman in an unpublished paper which confirms observations of several other investigators, has shown that the shells in the headwaters of streams are usually smaller and more compressed than the same species in the lower stretches, where they have become more highly inflated. Some factor in the environment may thus inhibit the full physical development of the shell in the headwaters, but its racial metabolism, evident in greater development down stream, may find an outlet in the production of pigment, a variation hardly as harmful to it as increase in size and inflation would be in the swift streams of the headwaters. Against the above we have the check of Koifoids observation, (9), that the plankton elements on which these creatures feed increase with the temperature, and are more abundant in the lower stretches of the stream where there is more silt, and where the shells are more highly inflated. Finally it must be remembered that in so far as outside conditions are concerned, the nacre throughout life is protected by the greater thickness of the shell.

In the preceding, endeavor has been made to consider the more plausible factors responsible for variation in nacreous color among the Najades. If a theory of "progressive metabilism" in organisms be held accountable in any way for variation in the nacreous color of Najades, a factor of possible connection is that of the age of the mussels. In obtaining any light upon the relation of the nacreous color and the age of the animal, a difficulty which presents itself is the accurate determination of the latter. Isely* who has probably made the most extensive study of the growth of Fresh Water Mussels, states that ordinarily the prominent rings of the shell are presumably winter rings, (delayed growth), and therefore each may represent a year of the animals life. However, rings may develop as the result of unfavorable conditions such as water shrinkage, temporary stranding, etc., and at any time of the year. Moreover, the rate of growth is variable for individuals of a single species in the same stream apparently depending on conditions of food, oxygen etc. . . . Growth may also slow down after sexual maturity. All these unfavorable conditions probably act to some degree on shells in the Upper Ohio Drainage. However at the time the color data was recorded, the writer estimated the age of these and those from L. Erie by counting the rings of greatest prominence, which Isely indicates are presumably the winter rest rings. Here it may be remarked as already shown elsewhere,(3), that the shells of L. Erie are under more stable conditions, and greater confidence may be placed in such a method of estimating the age of them. This latter fact was the basis of a check in the following procedure.

There was only the task of rearranging the different recorded colors by classes of the estimated age, and this being done to see whether association was evident between the recorded hues and the estimated age. As insufficient space prevents reproduction of the tabulations thus secured, it can only be stated that all of the colors of all species were found to be distributed through all ages rather than being peculiar of certain ones. Certain generalizations are worthy of note,† that as a rule deeper colors in all species fade

* Isely, F. B. "Experimental Study of Growth and Migration of Fresh Water Mussels" Bureau of Fisheries Document, 792 (1914)

† Thus with age, (using terminology of Simpson); in *Fusconaia*, the percentage of whites and salmons increase, rose tints decrease; *Amblema*, the bluish colors tend toward lilac shades; salmon, straw, and white increase in *Elliptio*, purples become lighter as also in *Proptera* and *Paraptera;* the reds fade out in *Pleurobema* and the salmons and buff in *Symphnota*, when the pinkish hues become more prominent. Bluish white increases in *Anodonta*

with age, most of them tending to revert back to the "pearl blue or whitish" ground color. Similar treatment of L. Erie shells apart from those of the Upper Ohio corroborate this finding. But to be considered with such a generalization, is the fact that very frequently large nos. of shells of different ages from the same locality show an almost uniform nacre color.

IX. Relative Variation in Nacreous Color in the Species Dealt With.

The shells were so unevenly distributed with regard to localities, that it was impossible to determine those places where the greatest amount of nacreous color took place. Some idea may be obtained from Pl. III. In an effort to make a balanced determination of the relative variability of nacreous color among them a rough and arbitrary comparison was taken by dividing the number of "relative colors" observed in each shell by the number of that species examined. Rough as the writer feels his methods to have been in exploring this uncharted field, it seems that within the limits of this investigation that the larger number of shells is apparently associated with less variation in nacre color. At the same time, these results are hardly fair for those species represented by a small number of specimens. Results from this method show the relative variability of the shells to be as indicated in the following table.

	No. of Relative Colors Taken	*No. of Shells*	*Factor Colculated*
1. *Eurynia recta*	29	54	.53
2. *Proptera alata*	26	55	.47
3. *Paraptera fragilis*	23	53	.40
4. *P. obliquum coccin*	53	263	.20
5. *Amblema plicata*	35	185	.18
6. *Anodont ferrussacianus*	8	45	.17
7. *Anodonta grandis*	19	119	.16
8. *Fusconaja flava*	40	273	.14
9. *Lampsilis ovata*	31	214	.14
10. *Elliptio dilatatus*	76	561	.13
11. *Symphynota costata*	19	68	.13
12. *Lampsilis luteola*	26	289	.09

A similar study of variation in Epidermal Color in the animals is expected to appear in a later number of this publication.

---

and *Anodontoides,* while the purples tend to disappear. *Eurynia, L. luteola,* and *L. ovata* appear to retain their vivid colors to later age than the rest of the species, but all of the latter tend to revert to "bluish-white."

Sources of Error.

The Ridgeway Nomenclature was used carefully following directions given in it. It may well be urged that the sense of color is so varied in its development among huminity that results of this kind may not have the same significance for a great number of those interested in these problems. But the same criticism could be applied to the ornithologist who uses the Nomenclature. The writers confidence in his own observations is largely based on the fact that U. S. Army tests have shown his sense of sight to be normal in every respect.

It is also true that at times the mussels migrate from place to place in the same stream and from the river into the tributary. Where a small number of shells were used in making a comparison, this might have some effect on the results obtained, but as the evidence of most observers is that migration is comparatively rare among them, this can have hardly any effect on the general impressions this paper has hoped to convey.

Washington and Jefferson College,
Washington, Pa.

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Dr. Joel Lunell.

A great loss to the science of taxonomical Botany was felt when Dr. Lunell passed away at Leeds, North Dakota, on Thursday, May 27, 1920. Living nearly all his life in a region which botanically was a fertile field for investigation scarcely worked up in a painstaking and orderly way, he brought to his avocation a love of nature, a clear discerning judgment of specific differences, and well trained classical education. He was born in an old castle, "Kalmar Fort," a beautiful place facing the Baltic Sea which was built about the year 1000. His early schooling was finished with unusual honors. His studies in medicine was finished at the great and historical University of Upsala where Linnaeus himself was professor over a century previous. The remarkably broad education in medicine, classics, natural science which he possessed was augmented by a keen appreciative love of music as well as proficiency in modern languages. During his six years of study at Upsala he spent his vacation as tutor in latin and music. Among the books he wrote and translated about this time were some in branches as varied as the following. He published a Physicians' Dietary Cook Book, and a Cook Book on Mushrooms, He translated into Swedish, his native tongue, from German, French, and English the following works. *Physiologie de Got* by Brillat, *The Prince and the Pauper* Savarin, *Innocents Abroad*, by Mark Twain, *What Shall We Do?* by Tschernyschevsky. After finishing at Upsala he took a post graduate course at the Carolyn Institute at the University of Stockholm. In 1888 he came to America and became an associate to Dr. Fleisburg at St. Paul but longed for the frontier life of the new country and settled at Willow City, North Dakota, then a primeval town of a few board houses. Being the only physician in the whole county his zeal for his profession kept him so busy travelling around to help the sick that he was often eighteen to twenty hours without food. He was during these strenuous times also president of the village council, alderman, coroner, U. S. examining physician, and postmaster.

Overwork forced him to relax for vacation from so many numerous pursuits; he left several times but always came back after a few months. In 1894 he came to Leeds where he held office as mayor, alderman and coroner besides his duties as physician.

Dr. Lunell devoted his leisure time to the study of the flora of his region. He published some of his investigations in the Botanical Gazette and published several numbers of *Contributions from the Leeds Herbarium.* Most of his later writings appeared in the *Midland Naturalist*, notably a number of diagnoses of new species and a list of the plants of North Dakota. Unprejudiced by codes as a man of his broad classical training he throws aside any leaning to nomenclature codes of present expediency and adopted system of absolute priority of names for this list. He collected a large herbarium (30,000 plants) the specimens being remarkably well mounted, a collection which is scarcely without a peer in perfection of technique, exactness and completeness in every detail. The passing away of one whose love for nature was observation and whose pursuit of knowledge of the plants of his region was an unselfish contribution to science leaves a gap that will be hard to fill. The following notice in the *Leeds News* of June 3, 1920, brings out other features of his life not already touched upon.

A short time ago we were surprised to hear that Dr. J. Lunell was ill at his home and that his illness was considered serious. Always an active man and accustomed to be about daily it was hard to believe that we had seen him on the street one day and that he was seriously ill the next. Such, however, was the case. On Friday the news that he had passed away on Thursday night was quickly spread through the city. Another pioneer had passed to his reward.

With the passing of Dr. Lunell this generation loses one of nature's noblemen. A lover of the great out-of-door and deeply interested in botany he mingled with flowers all his life, and the study of plants and music was his chief delight. His was a sensitive nature, easily hurt, but never did he allow hatred to enter his heart. Kind hearted and sympathetic, he felt deeply the pain and sorrow of those in trouble. Those who knew him best knew him as a man who followed Christ's teachings in all that he did, and loved him for his kindly, sympathetic nature.

Joel Lunell was born in Kalmar, Sweden, March 30th, 1851, and spent his boyhood days there. His father was Doctor of Theology and Philosophy and pastor of the Lutheran State Church, in which creed Joel Lunell was baptized. As he grew to manhood many hours were spent at the great pipe organ in the church and his knowledge of music gave him daily pleasure in later years.

At the age of eighteen he entered the university at Upsala, Sweden, to study philosophy and medicine.

He was married at Kalmar, Sweden, in 1884, to Miss Emma Swenson. In 1888 they came to America and settled at St. Paul where he was associated with Dr. Fleisburg. Later he moved to Willow City, where he practised his profession. In 1894 he moved his family to Leeds and has since made his home here.

In the early days of his career he worked so unceasingly among the sick that his health was broken, but in spite of this fact he still carried on. During the flu epidemic of 1918 he did his bit with the other and younger physicians, attending cases night and day until the danger had passed.

Besides keeping up his medical practice Dr. Lunell compiled a herbarium of over 30,000 specimens of plant life, including plants from all over the world. During the past thirteen years he has written botanical articles for the *American Midland Naturalist*, published at Notre Dame, Indiana.

Funeral services were held Monday afternoon from the Lutheran Church and interment made here. He is survived by his wife, six children and a brother.

"Waterfowl in Nebraska."

This very interesting and informing paper forms Part I. of Bulletin 794 of the U. S. Department of Agriculture. The following are the contents:—Introduction; Effect of Federal Protective Laws; Future of Waterfowl in the Sandhill Region; Natural Enemies; Hunting Grounds; Waterfowl Hunting in the Autumn of 1915; General Description of the Sandhill Region; Annotated List of Birds; Game Birds; Nongame Birds.

Seldom have I enjoyed a more interesting article on bird life than the one under consideration. And an important element of this interest is the description of the Sandhill Region where Dr.

Oberholzer made his observations. I think this large and unique territory is comparatively unknown, at least to that portion of the community that is not especially devoted to the sportsman's gun. But quite apart from the attraction that a hunter would naturally have for such a paradise of game birds, the Sandhill Region of Nebraska should be known to all Americans. There is probably no other similar territory that can approach in their vast extent and unique character the Sandhills of Nebraska.

As the contents of Dr. Oberholzer's paper indicate, he has made a very careful study of the waterfowl of the Sandhill Region of Nebraska. The reading of his article quite makes the bird lover envy the writer the excellent opportunity he had to study waterfowl. Most observers, unless they live in a favorable place, near a quiet lake or river, can not become acquainted with water birds. This has been my own experience, and I often regret that my home is not located where the study of waterfowl is possible. Dr. Oberholzer's contribution is, then, of great interest to the student of general ornithology, and will, no doubt, be universally appreciated.

A feature of Dr. Oberholzer's article that calls for special mention is the manner of treating his subject. Not too technical for the general reader, and still of genuine value to the special student or the hunter, his paper is a model of attractive writing on ornithology. The great detail (which shows minute observation) of the article can not be too highly commended. The author's work has been so well done that the reader feels grateful to him for the knowledge and pleasure that were made possible by the perusal of this fine production. It is to be hoped that many more similar opportunities will be afforded Dr. Oberholzer to visit regions where waterfowl are abundant. This seems to be a phase of ornithology in which the doctor should specialize, for his present paper points unmistakably to his ability to cultivate this field most profitably.

Brother Alphonsus, C. S. C.,
Notre Dame, Indiana.

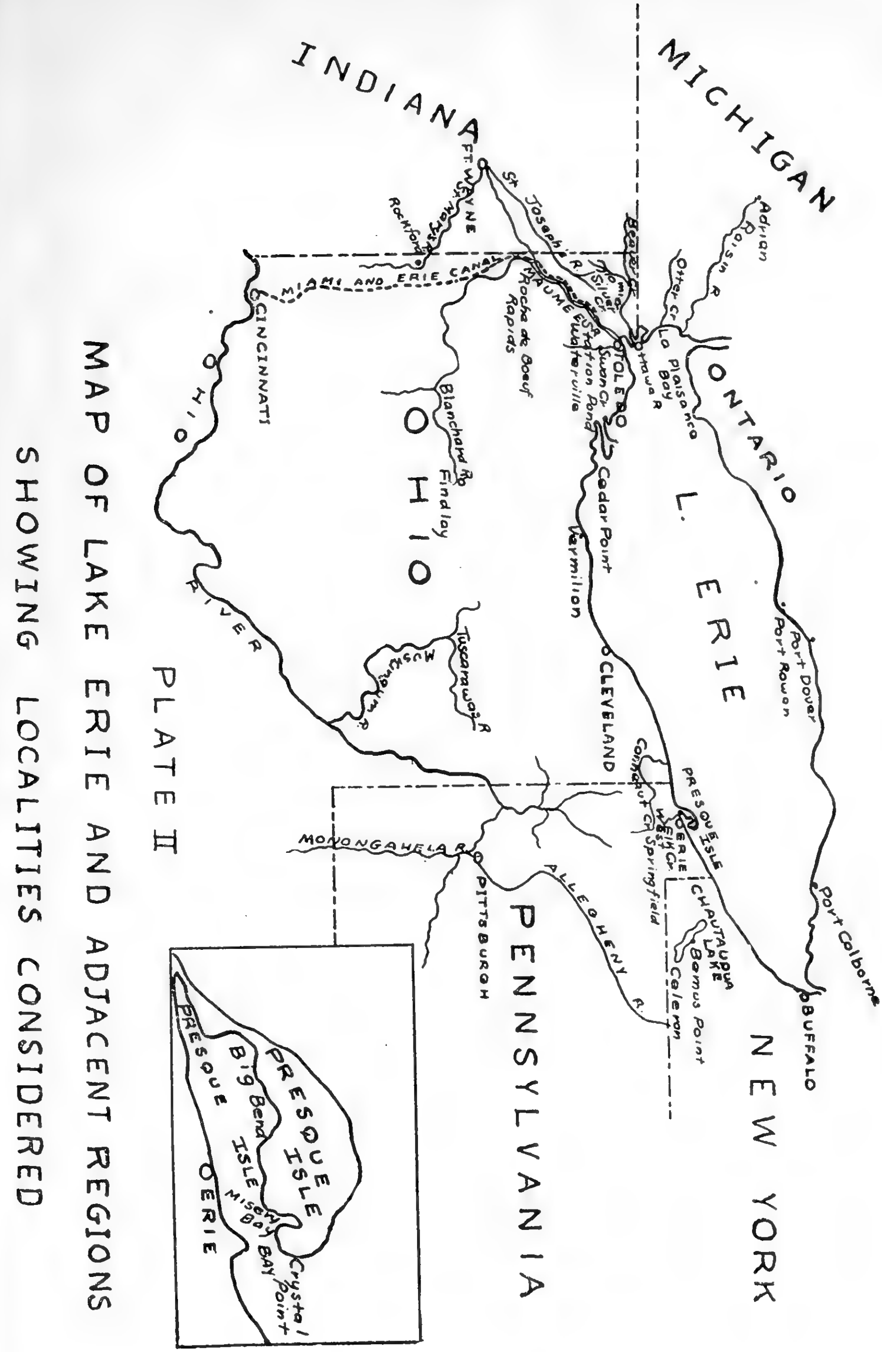

PLATE II.—GRIER ON VARIATION IN NACREOUS COLOR OF CERTAIN SPECIES OF NAIADES.

NOTE

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Variation in Epidermal Color of Certain Species of Najades Inhabiting the Upper Ohio Drainage and their Corresponding Ones in L. Erie.

BY N. M. GRIER, PH. D.

I.—Introductory Statement of the Problem.

This paper is a continuation of the study of the color problem in certain species of Najades, first begun with an account of the variation in nacreous color in the same species. (4). Besides the major object as indicated in the title, now as previously an effort will be made to show how the standard scientific Color Nomenclature of Ridgeway, (14), may be applied to the corresponding descriptive characters of the species of Najades concerned. Again, as it has already been shown that changes in the morphological features of shells parallel changes in the accompanying physical conditions under which they are found, (1,2), effort will be made to show that in the epidermis of mussel shells, as well as in the nacre, changes in color which may be similarly associated take place.

The subject of the epidermal color of mussel shells does not seem to have been made the subject of extended investigation. v. Huber, (6), in studying some European and unrelated species remarks that the epidermis of river forms is generally brown, but at times a dirty green. Juveniles found in a subterranean canal were greenish in color, becoming black with age. v. Sell (15) observed that the lake variety of *Unio pictorum* often had a green coloring, (or rays), posteriorly, which was lacking in river forms of the same species. v. Israel, (7), noted that the males of *Unio crassus* were often reddish, while the females were gray. Marshall, (9), states that "as a rule it may be said that the color of very young specimens when not affected by foreign substances in the water is a light or olive gray in the growing shell, gradually assuming the colors by which it is known in the adult state." It is known generally also that the shells of certain species at least blacken with age, but some effort has been made to ascribe this blackening in part to extraneous influences. Hay, (5), studied *U. tumidus* and *U. pictorum* from the Ouse and Foss Rivers in England. The Foss river had the more natural conditions, a bottom of mud, abundant aquatic vegetation, a gentler current, and received less polluting material than the Ouse. Its shells were lustrous and with a bright nacre. The Ouse River was wider, had a superabundance of mud in the bottom, and the shells in it were eroded, due either to the rapidity of the current or dissolved CO_2 in the water. The shells from this stream were dark or dead brown in color, erosion of the epidermis was considerably advanced, and the pearliness of the nacre was dull, possibly because this stream received the greater abundance and variety of drainage material. Hey believed the differences in coloration observed to be due the amount of such substances received. We may add here in order the observations of two experienced students of the Najades; Messrs. Calvin Goodrich of Toledo, Ohio, and V. S. Frierson, Frierson, La., as kindly given the writer in correspondence.

"Shells of the same species vary in color of epidermis in different streams, sometimes in the same stream under variations of environment. For example, the shells in the pools of Roche de Boeuf rapids, Maumee River are rough and dull hued. They are most of them covered with limy deposits and blotched with some black material which after removal leaves the shells little improved in appearance. The Miami and Erie Canal, upon the bank above these rapids, is fed from the Maumee 7 miles above. The shells of the canal are smooth, polished, often with a sheen like silk and lighter of color. The shells off Catawba Island, Ottawa Co., Ohio, are a bright, shining lot; those in La Plasaince bay, at the west end of the Lake, much dulled by comparison. The La Plaisance shells seem to be abraded by sand; those of Catawba Island escaping this treatment. On the north shore, many of the shells are stained with black and roughened with lime. Algæ, lime, sewage, vegetable growths and mineral matter of one kind and another appear to affect the color of the epidermis. I suppose light has some share in the business. You have no doubt, noticed that the older specimens of the museums show a distinct modification in color." . . . "There is near me a lake one quarter of a mile wide, two miles long, five to twenty feet deep. It is really the old bed of a stream defunct several years ago. But the small streams which feed this lake and which cease to flow during droughts both produce an abundant crop of *Anodons*. Now in the lake, these grow to a large size, much inflated, smooth, somewhat rayed, brightly colored. But in the pools of the headwaters, creeks ten to fifteen feet deep, thirty feet wide, covered with trees, full of decaying leaves and black mud, grow shells elongate, compressed, rough, black and hardly to be differentiated from *Unio comptodon* by its external appearance. Yet they are no doubt the same species, or *no doubt frequently mother and daughter. This is environment.*"

Following the clues given in the foregoing, effort will be made in this paper to throw light on the following problems connected with the color of the epidermis in the species of Najades dealt with:

1. *In those species commonly assigned more than one epidermal color, to determine as far as possible the relative prevalence of each color in all the shells as a whole, and the difference between L. Erie and Upper Ohio shells in this regard.*

2. (*a.*) *To ascertain whether any change in epidermal color takes place going down stream, both in the rivers and in their tributaries and to learn whether in any of the species a particular shade of the described epidermal color is peculiar to the body of water concerned.*

(*b.*) *To study the prevalence and qualities of the rays of the epidermis under conditions indicated for this and the preceding problem.*

3. *As a partial check on problems one and two as well as for their own biological interest to show,* (*a*) *any relation existing between the epidermal colors and the estimated age of the animals;* (*b*) *any association of the epidermal colors with their sex.*

II.—List of Species Used.

LAKE ERIE	UPPER OHIO DRAINAGE
Fusconaja flava parvula, Grier	*Fusconaja flava, Rafinesque.*
Amblema plicata, Say.	*Amblema costata, Rafinesque.*
Pleurobema obliquum pauperculum, Simpson	*Pleurobema obliquum coccineum, Conrad.*
Elliptio dilatatus sterkii, Grier	*Elliptio dilatatus, Raf.*
Symphynota costata eriganensis, Grier	*Symphynota costata, Raf.*
Anodonta grandis footiana, Lea.	*Anodonta grandis, Say.*
Paraptera fragilis, Raf.	*Paraptera fragilis, Raf.*
Proptera alata, Say.	*Proptera alata, Say.*
Anodontoides ferrussacianus subcylindricus, Lea.	*Anodontoides ferussacianus, Lea.*
Eurynia recta, Lamarck.	*Eurynia recta latissima, Rafinesque.*

Lampsilis luteola rosacea, Dekay.	*Lampsilis luteola, Lamarck.*
Lampsilis ovata canadensis, Lea.	*Lampsilis ovata ventricosa, Lamarck.*

The accompanying map, and list of localities as given in Plate III showing collecting stations will give some idea of their distribution in the Upper Ohio Drainage and L. Erie. The material used was collected by Dr. A. E. Ortmann over a number of years, (1903-07), in Western Pennsylvania and L. Erie, or secured by him in smaller amount as exchanges. Dr. Ortmann, besides suggesting the value of an introductory study to the color problem in Najades, has done everything in his power to assist the investigation, for which data was obtained at the Carnegie Museum in Pittsburgh. I am indebted to Dr. W. J. Holland, Director, for the freest use of the Museum's facilities in connection.

III.—Physical Conditions and type of Mussel Fauna.

The type of Mussel Fauna has already been admirably treated in papers by Walker (18) and Ortmann, (10-13 inclus.). These and the physical conditions concerned have already been summarized by the writer elsewhere (1); those for L. Erie being ably stated by Jennings, (8), and for the Upper Ohio Drainage in the Water Supply Papers of the U. S. Geological Survey.* At this point we may conveniently add Simpson's observations on the type of Mussel Fauna concerned particularly with regard to the problem we are dealing with. (16). "Species from the Mississippi Valley are more richly colored internally and externally than those of any other part of the globe. . . . All the Mississippi Valley species of Najades that have entered the St. Lawrence or any part of the Atlantic Drainage area have become changed . . . the nacre losing its brilliancy; instead of the bright epidermis often painted beautifully with rays in wonderful patterns, rich greens, yellows, olives we have mostly dull, livid, ashy, rusty reddish or brownish exteriors." Simpson did not believe these changes were due in any measure to climate or colder water, for the shells reach a similar development elsewhere. He further remarks that the changes in form, size and coloring have led students to create new species and varieties for what were originally Mississippi Valley shells. For sake of convenience however, the outstanding

* See Horton, T. H., Hall, M. R., Bolster, R. H. Leighton, M. D. "Surface Water Supply of the United States 1907–08. Part III Ohio River Basin, p. 29, 35, 47. Water Supply papers, U. S. G. S.

points concerning the physical conditions are given in the following contrasting columns.

LAKE ERIE

Water colder than in Upper Ohio but with more even regulation of temperature. Currents much less rapid than in streams; less agitated, except by very moderate currents carrying but little sediment. Bottom of pebbles or sand or mixture of these depending on region of lake, with coarser sediment derived from wear of land. Temperature conditions favor a more uniform production of food if in less abundance. Water is more highly alkaline than that of Upper Ohio Drainage.

UPPER OHIO DRAINAGE

Water warmer, but with greater extremes of temperature to face. Streams more rapid than current of L. Erie; greater agitation, frequent falls and rapids, short stretches of quiet pools. Rivers carry a load of debris moving quickly over the bottom which consists of mud, glacial fill, cobbles. Food conditions (due to extremes of temperature), are less stable, even if at times food is more abundant.

Walker, (18) observes that L. Erie shells as a whole have brighter, (clearer) colors than their fellows of the Upper Ohio Drainage, are exceptionally polished, and otherwise characterized in distinction by their well developed lines of growth.

IV.—Method.

Before attempting the study of the shells, the epidermis of each was lightly scrubbed with a moderately stiff brush to remove any sediment, etc., adhering to it. Care was taken not to injure the epidermis in any way. Shells so badly eroded that a positive determination of nacre color was impossible were ignored in further study. The method pursued in the study of variation in epidermal color was largely that used in the investigation of nacreous color. (4). Here as with the nacreous colors, the epidermal colors did not lend themselves to the determination of any well defined color pattern. The problem is even more complicated in the latter, since a large number of different colors may be represented in the epidermis, due either to inherent causes or as the result of the interaction, as we shall see is probable, with the environment. To simplify matters to a stage where the problem could be grappled with, at least two colors, obtained by comparison with the standard colors of Ridgeway (14), were recorded for each shell. Following the clue cited from Marshall's paper, the first, (or primary), of these two colors was that, which by its lighter hues, distribution and relation to the other, (secondary) one taken was evidently the present if not the original (juvenile) ground color of the entire shell. In most cases this color was confined to the anterior and inferior portions of the shell. The secondary color was that most evident on the superior and posterior portions. If present at all, it was usually, but not always darker than the primary color from which it was derived, and general observation showed that the regions of the shell where it was found, to be the place of transition from the primary color to it, whether to lighter or darker shades. Where there seemed to be doubtful relationships between these two recorded colors, two or three additional ones were taken for the purpose of tracing genetic relationship in the sequence of color changes. The colors then judged most to match the Ridgeway Standard Colors were then written in figuring books opposite calculatings made for the morphological features of each shell. Only one color was usually taken in consideration when effort was made to trace the sequence of change of color, but in view of the fact that color variation might be traceable as stated above to various influences, it was thought well to possess data which would serve to balance the conclusions. In Pl. III, (whose synthesis is afterwards described), two colors are given, the first is the secondary color; where only one is given, it represents the sole color determinable. Further, as the specific descriptions given of some of the shells indicate that the umbo may be lighter colored than the rest of the shell, some confusion may arise when in carrying the writers scheme in mind, it is observed that in Pl. III some of the secondary colors are lighter than the primary ones, as obtained by the above procedure. The general plan when the tables of distribution of color were prepared, was to give preference to that color most impressing the eye with its preponderance or vividness in the epidermis.

The prevailing color then being alone taken into consideration for the calculations, tables were prepared in the following way. Where a large number of shells from one locality were concerned, it was the usual practice to group all shells of a closely similar epidermal color and compare as a whole with the shades given in Ridgeway. By this means a general or average hue was obtained, not accurate of course for every shell, but very convenient in determining the "relative colors" of the shells at that locality to ones near it, above or below in the particular body of water. As a rule these relative colors were taken from a fairly large number of shells, although a lack of material often compelled the use of smaller numbers. Against such treatment however was the check of a separate color comparison for each shell. By means of this method, it was possible to determine for each species shades of epidermal color peculiar to the locality where the shells had been collected, and this being done, charts were prepared showing the sequence of color changes passing down stream, or the distribution in different parts of the same body of water. This data, in consolidated form is presented in Pl. III. Even by this process of condensation, a very large number of colors was obtained for each species, making it imperative to simplify further in order that the evidence for the relative prevalence of different epidermal colors in those species where more than one was described might be rendered more intelligible for report. Just as the systematist for rough descriptive purposes has picked out a number of the more prominent epidermal colors of each species, the writer, following largely Simpsons Descriptive Catalogue of the Naiades, (17), chose from the previously prepared charts the ten to thirty leading colors, (primary or secondary), in the epidermal colors of each species to which the large majority of the rest could be assigned. Percentages of these leading colors were then calculated for each species in the bodies of water, drainages, groups of drainages in which they were found, as best seemed to throw light on the problems to be attacked. While all recorded shades in a large number of cases would not conform to this treatment, they represent percentages in the extreme minority, and may be inferred to exist in those species where the tables of Distribution of Colors as a Whole does not add up to 100%. Strictly speaking, even this comparatively large number of "leading colors" could have been condensed to a smaller number, but the larger number was necessary in order that certain close distinctions in the colors of the epidermis for the purposes of the investigation might be made, for example, between the colors of shells from a river and those from its tributaries. In the discussion of any particular body of water, however, the leading colors given, represent my reduction to lowest terms of the colors represented in it.

Data on the sex of the animal, prevalence of rays, etc., were taken at the time color comparisons were made. So far as observations on epidermal color as associated with the sex of the animal are concerned, the small number of shells on which they are based is explained by the fact that the specimens were collected before Dr.

Ortmann's discovery that the sex of the animal is readily determinable from the structure of the gills. In associating epidermal color with the estimated age of the animal, the latter was determined by counting the number of winter rings on the shell. As I have given elsewhere some discussion of the accuracy and inaccuracy of the results attending this method, (4), it need only be stated that the conclusion staken from the Upper Ohio shells were checked by similar ones from the L. Erie specimens, where this method of estimating the age is less objectionable. Moreover, the conclusions are so general in character as not to be readily affected by mistakes in the age of a very small minority. Pressure of these observations, and also the fact that as a whole few differences could be observed in the texture of the epidermis of shells, lead me to disregard the latter character altogether.

V.—Results.

Each species is dealt with separately, there first being given in parallel columns:

(a.) Descriptive material concerning epidermal color as taken from Simpson.

(b.) The equivalent in the writers opinion of the Simpson Colors in terms of the Ridgeway Color Nomenclature.

It is felt that by this arrangement and the inferences to be drawn from the names of the Ridgeway Colors themselves, it will be possible for the reader to sufficiently understand the terminology used as to convey the principles this paper hopes to make clear. Additionally the writer has endeavored to supplement this by the use of such generalized color terms as he could command. For the sake of greater clarity there are also given latterly in the Ridgeway column the peculiar shades of the L. Erie shells, although these are by the convenient and arbitrary arrangement adopted, but varieties of the hues given in the tables dealing with "Distribution of Colors as a Whole," in which effort is made to throw light upon the first problem stated. There then follow tables giving the relative distribution of epidermal colors in the Upper Ohio Drainage as a whole; and separately, the component drainages. The same is done for L. Erie and its various collecting stations. Additionally, remarks largely in explanation of Pl. III, (chart illustrating sequence of epidermal color changes), and on the prevalence and quality of the rays of the epidermis. The discussion of each species terminates with the evidence for association of particular hues of the epidermis with the estimated age of the animal and its sex.

1.—*Fusconaja flava*

SIMPSON	RIDGEWAY
Brown	Brownish Olive.
Greenish Brown	Ecru Olive, Yellowish Citrine
Brownish, Blackish, (when old)	Bister, Dresden Brown, Sepia, Carob Brown, Seal Brown.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie. (275 shells).

Dresden Brown	40%
Bister	20%
Brownish Olive	20%
Ecru Olive	10%
Sepia	10%

Distribution of Colors as a Whole in Upper Ohio Drainage. (225 shells).

Dresden Brown	40%
Bister	20%
Brownish Olive	20%
Sepia	10%
Ecru Olive	10%

Distribution of Colors as a Whole in Upper Ohio Tributaries, etc.

	Alle'ny Tribs.	*Alle'ny River*	*Mon'g. Tribs.*	*Mon'g. River*	*Ohio River*	*Ohio Tribs.*
Dresden Brown	25%	25%	20%	20%	20%	
Bister	25%	25%			20%	50%
Sepia	50%	25%		20%	20%	
Ecru Olive			20%	20%	20%	
Seal Brown		25%				
Yellowish Citrine			40%			25%
Brownish Olive			20%	40%	20%	25%

Distribution of Colors as a Whole in L. Erie (50 shells).

Carob Brown	30%
Yellowish Citrine	20%
Seal Brown	20%
Dresden Brown	20%
Ecru Olive	10%

Distribution in L. Erie,—localities.

	La Plaisance Bay	*Cedar Point*	*Presque Isle Bay*	*Maumee R. Drain*
Carob Brown				66%
Yellowish Citrine	40%	25%		33%
Seal Brown			25%	

Dresden	20%		25%
Ecru Olive	25%	25%	25%
Tawney Olive	15%	50%	25%

Deductions from Tables of Percentages and Pl. III.

Yellowish greens are more abundant in L. Erie than in the Upper Ohio Drainage; the browns of L. Erie are of a reddish variety, those of the Upper Ohio darker, towards black. Generally, the shells of L. Erie are seen to be lighter in color.

In the Upper Ohio Drainage.

With few exceptions, the color of the epidermis is darker in the rivers than in their tributaries, and darker at the lower stations of the latter than at the upper. This applies to both primary and secondary colors. At Crooked Creek, Creekside, the primary color is a sort of Greenish Olive, but lower down at Rosston, this is succeeded by a darker Yellowish Olive. The secondary colors has deepened to a Seal Brown, acquiring at a near station on the Allegheny, Kelley, a Cinnamon Brown, while the primary color has deepened to a Brownish Olive.* The same type of change may be traced down the latter stream, as well as from the tributaries of the Monongahela, Dunkard and 10 mi. Creeks to that body of water. As the Ohio River is approached, epidermal color becomes darker and darker. Some characteristic primary colors of streams are Brownish Olive for the Allegheny; Greenish Olive for Crooked Creek.

In L. Erie.

The shells at Presque Isle have less Yellowish Green than those at La Plaisance Bay. Cedar Point is characterized by a large percentage of Tawney Olive colors, while the Maumee River draining into L. Erie has an excessive proportion of brown among its shells. In this as well as in other species, different parts of the same collecting locality, such as the various parts of Presque Isle Bay, are apt to show a peculiarly distinctive epidermal color.

Rays of Epidermis.

According to Simpson, this shell is faintly rayed in the young state. 29 of 275 shells had rays, mostly medium in size. My observations indicated that they persisted in some until the 11th year. Raying was most abundant in specimens from the small rivers and creeks, rather than in the larger rivers and lakes. Their prevailing colors were olive, yellowish or darker green.

* Names of Ridgeway Colors are capitalized in this paper.

Relation of Epidermal Color to Estimated Age of Animals.

Young shells of this species in the Upper Ohio Drainage are mostly Yellowish Brown; in L. Erie, mostly Brownish Green. In the former they become brownish or black rapidly as early as the 3rd and after the 5th–8th year, where in my material yellowish brown, was represented in only 1-8 of the shells. Yellowish brown and brown were nearly equally represented in L. Erie shells. No one color or group of colors seemed peculiar to a given age except the deep browns and blacks of old age or advanced maturity.

Observation on Sex Correlative Coloration as Related to Epidermal Color.

Older males are characterized by a Seal Brown color, younger by more of a greenish yellow. Females have larger proportions of more vivid Reddish Brown colors, while the younger ones tend toward Buffy Olive Colors.

2—*Amblema costata*

SIMPSON	RIDGEWAY
Yellowish green	Yellowish Olive. Yellowish Citrine, Dull Citrine.
Brown or blackish	Bister, Mars Brown, Prouts Brown, Dresden Brown

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (185 shells).

Yellowish Olive	40%
Prouts Brown	20%
Mars Brown	20%
Dresden Brown	10%
Bister	10%

Distribution of Colors as a Whole in Upper Ohio Drainage (107 shells).

Prouts Brown	30%
Yellowish Citrine	20%
Dresden Brown	20%
Bister	20%
Buffy Citrine	10%

Distribution of Colors as a Whole in Upper Ohio Tributaries etc.

	Alle'ny Tribs.	*Alle'ny River*	*Beaver Tribs.*	*Beaver River*	*Ohio River*
Prouts Brown	40%	60%	32%	33%	25%
Yellowish Citrine	20%		37%	33%	
Dresden Brown	40%		12%		50%
Bister		40%	6%		25%
Buffy Citrine			12%	33%	

Distribution of Colors as a Whole in L. Erie.

Prouts Brown	30%
Dull Citrine	20%
Yellowish Citrine	20%
Mars Brown	20%
Yellowish Olive	10%

Distribution in L. Erie—Localities.

	La Plaisance Bay	*Cedar Point*	*Presque Isle*
Prouts Brown	50%		
Dull Citrine	25%	25%	25%
Yellowish Citrine		25%	25%
Mars Brown	25%		
Yellowish Olive		50%	50%

Deductions from Tables of Percentages and Pl. III.

Yellowish and greenish hues are most abundant in L. Erie, showing that shells there have brighter colors. There are more buffy or darker colors in the Upper Ohio Drainage, where reddish browns are characteristic.

In the Upper Ohio Drainage.

We observe from the above tables that the darker browns are more abundant in the rivers, the lighter colors in the tributary streams. Primary and secondary colors are observed to darken descending the Allegheny, Shenango Rivers and French Creek. Characteristic stream colors for this and most of the species of shells dealt with are best given in Pl. III. In the tributaries the colors are usually greenish yellow hues. Characteristic stream colors are yellowish green. (Citrine), in the Allegheny, greener shades of Citrine in French Creek, buff varieties of this in the Shenango, olive varieties in the Mahoning. At the nearest approach of these streams to the Ohio the shells are found to blacken.

In L. Erie.

Presque Isle shells have yellow colors, La Plaisance Bay, brown. Those of Cedar Point are more of a Yellowish Olive.

Rays of Epidermis.

Simpson reports no rays for this species. 4 of 107 shells were rayed, persisting at least until the 10th year. The rayed shells were L. Erie specimens. The prevailing color was Greenish Olive.

Relation of Epidermal Color to Estimated Age of Animal.

Juvenile shells are mostly yellowish in the Upper Ohio, those from L. Erie are green. L. Erie shells have also a larger proportion of green with advancing age. Shells in both become black and brownish with age, but in L. Erie later than in the Upper Ohio. These old age colors appear at 4 years and are complete at 9. No one color or group of colors was found to be peculiar of any age.

Observation on Sex-Correlative Coloration as Related to Epidermal Color (11 Shells.)

Young males are of a Buffy Olive color, becoming reddish brown with age. Females in youth are of a Yellowish Olive hue, becoming brownish red with age and tending to blacken.

3.—*Elliptio dilatatus*

Dull green, young shells	Buffy Citrine, Yellowish Citrine
Yellowish brown	Bister, Warm Sepia, Dresden Brown, Ani-
Darker, when old.	line Black, Chestnut, Cinnamon.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie. (561 shells.)

Bister	30%
Warm Sepia	20%
Dresden Brown	20%
Buffy Citrine	20%
Aniline Black	10%

Distribution of Colors as a Whole in the Upper Ohio Drainage (509 shells).

Bister	20%
Warm Sepia	20%
Dresden Brown	20%
Dresden Brown	20%
Seal Brown	20%
Brownish Olive	20%

Distribution of Colors as a Whole in Upper Ohio Tributaries etc.

	Alle'ny Tribs.	*Alle'ny River*	*Mon'g Tribs.*	*Mon'g River*	*Ohio River*	*Beaver Tribs.*	*Beaver River*
Bister	22%	40%	25%	50%	25%	12%	
Warm Sepia	27%	20%	12%		25%	30%	25%
Dresden Brown	22%	40%			25%	12%	25%
Seal Brown	29%		25%		25%	12%	
Brownish Olive			37%	50%		33%	50%

Distribution of Colors as a Whole in L. Erie (52 shells).

Chestnut Brown	30%
Dresden Brown	20%
Cinnamon Brown	20%
Yellowish Citrine	20%
Aniline Black	10%

Distribution in L. Erie—Localities.

	La Plaisance	Presque I.	Chautauqua L.
Chestnut Brown		25%	25%
Dresden Brown	25%	25%	
Cinnamon Brown	25%		25%
Yellowish Citrine	50%	25%	25%
Brownish Olive		25%	25%

Deductions from Tables of Percentages and Pl. III.

L. Erie is seen to contain more yellow shells than the Upper Ohio Drainage, and its browns are of a lighter color. Black seems to be in a minority in the Upper Ohio Drainage.

In the Upper Ohio Drainage.

Here we observe there is a greater percentage of dark colors in the rivers than in the tributaries. A general darkening may be observed descending the Allegheny—the primary color, originally of an olive hue assuring brownish and buffy hues, while the secondary colors pass from light reddish brown shades to dark ones. A similar change may be observed in French Creek, the Shenango and Mahoning Rivers. A characteristic stream color of the latter is an olive shade; that of the Allegheny, a brown. For others see the combinations of primary and secondary colors presented presented on Pl. III.

Buffy primary colors characterize the Allegheny, Brownish Olive French Creek, Buffy Olive the Shenango, Olive the Mahoning.

In L. Erie.

La Plaisance Bay alone is represented by yellow colors to an appreciable amount, those of Presque Isle are prevailingly brown.

Chautauqua Lake stands out for the absence there of vivid reddish shades of brown.

Rays of Epidermis

Simpson—"often faintly rayed in young specimens"—32 of 509 shells were rayed. Rays may persist as late as the 14th year, and were most abundant in specimens from small rivers and creeks, were mostly medium in texture, and Greenish Olive was their most common color.

Relation of Epidermal Color to Estimated Age of Animal.

Dull green is more plentiful in the young of Upper Ohio shells, yellowish brown in those of L. Erie. Shells from the former darken rapidly after the 6th year, in the latter about the 8th. The mature or old age colors of brown and black may begin at 3-4 years and be complete at 6. No one color or group of colors was found to be peculiar of any age.

Observation on Sex-Correlative Coloration as Related to Epidermal Color. (15 shells).

Males have a larger proportion of clear brown colors, young males are largely brownish olive. Females are represented by larger proportions of reddish browns, young females being Buffy Olive.

4.—*Pleurobema obliquum coccineum*

SIMPSON	RIDGEWAY
Tawney or yellowish green when young.	Buffy Citrine
Brownish	Prouts Brown, Mummy Brown, Mars Brown, Aniline Black
Reddish Brown	Seal Brown, Warm Blackish Brown.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (263 shells.)

Prouts Brown	30%
Mummy Brown	30%
Mars Brown	20%
Buffy Citrine	10%
Aniline Black	10%

Distribution of Colors as a Whole in Upper Ohio Drainage (247 shells).

Prouts Brown	30%
Mummy Brown	30%
Mars Brown	20%
Buffy Citrine	10%
Aniline Black	10%

Distribution of Color as a Whole in Upper Ohio Tributaries etc.

	Alleghney Tribs.	*Alleghney River*	*Beaver Tribs.*	*Beaver River*	*Tusca. River*
Prouts Brown	33%	25%	30%	25%	
Mummy Brown	35%	50%	30%	25%	75%
Mars Brown	15%	25%	25%	25%	
Buffy Citrine	10%		5%	25%	25%
Aniline Black	5%		10%		

Distribution of Colors as a Whole in L. Erie (16 shells).

Warm Blackish Brown	20%
Cinnamon Brown	20%
Buffy Citrine	20%

Seal Brown	20%
Buffy Citrine	10%
Aniline Black	10%

Distribution in L. Erie—Localities.

	La Plaisance Bay	*Presque Isle*
Warm Blackish Brown		50%
Cinnamon Brown	50%	
Buffy Citrine	50%	25%
Seal Brown		25%

Deductions from Tables of Percentages and Pl. III.

Again we find that the shells of L. Erie have lighter browns and greater percentages of yellow.

In the Upper Ohio Drainage

The darkening of both primary and secondary colors, (Yellowish Olive and light browns to Brownish Olive and dark browns) is observed descending stream in the Allegheny Shenango, Mahoning Rivers and French Creek. In many cases the darkening in secondary colors can only be traced from tributaries to rivers. Some characteristic primary stream colors are olive in the Allegheny, yellow or brownish olive in Crooked Creek, greenish or brownish yellow in the Shenango, Yellowish Olive in the Mahoning.

In L. Erie.

The shells of La Plaisance Bay are brownish yellow; those of Presque Isle are prevailingly blackish brown, like those of the Tuscarawas River in the Upper Ohio Drainage.

Rays of Epidermis.

Simpson—"shell rayed when young." 27 of 247 shells were rayed. persisting in some cases until the 14th year. In quality, these were finest in the largest rivers, medium in the small rivers and creeks, where they were also more abundant. Prevailing color was Greenish Olive.

Relation of Epidermal Color to Estimated Age of Animals.

With age, shells become reddish brown in the Upper Ohio Drainage. Data concerning L. Erie shells is fragmentary, but as a rule in both, brownish, tawney, and greenish hues decrease with age. Darkening occurs early, about the 4-5 year. Older shells are mostly reddish brown. No color or group of colors seemed peculiar to any given age.

Chart Giving Partial Range of Variation of Nacre Color in the Species Discussed

LOCATION

Beaver River Drainage	Fusconaja flava	Amblema costata	Pleurobema coccineum	Elliptio dilatatus	Symphynota costata
68. Shenango River Pulaski		Grayish Lavender	Pale Congo Pink	Light Vinaceous Purple	
69. Shenango River Harbor Bridge		Grayish Lavender	Light Grayish Blue violet	Pale Grayish Vinaceous	Pale Pinkish Buff
70. Otter Creek					Pale Pinkish Buff
71. Neshannock Cr. Leesburg			Pale Persian Lilac	Deep Vinaceous Lavender	Sea Shell Pink
72. Neshannock Cr. Eastbrook			Pale flesh Color	Light Vinaceous Purple	
73. Neshannok Cr. Eastbranch			Pale vinaceous Pink	Purple Drab	Sea Shell Pink
74. Mahoning River Leavittsburgh Ohio					
75. Mahoning River Edinboro		Pale Campanula Blue		Vinaceous Drab	
76. Mahoning River Hillville		Lilac Gray		Pale Grayish Vinaceous	
77. Mahoning River Coverts		Pearly Blue	Pale Pinkish Cinnamon	Deep Vinaceous Gray	
78. Mahoning River Mahoningstown, Pa.		Pearl Blue	Grayish Lavender	Dark Purple Drab	Pale Pinkish Buff
79. Beaver River [illegible]		Very Pale Vinaceous	Pale Ochraceous Buff	Light Vinaceous Lilac	

PLATE III.

Chart Giving Partial Range of Variation of Nacre Color in the Species Discussed and Showing Association of Certain Shades of Nacre Color with Certain Localities

LOCATION	SPECIES: [illegible]	[illegible]	Pleurobema coccineum	Elliptio dilatatus	Symphynota costata	Anodonta grandis	Anodontoides ferussacianus	[illegible]	Proptera alata	Eurynia recta	Lampsilis luteola	Lampsilis ovata
BEAVER RIVER DRAINAGE												
68. Shenango R. Pulaski			Pale Congo Pink	Light Vinaceous Purple								
69. Shenango R. Harbor Bend			Light Grayish Blue Violet	Pale Grayish Vinaceous	Pale Pinkish Buff						Pearl Blue Light Pinkish Lilac	
70. Otter Creek					Pale Pinkish Buff						Pearl Blue to Light Pinkish Lilac	Pale Grayish Blue Violet
71. Neshannock Cr. [illegible]			Pale Persian Lilac	Light Vinaceous Lavender	Sea Shell Pink						[illegible]	
72. Neshannock Cr. [illegible]			Pale [illegible]	Light Vinaceous Purple								Pale Grayish Blue Violet
73. Neshannock Cr. [illegible]			Pale Vinaceous Pink	Purple Drab	Sea Shell Pink							Pale Purplish Vinaceous
74. Mahoning River Leavittsburgh											[illegible]	[illegible] Pale Grayish Blue Violet
75. Mahoning River Edinboro		Campanula Blue		Vinaceous Drab				[illegible]				
76. Mahoning River Hillsville		[illegible]		Pale Grayish Vinaceous								
77. Mahoning River [illegible]		Pearl Blue	[illegible]									
78. Mahoning River Mahoningtown, Pa.		Pearl Blue	Gray [illegible]	[illegible]	Pale Pinkish Buff						White to Light Vinaceous Lilac	Light Pinkish Lilac
79. Beaver River Wampum		Very Pale Vinaceous [illegible]	[illegible]	[illegible]							[illegible] Pinkish Lilac	White to Light Grayish Blue Violet
80. Slippery Rock Cr. Rose Point				[illegible]		Pearl Blue					Light Pinkish Lilac	
81. Slippery Rock Cr. Wurtemburg		Pearl Blue	Pale Cinnamon Pink	Brownish Vinaceous	Pale Pinkish Buff							
82. Connoquenessing Cr. Connoquenessing												[illegible]
83. Connoquenessing Cr. Harmony			Salmon Color									
84. Connoquenessing Cr. Zelienople												
85. Brush Cr. [illegible]						Pearl Blue						
86. Connoquenessing Cr. Ellwood City			Pearl Blue									
LITTLE BEAVER CR. DRAINAGE												
87. Little Beaver Cr. Lisbon Vale				Vinaceous Lilac								White to Pale Pinkish
88. Little Beaver Creek St. W. Franklin				Vinaceous Lilac								
89. Little Beaver Creek Cannelton					Pale Pinkish Buff							
90. Little Beaver Creek Darlington				Deep Vinaceous Lavender								Pearl Blue Pale Grayish Blue Violet
91. Little Beaver Creek New Galilee				Light Purplish Vinaceous							Pearl Blue [illegible] Pinkish Lilac	Pearl Blue Light [illegible]
OHIO RIVER												
92. Raccoon Cr. New Sheffield	Deeper Hermosa Pink				Sea Shell Pink	Pale Grayish Blue Violet						Pearl Blue Light Pinkish Lilac
93. Ohio River, Shippingport		Pale Grayish Vinaceous		Vinaceous Gray				Light Russet Vinaceous	White to Pale Lilac			
94. Ohio River, Industry		Pale Vinaceous Gray		Pearl Blue Pale Pinkish Lilac				Pale Vinaceous Lilac	Light Purplish Vinaceous	White	Pearl Blue to Light Pinkish Lilac	Light Pinkish Lilac Pearl Blue
95. Ohio River, Cook Ferry		Pale Grayish Vinaceous		Pearl Blue to Light Pinkish Buff				Pale Lychnis Pink	Pale Congo Pink			Light Pinkish Lilac Blue Pearl
96. Ohio River Smith's Ferry				Purplish Lilac		Pale Grayish Blue Violet		Pale Purplish Vinaceous				
LAKE ERIE												
97. La Plaisance Bay Mich.	Light Gray Bl. Vio. Light Flesh Pink	Light Pinkish Violet	Burn Blue	Deep Vinaceous Gray	Light Buff, Pale Cinnamon Pink			Pale Pinkish Lilac	Hydrangea Pink	Pale Lilac	Light Pinkish Lilac	Pale Purplish Vinaceous
98. Cedar Point, Ohio	Light Salmon Orange	Pearl Blue		Vinaceous Lavender		Pearl Blue			Light Pinkish Lilac	Pearl Blue	Pale Rhodonite Pink	Light Pinkish Lilac
99. Vermillion, Ohio				Pearl Blue					Lychnis Pink	Pearl Blue	Light Pinkish [illegible]	White to Pearl Blue
100. PRESQUE ISLE Lake Erie off Presque Isle				Deep Vinaceous Lavender			Pearl Blue				[illegible]	[illegible]
Presque Isle Bay Beach Pools						Light Grayish Blue Violet Pearl Blue	Pale Bluish Lavender				Pale Rhodonite Pink	Pale Grayish Violet
Pond North Shore						Pearl Blue				Light Pinkish Lilac	Pearl Blue	
Beach Pool E. E. East End				Pale Rhodonite Pink		Deep Lavender Pearl Blue						Pale Persian Lilac
East End, Outer Beach South Shore	La France Blue	Pale Aniline Violet		Pearl Blue Vinaceous Lilac							Light Pinkish Lilac	
Flats near West End Big Bend	Light Grayish Violet	Pale Verbena Violet		Light Vinaceous Purple	Pale Ochraceous Salmon	Pale Aniline Lilac	Lavender	Pale Rhodonite Pink	Hydrangea Pink	Pearl Blue	Lavender, Pearl Blue, Pale Lilac	Light Pinkish Lilac
Big Bend West of Water Works Big Bend off Waterworks	Light Flesh Pink	Deep Grayish Lav. Pearl Blue	Pale Vinaceous Pink	Dark Vinaceous Gray	Pale Ochraceous Buff	-	Pale Aniline Lilac	Pale Pinkish Lilac	Light Purplish Vinaceous		Pale Pinkish Lilac Pale Rhodonite Pink	White Pearl Blue
Big Bend, West End Big Bend, East End			Burn Blue			Pale Pinkish Buff Pearl Blue	Pale Bluish Lavender		Pale Vinaceous Pink			
Misery Bay Crystal Point		Pearl Blue Pale Verbena Violet	Burn Blue	Deep Vinaceous Lav., Pearl Blue	Pale Pinkish Buff			Pale Congo Pink	Pale Persian Lilac		White, Pale Pinkish Lilac, Pearl Blue	White
North Shore Crystal Point Horse-shoe Bend	Light Salmon	Pearl Blue Pearl Blue										
Beach Pools, L. Erie							Pale Bluish Lavender					
101. Buffalo							Pearl Blue					
102. Port Colborne											White to Light Pinkish Lilac	White Pearl Blue
103. Port Dover							Pale Aniline Lilac				[illegible]	[illegible]
104. Port Rowan												
MAUMEE RIVER DRAINAGE												
105. St. Mary's River Rockford, Ohio											[illegible]	
106. Blanchard River Findley, Ohio											[illegible]	
107. Silver Creek Williams Co., Ohio							Pearl Blue					
108. Maumee River Rapids						Pale Grayish Blue Violet			Light Purplish Lilac	Light Pinkish Lilac	Pale Persian Lilac	Pale Grayish Blue Violet Pearl Blue
109. Maumee River Station Pond											White	
110. Maumee River Allan Co., Ohio											White to [illegible]	
111. Beaver Creek Williams Co., Ohio											Pearl Blue [illegible]	
112. Swan Creek Toledo, Ohio							Pale Grayish Blue Violet					
113. Miami and Erie Canal Waterville, Ohio	Gravish Lavender										Pearl Blue [illegible]	
114. Ten Mile Creek Silica, Ohio							Pale Aniline Lilac					White
115. St. Joseph's River Indiana												
OTHER STREAMS DRAINING TO L. ERIE												
116. Raisin River Adrian Michigan							Pale Aniline Lilac				Light Pinkish Lilac	
117. Otter Creek Monroe Co., Mich.												Pale Pinkish Lilac
118. Conneaut Creek West Springfield, Pa.				Vinaceous Lilac	Pearl Blue	Light Grayish Blue [illegible]						
119. Elk Creek Mills Girard, Pa.						Pale Pinkish Cinnamon; Pearl Blue	Pearl Blue				[illegible] Pink	
120. Tuscarawas River Ohio	Pale Grayish Blue Violet			Deep Vinaceous Gray								
121. Chautauqua, N. Y. Lake										Vinaceous Pink	Pale Pinkish Lilac Light Pinkish Lilac	Pearl Blue Pale Pinkish Lilac
Bemus Point Celeron											Pale Pinkish Lilac	Pale Verbena Violet
Griffiths Landing												

III.

d Showing Association of Certain Shades of Nacre Color with Certain Localities

	Pearl Blue					
Grayish Violet			Light Purplish Lilac	Light Pinkish Lilac	Pale Persian Lilac	Pale Grayish Blue, Violet
						Pearl Blue
					White	
					White Pale Rhodonite Pink	
	Pale Grayish Blue Violet				Pearl Blue Light Pinkish Lilac	
	Pale Aniline Lilac				Pearl Blue Pale Rhononite Pink	
						White

120. Tuscarawas River Ohio	Pale Grayish Blue Violet			Deep Vinacious Gray	
121. Chautaugua (N. Y.) Lake					
Bemus Point Celeron					
Griffiths Landing					

Observation on Sex-Correlative Coloration as Related to Epidermal Color. (13 shells)

Older males have warm reddish brown colors; in youth, lighter yellows and olives are representative. Females have a greater tendency to blacken, and have darker colors throughout life.

5.—*Symphynota costata*

SIMPSON	RIDGEWAY
Yellowish Green	Buffy Citrine
Tawney	Brownish Olive
Brownish	Bister, Chestnut, Mars Brown, Prouts Brown, Mummy Brown.

Distribution of Colors in Upper Ohio Drainage and L. Erie (68 shells).

Bister	20%
Brownish Olive	20%
Buffy Citrine	20%
Chestnut	20%
Mars Brown	20%

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (47 shells.)

Warm Sepia	30%
Brownish Olive	20%
Buffy Olive	20%
Mummy Brown	20%
Bister	10%

Distribution of Colors as a Whole in Upper Ohio Tributaries etc.

	Alle'nv Tribs.	*Alle'ny River*	*Ohio River*	*Monong River*	*Beaver Tribs.*
Warm Sepia	50%	20%		25%	
Brownish Olive	12%	20%	25%	50%	37%
Buffy Olive	12%	20%	50%	25%	25%
Mummy Brown	12%	20%			25%
Bister	12%	20%	25%		13%

Distribution of Colors as a Whole in L. Erie (21 shells).

Buffy Citrine	40%
Chestnut	20%
Mars Brown	20%
Prouts Brown	10%
Mummy Brown	10%

Distribution in L. Erie—Localities.

	La Plaisance Bay	*Presque Isle*
Buffy Citrine	25%	
Chestnut	25%	50%
Mars Brown	25%	25%

PLATE III.

Chart Giving Partial Range of Variation of Nacre Color in the Species Discussed and Showing Association of Certain Shades of Nacre Color with Certain Localities

Location	Fusconaja flava	Amblema costata	Pleurobema coccin.	Elliptio dilatat.	Symphynota costata	Anodonta grandis	[illegible] Ferus-	Paraptera fragilis	[illegible]ptera alata	[illegible] recta	Lampsilis lu[illegible]	Lampsilis [illegible]
Upper Ohio Drainage												
1. Potato Creek, Southport				Light Purple Drab	Light Ochraceous Salmon							
2. Allegheny River, Larabee			[illegible] Lilac	Light Vinaceous Purple						Pinkish Lilac	Light Rhodonite Pink	White to Light Pinkish Lilac
3. Allegheny River, Warren			Buff Pink	[illegible] Lilac							White to Pale Pinkish Lilac	White to Light Pinkish Lilac
4. Conewongo Creek, Russell			Pearl Blue	Brownish Vinaceous						Light Pinkish Lilac	Light Pinkish Lilac	
5. Allegheny River, Hickory			Pale Shell Pink	Vinaceous Lilac	Pale Pinkish Buff					Pinkish Lilac		Pale Grayish Blue Violet
6. Brokenstraw Creek, Garland			Dark Vinaceous		Pale Pinkish Cinnamon	Pale Grayish Blue Violet						
7. Allegheny River, Tionesta			[illegible] Blue	Deep Vinaceous Gray	Pale Grayish Vinaceous					White		Pale Rhodonite Pink
8. Allegheny River, Walnut Bend		Pearl Blue	Light Grayish Blue Vinaceous	Light Vinaceous Purple	Pinkish Buff					Pearl Blue		White to Lavender
9. Sandy Creek			Pearl Blue	Vinaceous Lilac		Pearl Blue						
10. Allegheny River, Parker's Landing				Light Purplish Vinaceous								
11. Allegheny River, Templeton			Shell Pink						Light Purplish	Light Pinkish Lilac	Pale Aniline Lilac	Pale Persian Lilac
12. Allegheny River, Mosgrove		Pale Verbena Blue		Pale Bluish Lavendar						Pale Persian Lilac		Pearl Blue
13. Allegheny River, R[illegible]ston	Light Orange Pink	Pale Verbena Lilac	Light Grayish Blue Violet							Livid Pink	Light Pinkish Lilac	Pale Grayish Blue Vinaceous
14. Allegheny River, Kelly	Light Salmon		Pale Grayish Blue Violet	Deep Vinaceous Lavender	Pale Salmon			Pearl Blue	Pale Persian Lilac	White	Pinkish Lilac to Pearl Blue	Pale Grayish Blue Violet
15. Allegheny River, G[illegible]	Pale Salmon	Pale Vinaceous Gray	Pearl Blue	Light Vinaceous Lilac	Pale Pinkish Buff			Flesh Pink	Light Purplish Vinaceous			
16. Allegheny River, White Rock				Pearl Blue to Light Buff								
17. Allegheny River, M[illegible]		Pearl Blue	Pearl Blue					Congo Pink		White		Pale Lilac
18. Buffalo Creek, Harb[illegible]			Pearl Blue		Salmon Buff							White Light Pinkish Lilac
19. Allegheny River, Schenley				Pearl Blue						Pale Vinaceous		
20. Allegheny River, Natrona				Purplish Lilac								
21. Harmarville, Pond						Pale Grayish Blue Violet						
French Creek Drainage												
22. Le Boeuf Creek		Pale Verbena Violet	Venetian Pink	Light Vinaceous Lilac	Pale Ochraceous Buff	Pearl Blue					Pale Rhodonite Pink	
23. Cambridge Springs			Chatenay Pink			Light Grayish Blue Violet					White to Pinkish Lilac	White Pearl Blue
24. Conneauttee Lake						Pale Grayish Blue Violet					Pale Grayish Blue Violet	
25. Conneauttee Creek					Pale Pinkish Buff						Pearl Blue	White to Pale Persian Lilac
26. Meadville		Lavender					Pale Aniline Lilac				Light Pinkish Lilac	
27. Conneaut Lake				Brownish								
28. Conneaut Lake N. E. Shore				Brownish Vinaceous		Light Pinkish Lilac	Light Grayish Blue Violet					
29. Conneaut Lake E. Shore				Deep Vinaceous Lavender		Light Pinkish Lilac						
30. Conneaut Lake W. Shore				Purplish Vinaceous								
31. Conneaut Lake Outlet		Pearl Blue	Light Lavender Blue	Purplish Vinaceous			Pale Grayish Blue Violet				Pale Rhodonite Pink	
32. Cochranton (Fr. Creek)		Pearl Blue		Light Vinaceous Lilac	Sea Shell Pink		Pale Grayish Blue Violet			Pale Persian Lilac	Pale Grayish Blue Violet	
33. Utica (Fr. Creek)		Light Pearl Blue	Venetian Pink	Slate Violet	Pinkish Buff					White		
34. Sugar Creek, Cooperstown						Vinaceous Pink						
Red Bank Creek Drainage												
35. Little Mahoning Creek, Goodville			Pale Chatenay Pink	Deep Vinaceous Gray							Pale Grayish Blue Violet	Pearl Blue to Lavender
Crooked Creek Drainage												
36. Creekside	Light Grayish Blue Violet					Pearl Blue					White to Light Pinkish Lilac	
37. Southbend				Dark Vinaceous Drab								
38. Rosston	Light Orange Pink	Pallid Grayish Blue Violet	Pale Salmon	Light Purplish Vinaceous	Shell Pink	Pale Grayish Blue Violet				Pale Grayish Vinaceous	White to Light Pinkish Lilac	Light Pinkish Lilac
Kiskiminetas River Drainage												
39. Yellow Creek, Homer				White to Pearl Blue								
40. Quemahoning, [illegible] Mill				Light Vinaceous Lilac	Ochraceous Buff							
41. Conemaugh River (New Florence)			Pearl Blue									
42. Loyalhanna R. (Ligonier)				Light Purplish Vinaceous								White, Pearl Blue
43. Loyalhanna R. (Idle Park)			Pearl Blue	Pearl Blue		Pearl Blue						White, Pearl Blue
Monongahela R. Drainage												
44. Cheat River, Cheat Haven				Light Vinaceous Purple								Pearl Blue Light Pinkish Lilac
45. Dunkard R., Mt. Morris	Light Orange Pink	Pale Orange Vinaceous	Cameo Pink	Light Purplish Vinaceous	Salmon Buff	Pearl Blue						
46. Dunkard Cr., Wiley	Light Salmon			Heliotrope Gray								Pale Grayish Vinaceous
47. South Fork Ten Mile Cr., Waynesburg	Pale Verbena Violet				Pale Pinkish Buff							Pale Persian Lilac
48. Ten Mile Creek, Amity	Pale Grayish Vinaceous					Pale Grayish Blue Violet					Pale Grayish Blue Violet	
49. Ten Mile Creek, Clarksville	Pale Pinkish Cinnamon											Light Pinkish Lilac
50. Monongahela River, Millsboro	Pale Verbena Violet			Light Purple Drab								
51. Monongahela River, Charleroi	Pale Pinkish Cinnamon			Vinaceous Gray	Sea Shell Pink							
52. Monongahela River, Westmoreland Co.	Pale Pinkish Buff			Light Vinaceous Lilac	Pale Pinkish Buff				Light Russet Vinaceous			
53. Monongahela River, Elizabeth	Pale Grayish [illegible]				Pale Ochraceous Buff						White to Light Pinkish lilac	White Light Pinkish lilac
Ohio River Drainage												
54. Chartiers Cr., Carnegie	Pale Pinkish Cinnamon											Pale Aniline Lilac
55. Ohio River, Neville Island	Pale Pinkish Buff			Pearl Blue Pale Vinaceous Lilac	Shell Pink				Pale Vinaceous	White	White to Pale Vinaceous Lilac	White to Light Pinkish Lilac
56. Ohio River, Coraopolis				Purple Drab								White to Pale Grayish Blue Violet
57. Ohio River, Dead Man's Island				Purple Drab				Hydrangea Pink				
58. Ohio River, Edgeworth								Pale Lobelia Violet	Light Russet Vinaceous			White, Pale Grayish Blue Violet
59. Ohio River, Beaver								Pale Vinaceous Pink				
Beaver River Drainage												
60. Padan Creek, Linesville		Pearly Blue				Pale Pinkish Buff	Pale Grayish Violet					
61. Randolph Run, Hartstown											Pearl Blue Light Pinkish Lilac	
62. Shenango River, Jamestown			Shell Pink	Purple Drab		Pale Grayish Blue Violet					White, Pinkish Lilac	Pearl Blue Pale Grayish Vinaceous
63. Shenango River, Greenville				Vinaceous Lavender			Light Grayish Blue Violet				Light Pinkish Lilac	White Pale Pinkish Lilac
64. Shenango River, Shenango		Pearl Blue	Light Ochraceous Buff	Light Vinaceous Purple			Pale Windsor Blue				Pale Grayish Blue Violet	Pale Persian Lilac
65. Shenango River, Clarksville		Pearl Blue	Chatenay Pink	Dark Vinaceous Gray	Pale Ochraceous Salmon						Light Pinkish Lilac	White Pearl Blue
66. Pymatuning Cr., Pymatuning Twshp.		Pale Aniline Lilac	Pearl Blue	Deep Vinaceous Gray	Pale Ochraceous Buff	Lavender Gray	Pearl Blue				Pearl Blue	Light Pinkish Lilac
67. Shenango River, Sharpsville		Pearl Blue	Pale Aniline Lilac	Light Vinaceous Lilac	Light Buff	Light Grayish Blue Violet	Pearl Blue				White to Pale Persian Lilac	

Prouts Brown		25%
Mummy Brown	25%	

Deductions from Tables of Percentages and Pl. III.

Light colors, (Buffy Olive), are apparently equivalent in the Upper Ohio Drainage and L. Erie, but the browns are deeper hued in the latter, much as in the preceding species.

In the Upper Ohio Drainage.

Shells from the rivers are darker than those from the tributaries. A partially incomplete series of darkening primary and secondary colors may be traced descending the Allegheny, Shenango, and Mahoning Rivers. This would be more complete had more material been available. Characteristic primary colors are Buffy ones for the Allegheny, Citrine for the Shenango. Due again to lack of material, there is no outstanding differences between the shells of the Monongahela and its Tributaries. Darkening of the epidermis occurs descending the Ohio.

In L. Erie

Presque Isle shells are distinguished from those of La Plaisance Bay by the abundance of browns, and the practical absence of yellow colors.

Rays of Epidermis

Simpson—"often rayed." 3 of 68 shells showed raying, in shells 9-12 years of age, and persisting at least until that age. The prevailing color of rays was greenish olive.

Relation of Epidermal Color to Estimated Age of Animal.

With age, the Chestnut or dark colors become in the majority. Darkening may occur as early as the 7-9 year, and seems complete at 15. "Greenish" is always a minority color. Darkening occurs less rapidly in L. Erie, and the percentage of yellows apparently increases with age in the Upper Ohio Drainage. Young shells were not plentiful among my material.

Observation on Sex-Correlative Coloration as Associated with Epidermal Color (6 shells).

Within the limits of the small number of shells considered, the males stand out for blackish colors with age, and Buffy Olives in youth. Females had lighter browns than males, and young specimens were Brownish Olives.

6.—*Anodonta grandis*

SIMPSON	RIDGEWAY
Greenish brown	Yellowish Olive, Olive Green
Brownish green	Brownish Olive, Ecru Olive
	Other Colors:
	Buffy Citrine, Varley Green, Straw Yellow, White.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (119 shells).

Brownish Olive	40%
Yellowish Olive	20%
Olive Green	20%
Ecru Olive	10%
Buffy Citrine	10%

Distribution of Color as a Whole in Upper Ohio Drainage (97 shells).

Brownish Olive	40%
Olive Green	20%
Saccardos Olive	20%
Ecru Olive	10%
Buffy Citrine	10%

Distribution of Colors in Upper Ohio Tributaries etc.

	Allegheny Tribs.	*Beaver Tribs.*	*Mgnong. Tribs.*
Brownish Olive	50%	25%	
Olive Green		25%	25%
Saccardos Olive	12%		25%
Ecru Olive	25%	25%	
Buffy Citrine	12%	25%	
Mummy Brown			50%

Distribution of Colors as a Whole in L. Erie and by localities.

	As a Whole	*La Plaisance Bay*	*Cedar Point*	*Presque Isle*
Brownish Olive	30%	25%	25%	25%
Ecru Olive	30%		50%	25%
Varley Green	20%			25%
Straw Yellow	10%	50%	25%	25%
White	10%	25%		

Deductions from Tables of Percentages and Pl. III.

The L. Erie shells may be distinguished from those of the Upper Ohio by the abundance of yellowish and greenish yellow tints, those of the latter being Brownish or Yellowish Olive.

In the Upper Ohio Drainage.

A darkening descending the Allegheny was observed in the scanty material at hand. This is more evident in French Creek where an Olive hue is taken on, and to some extent is evident in the Shenango and the Mahoning Rivers. Characteristic primary colors are Yellowish Olive for the Shenango, and Varley, (bright) Green for the Mahoning. Shells from the Ohio are deeper in color than those from Raccoon Creek, a comparatively near tributary. The Allegheny Tribs. have the most Brownish Olive, the Monongahela Tribs. the most dark brown, greenish colors are most abundant in the Beaver Tribs.

In Lake Erie

Yellow colors predominate at La Plaisance Bay, Olive at Cedar Point and these are equivalent at Presque Isle.

Rays of Epidermis

Simpson—"rarely faintly rayed, but showing 3 broad dark rays on the posterior slope." Only a few specimens from creeks were noted. In these the rays were bright green and medium in texture. They were present at least until the 14th year.

Relation of Epidermal Color to Estimated Age of Animal.

In the Upper Ohio Drainage, Brownish rather than Yellowish Brown increases with age, but at old age, these colors seem to be equally prevalent. The old age colors of brown appear at 6-8 years in both groups of shells and may be complete at this age. L. Erie shells are mostly green at first. No colors seemed peculiar to any given age.

Observation on Sex-Correlative Coloration as associated with Epidermal Color. (8 shells)

In this small number of shells, males were distinguished by a preponderance of Olive colors; females ranged from yellowish green to brownish hues.

7.—Paraptera fragilis

SIMPSON	RIDGEWAY
Greenish yellow	Olive Lake, Deep Colonial Buff, Yellowish Citrine.
Pale Smoky brown	Brownish Olive, Buffy Olive.
Dark Colored	Ecru Olive.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (58 shells).

Ecru Olive	30%
Deep Colonial Buff	20%

Brownish Olive	20%
Olive Lake	20%
Buffy Olive	10%

Distribution of Colors as a Whole in Upper Ohio Drainage (28 shells).

Ecru Olive	20%
Olive Lake	20%
Brownish Olive	20%
Buffy Olive	20%
Yellowish Citrine	20%

Distribution of Colors as a Whole in Upper Ohio Tributaries, and River.

	Allegheny River	*Ohio River*
Ecru Olive		20%
Olive Lake	25%	20%
Brownish Olive	50%	40%
Buffy Olive	25%	----
Yellowish Citrine		20%

Distribution of Colors as a Whole in L. Erie (30 shells).

Deep Colonial Buff	30%
Brownish Olive	20%
Saccardos Olive	20%
Ecru Olive	20%
Grayish Olive	10%

Distribution of Colors in L. Erie—Localities.

	La Plaisance Bay	*Cedar Point*	*Presque Isle Bay*
Deep Colonial Buff	25%	50%	20%
Brownish Olive	25%		20%
Saccardos Olive	25%		
Ecru Olive	25%	25%	40%
Grayish Olive		25%	20%

Deductions from Tables of Percentages and Pl. III.

Shells from L. Erie are lighter than those from L. Erie although both possess many colors in common. Buff colors predominate in the former.

In the Upper Ohio Drainage

Shells darken, both primarily and secondarily in going down stream from the Allegheny to the Ohio. Olive Lake is a characteristic primary color for the former, Buffy Citrine for the latter.

In Lake Erie

Buff colors are in the lead at Cedar Point, Olive at Presque Isle, while Grayish Olive seems wanting at La Plaisance Bay.

Rays of Epidermis

Simpson "Often rayless, sometimes feebly rayed". 37 of 58 shells were rayed, the oldest age being 13. The texture of these from the lake was prevailingly fine those of the rivers medium. The most common color was a Dark Green.

Relation of Epidermal Colors to Estimated Age of Animals.

In youth, 1-2 of the shells are either Brown or Green. Most have become of a greenish hue about the 7th year. Green is more prominent in L. Erie shells. Old age colors may appear at 6, completely at 14 years. There appeared to be few if any completely dark colored specimens. No colors seemed to be peculiar to any given age.

Observation on Sex-Correlative Coloration as Associated with Epidermal Color. (5 shells).

In the small amount of L. Erie material only green colors seemed to characterize males, yellow, females.

8.—*Proptera alata*

SIMPSON	RIDGEWAY
Brownish	Mummy Brown, Buffy Brown, Bister, Light
Blackish	Brownish Olive
Olive Green	Buffy Citrine, Buffy Olive
Reddish	Dresden Brown.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (55 shells).

Buffy Citrine	30%
Mummy Brown	20%
Buffy Brown	20%
Bister	20%
Buffy Citrine	10%

Distribution of Colors as a Whole in Upper Ohio Drainage (24 shells).

Olive	20%
Mummy Brown	20%
Buffy Olive	20%
Aniline Black	20%
Snuff Brown	10%
Saccardos Umber	10%

Distribution of Colors as a Whole in Upper Ohio Drainage (24 shells).

Olive	20%
Mummy Brown	20%
Buffy Olive	20%

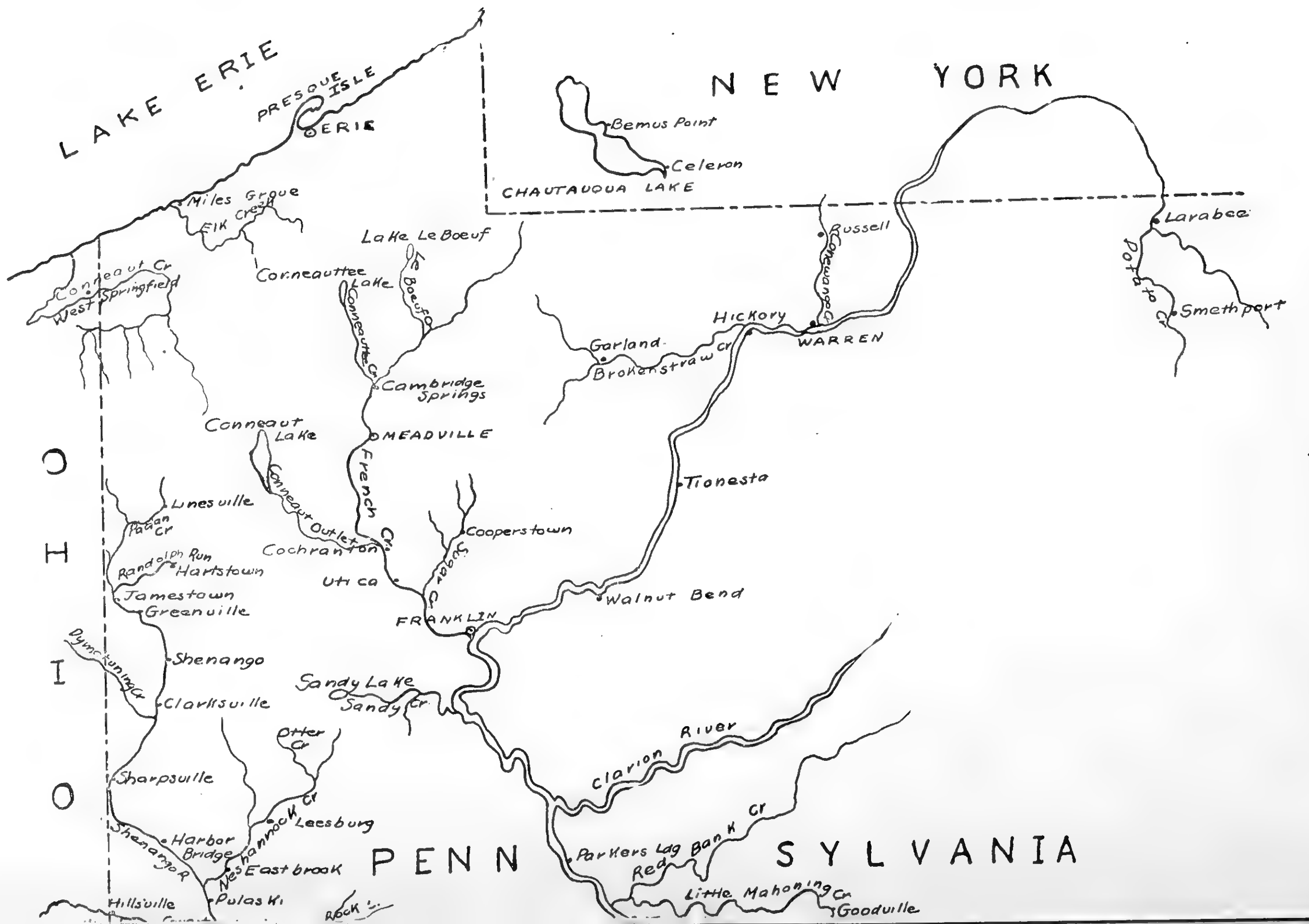
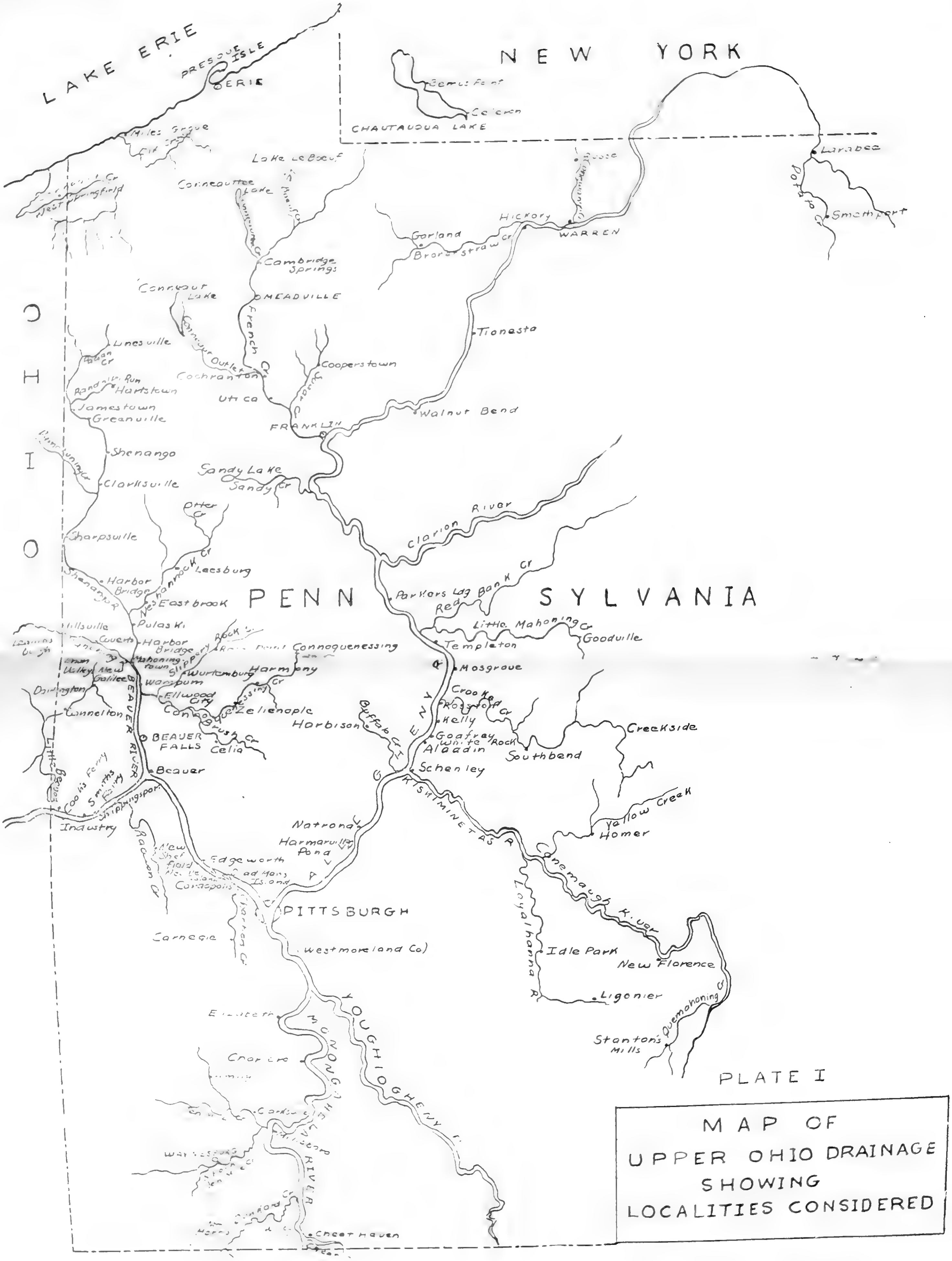

LAKE ERIE
PRESQUE ISLE
ERIE
NEW YORK
Bemus Point
Celeron
CHAUTAUQUA LAKE
Miles Grove
Elk Creek
Lake LeBoeuf
Le Boeuf Cr
Conneaut Cr
West Springfield
Conneauttee Lake
Conneauttee Cr
Russell
Conewango Cr
Larabee
Potato Cr
Smethport
Hickory
WARREN
Garland
Brokenstraw Cr
Cambridge Springs
MEADVILLE
Conneaut Lake
French Cr
Tionesta
O
H
I
O
Linesville
Pagan Cr
Conneaut Outlet
Cooperstown
Cochranton
Randolph Run
Hartstown
Utica
Sugar Cr
Jamestown
Greenville
Walnut Bend
FRANKLIN
Dymctuning Cr
Shenango
Sandy Lake
Sandy Cr
Clarksville
Otter Cr
River
Clarion
Sharpsville
Neshannock Cr
Leesburg
Harbor Bridge
Shenango R
Eastbrook
PENN
SYLVANIA
Parkers Lag
Red Bank Cr
Hillsville
Pulaski
Little Mahoning Cr
Goodville

PLATE I.—GRIER ON VARIATION OF EPIDERMAL COLOR OF CERTAIN SPECIES OF NAJADES.



LAKE ERIE
PRESQUE ISLE
ERIE
NEW YORK
CHAUTAUQUA LAKE
Celoron
Larabee
Potato Cr.
Smethport
Miles Grove
West Springfield
Lake Le Boeuf
Conneauttee Lake
Cambridge Springs
MEADVILLE
French Cr.
Conneaut Lake
Conneaut Outlet
Cochranton
Utica
Cooperstown
Sugar Cr.
FRANKLIN
Garland
Brokenstraw Cr.
Hickory
WARREN
Tionesta
Walnut Bend
OHIO
Linesville
Hartstown
Jamestown
Greenville
Shenango
Clarksville
Sandy Lake
Sandy Cr.
Otter Cr.
Sharpsville
Harbor Bridge
Leesburg
Neshannock Cr.
Eastbrook
Pulaski
Harbor Bridge
Mahoningtown
Slippery Rock Cr.
Connoquenessing
Wurtemburg
Harmony
Wampum
Ellwood City
Zelienople
New Galilee
Darlington
Cannelton
BEAVER RIVER
BEAVER FALLS
Celia
Brush Cr.
Beaver
Shippingsport
Industry
Little Beaver
Smiths Ferry
Raccoon Cr.
PENN SYLVANIA
Clarion River
Parkers Landing
Red Bank Cr.
Little Mahoning Cr.
Gooduille
Templeton
Mosgrove
Crooked Cr.
Kelly
Godfrey
White Rock
Aladdin
Southbend
Creekside
Schenley
Harbison
Buffalo Cr.
ALLEGHENY
KISKIMINETAS R.
Natrona
Harmarville Pond
Yellow Creek
Homer
Conemaugh River
Loyalhanna R.
Idle Park
New Florence
Ligonier
Quemahoning Cr.
Stanton's Mills
Edgeworth
Coraopolis
PITTSBURGH
Carnegie
Chartiers Cr.
Westmoreland Co.
YOUGHIOGHENY R.
MONONGAHELA RIVER
Elizabeth
Charleroi
Cheat Haven
PLATE I
MAP OF
UPPER OHIO DRAINAGE
SHOWING
LOCALITIES CONSIDERED

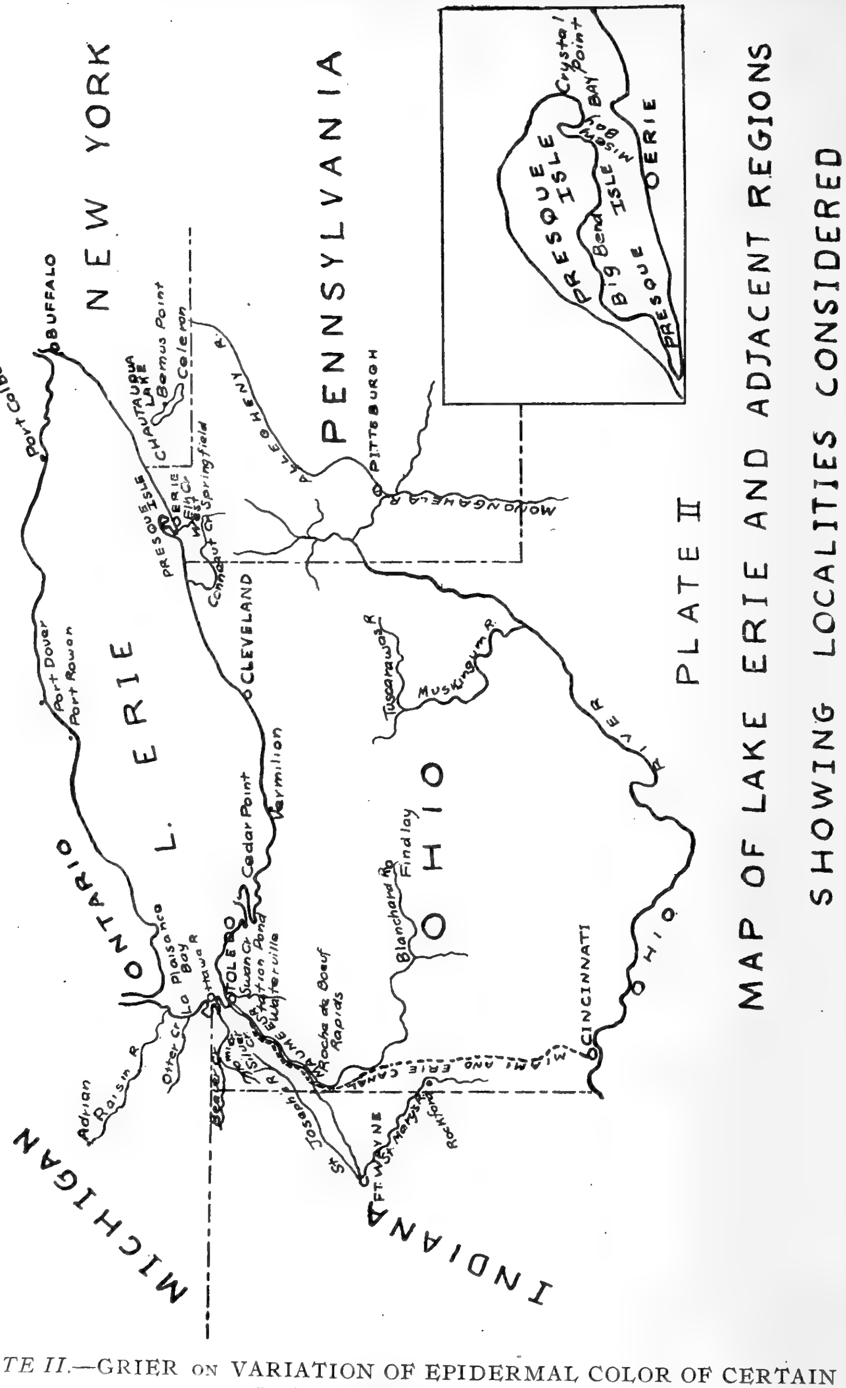


PLATE II.—GRIER ON VARIATION OF EPIDERMAL COLOR OF CERTAIN SPECIES OF NAJADES.

Aniline Black	20%
Snuff Brown	10%
Saccardos Umber	10%

Distribution of Colors as a Whole in Upper Ohio Tributaries.

	Alle'ny Riv.	*Monong. Riv.*	*Ohio Riv.*
Olive		25%	25%
Mummy Brown	50%	25%	
Buffy Olive			25%
Aniline Black		25%	25%
Snuff Brown	25%	25%	25%
Saccardos Umber	25%		

Distribution of Colors as a Whole in L. Erie (31 shells).

Light Brownish Olive	30%
Buffy Citrine	20%
Buffy Olive	20%
Mummy Brown	20%
Dresden Brown	10%

Distribution in L. Erie—Localities.

	Cedar Point	*Presque Isle*	*Maumee River*
Light Brownish Olive	25%	25%	
Buffy Citrine	25%	25%	25%
Buffy Olive	25%		25%
Mummy Brown	25%	25%	25%
Dresden Brown		25%	25%

Deductions from Tables of Percentages and Pl. III.

In this species also it is noted that the colors of the shells from the Upper Ohio Drainage are darker. The browns of L. Erie are of reddish hues, those from the Upper Ohio Drainage more blackish in nature. L. Erie has also a larger percentage of olive colors.

In the Upper Ohio Drainage

A darkening of colors from olive to brown may be traced down the Allegheny and in primary colors, (olive to brown), from the Monongahela into the Ohio. Darkening from Brown to Blackish is characteristic of a large part of the Ohio. Saccardos Umber would be a secondary color for the Allegheny; Buffy Olive for the Ohio. Other characteristic colors are indicated in the tables given above.

In Lake Erie

Here the shells possess a brownish olive not found in the shells of the Maumee River which empties into it. Buffy Olive colors are peculiar to Cedar Point shells, while the deeper browns belong to Presque Isle shells.

Rays of Epidermis

Simpson mentions no rays in this species. However 34 of 55 shells were found to be rayed, and rays persist at least until the 15th year. In this case, lake shells had coarser rays than those of the river, although there were a large number of fine rayed specimens in both. Light green was the prevailing color.

Relation of Epidermal Color to Estimated Age of Animal.

The percentages of green colors tend to increase with age in both Upper Ohio and L. Erie, while brown, the other juvenile color, decreases with age. Color changes take place about the 12th-14th year, old age colors may appear as early as 10 years, more fully at 12. Blacks apparently decrease with age in the Upper Ohio, but this is based on fragmentary data. No color or group of colors seemed peculiar to any given age.

Observation on Sex-Correlative Coloration as related to Epidermal Color. (5 shells).

Males are more largely green, females brownish yellow.

9.—*Anodontoides ferussacianus*

SIMPSON	RIDGEWAY
Greenish	Hellebore green; *other colors:* Buffy Olive Brownish Olive, Yellowish Olive, Deep Olive Isabella Color.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (69 shells).

Buffy Olive	30%
Brownish Olive	20%
Yellowish Olive	20%
Deep Olive	20%
Olive	10%

Distribution of Colors as a Whole in Upper Ohio Drainage (45 shells.

Buffy Citrine	30%
Brownish Olive	20%
Isabella Color	20%
Hellebore Green	20%
Buffy Olive	10%

Distribution of Colors as a Whole in Upper Ohio Tributaries etc.

	Alle'ny Tribs.	*Beaver Tribs.*
Buffy Citrine	20%	20%
Brownish Olive	60%	20%

Isabella Color		20%
Hellebore Green		20%
Buffy Olive	20%	20%

Distribution of Colors as a Whole in L. Erie (24 shells).

Brownish Olive	30%
Chestnut Brown	30%
Yellowish Olive	20%
Deep Olive	10%
Hellebore Green	10%

Distribution in L. Erie, with that in other localities to be compared.

	Presque Isle	*Maumee River*	*Conneaut Lake*
Brownish Olive	40%	50%	
Chestnut Brown	20%		50%
Yellowish Olive	20%		
Deep Olive	20%	25%	25%
Hellebore Green		25%	25%

Deductions from Tables of Percentages etc.

Shells of L. Erie are olive or yellowish, whereas those of the Upper Ohio are brownish or buffy.

In the Upper Ohio

It is observed that shells become more buffy in color in the lower stretches of French Creek. A color change mostly toward darker green colors is observed going down the Shenango. Shells darken from greenish colors in Padan and Pymatuning Creeks, to brownish colors where they enter the Shenango. Characteristic primary colors are Buffy Citrine in French Creek, Olive colors in the Shenango. As a whole the Allegheny Tribs. stand out for brownish colors; the Beaver for Olive, green, or yellow.

In Lake Erie

Presque Isle possesses colors not found in the Maumee which drains into L. Erie. Conneaut Lake as compared with L. Erie has yellowish rather than brownish epidermal tints.

Rays of Epidermis

Simpson—"often faintly rayed." 34 of the 69 shells showed raying persisting at least until the 8th estimated year. Rays were distinctly medium in testure when compared with those of other species, and were most widely distributed in creeks. The prevailing color was Brownish Olive, and the oldest age recorded was 8 years.

Relation of Epidermal Colors to Estimated Age of Animals.

Bluish green is most common in young shells, decreasing with age when the shells become brown, which may be an early as the 4th or 5th year. Old age colors may appear completely at 6. A brownish deposit occurs on L. Erie shells of this and other species which at times is apt to confuse the observer as to the true color. No color or group of colors seemed peculiar to any given age.

Observation on Sex-Correlative Coloration as associated with Epidermal Color. (4 shells).

Males—brownish or Yellowish Olive.
Females—green.

10.—*Eurynia recta*

SIMPSON	RIDGEWAY
Black	Bister
Olive Green	Olive, Brownish Olive, Dark Greenish Olive *Other colors noted:* (browns) Warm Sepia, Snuff Brown, Mummy Brown.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (54 shells).

Olive	30%
Warm Sepia	20%
Snuff Brown	20%
Bister	20%
Brownish Olive	10%

Distribution of Colors as a Whole in Upper Ohio Drainage (33 shells).

Mummy Brown	30%
Olive	20%
Snuff Brown	20%
Warm Sepia	10%
Brownish Olive	10%
Dark Greenish Olive	10%

Distribution of Colors as a Whole in Upper Ohio Tributaries.

	Allegheny Tribs.	Allegheny River	Ohio River	Tuscarawas River
Mummy Brown	16%		20%	
Olive	16%	25%	20%	
Snuff Brown	16%	25%	20%	
Warm Sepia	16%	25%	20%	
Brownish Olive		12%	20%	50%
Dark Greenish Olive	32%	12%		50%

Distribution of Colors as a Whole in L. Erie—Localities.

Chestnut	20%

Olive Ochre	20%
Brownish Olive	20%
Carob Brown	20%
Bister	10%
Dark Greenish Olive	10%

Distribution of Colors in L. Erie—Localities.

	Cedar Point	*Presque Isle*
Chestnut	33%	16%
Olive Ochre	33%	33%
Brownish Olive	16%	16%
Carob Brown	16%	16%
Bister		16%

Deductions from Tables of Percentages, etc.

Browns are in excess in the Upper Ohio as compared with L. Erie. Olives and golden yellow hues are peculiar to L. Erie.

In the Upper Ohio Drainage

For a great part of the Allegheny's course a darkening may be seen in the primary color from greenish to olive and brownish colors. The series from French Creek and the Ohio apparently do not conform to the general rule. More positive evidence can only be secured with a larger number of shells. Dark Citrine could be termed a characteristic primary color for the Ohio, Yellowish Citrine for French Creek. We may note at any rate, that the darker colors are more abundant in the tributaries than in the rivers and vice-versa, while browns are more abundant in the Ohio than in the Allegheny.

In Lake Erie

Browns are most numerous at Cedar Point, while Presque Isle has the larger proportions of black colors.

Rays of Epidermis

6 of 54 shells showed raying persisting until the 15th year. They were coarse in the specimens examined and appeared only in those from rivers. Their color was Greenish Olive, and the oldest age to which they persisted was 16 years.

Relation of Epidermal Color to Estimated Age of Animals.

Juveniles of this species are mostly green. Darkening may occur as early as 7 years and is complete at 14. No color or group of colors seems peculiar to any given age.

Observation on Sex-Correlative Coloration as related to Epidermal Color. (45 shells).

Males are Greenish-Olive in younger stages. Snuff Brown when old. Females are Brownish Olive when young, becoming darker blackish brown with age.

11.—*Lampsilis luteola*

SIMPSON	RIDGEWAY
Straw Colored	Olive Lake
Yellowish	Buffy Olive
Greenish yellow	Ecru Olive
Brown when old.	Brownish Olive, Light Brownish Olive.

Dristribution of Colors as a Whole in the Upper Ohio Drainage and L. Erie (289 shells).

Brownish Olive	30%
Ecru Olive	20%
Buffy Olive	20%
Olive Lake	20%
Light Brownish Olive	10%

Distribution of Colors as a Whole in the Upper Drainage (187 shells).

Buffy Olive	30%
Olive Lake	20%
Brownish Olive	20%
Ecru Olive	10%
Light Brownish Olive	20%

Distribution of Colors as a Whole in Upper Ohio Tributaries etc.

	Alle'ny Tribs.	*Alle'ny River*	*Monong. River*	*Monong. Tribs.*	*Ohio River*	*Beaver River*	*Beaver Tribs.*
Buffy Olive	8%		25%	25%	25%	50%	10%
Olive Lake	32%	50%	25%	25%			30%
Brownish Olive	4%			25%	25%		50%
Ecru Olive	32%	25%	50%	25%	25%	25%	10%
Light Brownish Olive	24%	25%			25%	25%	

Distribution of Colors as a Whole in L. Erie (111 shells).

Mars Brown	30%
Olive Lake	20%
Dark Olive Buff	20%
Buffy Olive	20%
Ecru Olive	10%

Distribution of Colors in L. Erie—Localities.

	Conneaut Lake	*La Plaisance Bay*	*Presque Isle*	*Chautauqua L.*	*Maumee River*
Mars Brown			25%		
Olive Lake	25%	25%	25%	25%	
Dark Olive Buff	25%	50%		25%	50%

Buffy Olive	25%	25%	25%	25%	25%
Ecru Olive	25%		25%	25%	25%

Deductions from Tables of Percentages, etc.

L. Erie shells have greater proportions of Buffs and Yellows. Browns are more numerous in the Upper Ohio.

In the Upper Ohio Drainage

Shells lose their green color and become more yellowish descending the Allegheny. This is also mostly true of the French Creek, Crooked Creek, Shenango and Mahoning Rivers. The distinction is not clear cut between the Monongahela River and its Tribs. but is in the case of the other rivers and their tributaries which as the tables of percentages show have yellow rather than greenish colors characteristic. Changes in secondary colors are also not well marked. This species and *L. ovata* do not readily darken in the river. Characteristic primary stream colors are Yellowish Citrine for the Allegheny, Olive Lake for French Creek, Buffy Citrine for the Shenango, Light Brownish Olive for the Mahoning.

In Lake Erie

The Maumee River, (draining into L. Erie) as well as its near locality, La Plaisance Bay has a preponderance of buff colors. Presque Isle possesses more browns and olives. Chautauqua and Conneaut Lakes resemble Presque Isle in the distribution of color.

Rays of Epidermis

Simpson—"Normally showing bright rays throughout." 203 of 289 shells were rayed. Fine rays were most abundant in L. Erie, coarser ones in the rivers, medium ones in creeks. The oldest age to which they persisted was 24 years, although such an age estimated by counting the winter rings seems a little long for a color to persist in a mussel. Coarse rays were most abundant in male shells, fine in females. They persisted in all ages of the animals.

Relation of Epidermal Color to Estimated Age of Animals.

Juveniles are Yellow or Greenish Yellow, percentages of the former decreasing, that of the latter increasing with age. Greenish Yellow is perhaps always the more abundant color. Browns and blacks appear as early as the estimated 10th year in the Upper Ohio, and somewhat earlier in L. Erie. "Old age" colors as a rule are not abundant in this or in the following species. No color or group of colors seemed peculiar to any given age.

Observation on Sex-Correlative Coloration as Associated with Epidermal Color. (140 shells)

Young males are yellow green with maturity becoming brownish green. Young females are Buffy Olive in color, with age becoming a greenish gold, (Olive Lake.)

12—*Lampsilis ovata*

SIMPSON	RIDGEWAY
Greenish	Olive ochre
Greenish yellow	Brownish Olive, Colonial Buff.
Brownish	Buffy Olive, Mars Brown, Bister, Saccardos Umber, Buffy Citrine, Ecru Olive.

Distribution of Colors as a Whole in Upper Ohio Drainage and L. Erie (214 shells).

Ecru Olive	20%
Buffy Olive	20%
Brownish Olive	20%
Colonial Buff	20%
Buffy Citrine	20%

Distribution of Colors as a Whole in the Upper Ohio Drainage (188 shells).

Ecru Olive	20%
Buffy Olive	20%
Olive Ochre	20%
Brownish Olive	20%
Bister	10%
Saccardos Umber	10%

Distribution of Colors as a Whole in the Upper Ohio Tributaries.

	All'y Tribs.	*All'y River*	*Ohio River*	*Ohio Tribs.*	*Beaver River*	*Beaver Tribs.*
Ecru Olive	25%		25%	20%	25%	12%
Buffy Olive	25%	25%	25%	20%	25%	12%
Olive Ochre	20%	50%	25%	20%	50%	25%
Brownish Olive	25%	25%	25%	20%		37%
Bister	5%					12%
Saccardos Umber				20%		

Distribution of Colors as a Whole in L. Erie (26 shells).

Colonial Buff	30%
Buffy Olive	30%
Brownish Olive	20%
Buffy Citrine	10%
Mars Brown	10%

Distribution in L. Erie—localities, and Chautauqua Lake.

	La Plaisance Bay	*Cedar Point*	*Presque Isle*	*Chautauqua Lake*
Colonial Buff	50%	50%	50%	

Buffy Olive	25%	25%		50%
Brownish Olive	25%		25%	25%
Buffy Citrine		25%		
Mars Brown			25%	
Dark Olive Buff				25%

Deductions from Tables of Percentages and Pl. III.

Yellow and Yellow Green colors are prominent in L. Erie; browns in the Upper Ohio.

In the Upper Ohio Drainage

A tendency to darken both in primary and secondary colors is seen descending the Allegheny—from yellowish to brownish or buff colors. This is the general change found also in the course of the Crooked and Neshannock Creeks; Ohio, Shenango and Mahoning Rivers. In most cases the shells of the tributaries will be found to have lighter colors than those of the main streams. Characteristic primary stream colors are Olive Lake in the Allegheny, Isabella Color in the Ohio, Olive Ochre in the Shenango, Olive Yellow in the Mahoning, Buffy Citrine in the Little Beaver.

In L. Erie

Yellows appear to be equally abundant at all the lake stations given, but these differ in their proportions of Buffy and Brownish Colors. Chautauqua Lake seems characterized by an abundance of the former. As was found with nacreous color, this and the last named species show little variation in epidermal color.

Rays of Epidermis

Simpson: "Broad bright green rays, wanting in older shells." 140 of 180 shells were rayed. Coarse rays were most abundant in lake specimens, medium and fine rays in the rivers, with coarse and medium textures about equally divided in the creeks. Colors, yellow to dark green, with a tendency toward black in the Upper Ohio Drainage. Coarse and fine rays are most abundant in male shells; medium in female.

Relation of Epidermal Color to Estimated Age of Animal.

No juveniles were comprised in the material worked with. Green is most abundant in shells beneath 12 years of age. Greenish yellow appears to increase in older shells in both L. Erie and the Upper Ohio Drainages. Shells may become brown or black as early as 11 years, although such colors are not abundant in either of the Lampsiline shells possibly due to their more highly polished epidermis. No color or group of colors was found to be peculiar of any given age.

Observation on Sex-Correlative Coloration as associated with Epidermal Color. (106 shells).

Greenish gold colors, (Olive Lake) appear to predominate in males. Less of green and more of brown are to be found in females.

VI.—Conclusions.

1. In the species of Najades dealt with, there exists a wider range of variation of epidermal color than that indicated by standard specific descriptions.

2. In practically all the species dealt with, a decided change of epididermal color is observed going down stream from the headwaters to the mouth. The usual tendency is for the primary epidermal, or ground color to darken from an Olive Green or Olive Gray shade to Brownish or Buffy Colors, and this darkening is true in part of all colors of the epidermis, whether due to inherent causes or to those associated more with environmental causes. Within the limits of the material dealt with, it is further recognized that a darkening of the epidermis may occur with advanced maturity or old age, which is quite independent of the geographical locality, but such colors are always darkest in specimens from furthest down stream.

3. The shells of L. Erie have in general lighter epidermal colors than those of the Upper Ohio and Maumee Drainages. Lighter yellows, browns and greens are more common among them, and in this respect they resemble the smaller tributary streams of the Upper Ohio Drainage. The shells of Conneaut and Chautauqua Lakes have much the same relation as those of L. Erie. Other conclusions, not however as completely substantiated as those given above, but still sufficiently evident from the present data as to deserve mention are,

4. Each drainage leaves its own imprint on the shells collected from it in the additional form of an associated or peculiar hue of epidermal color, as has already been shown with regard to nacreous and certain other physical characters of the shell. While the same general hue may be present in different drainages, these may be characteristically differentiated when necessary by the presence of varying proportions of other colors.

5. As a rule, the color distinctions may be carried so far as to

say tentatively at least that certain shades of epidermal color are characteristic even of different parts of a given locality.

6. The rays of the epidermis disappear with age and have in the limits of the material worked with, their widest distribution is specimens from small rivers and creeks.

7. With regard to the relation of epidermal color to the estimated age of the animals, it was found that no one color or group of colors was peculiar to a given age of the animals, except the yellowish or grayish colors of early youth, or the deep browns and blacks of old age and advanced maturity.

8. The epidermis of most species shows clearly defined sex-correlative coloration.

VII.—Suggestions as to Causes of Facts.

Introductory remarks embody the writers comments on the first of these conclusions. In view of the evidence presented, the most plausible explanation of the second would seem to be found in the physical and chemical conditions under which the shells live. A summary of the more outstanding physical and chemical conditions in the Upper Ohio Drainage and L. Erie has been previously given.

A physical condition which may seem closely related to the problem of epidermal color is the warmer temperature of the water in the former, for it has been shown that the shells from the Upper Ohio possess more pigment, pigment is the result of chemical reactions, and the degree of chemical reaction in general is increased by heat.

It is readily comprehended that the problem of epidermal color is a more complicated one than that of nacreous color. The epidermis, protectory in function, is in direct contact with the environment, and is the recipient of all chemical and physical forces involved whereas the nacre, while probably the subject of all forces acting through solution, is probably interacted upon by relatively few physical forces. In a previous paper it was shown that the tints of nacreous color lighten going down stream in the Upper Ohio Drainage, and that the nacre of L. Erie shells possesses lighter hues than those of the former. Suggested causes for these phenomena were,

1. Presence of humic acid in the headwaters of streams, which with a greater amount of available light due to less amount of silt there, affords favorable conditions for the production of pigment.

2. Reaction of humic acid upon the yellow or red Fe_2O_3 of the soil or of the water, resulting in its reduction to FeO, whence FeO by interaction with CO_2 of soil water or environment becomes $FeCO_3$, a whitish or yellowish compound.* It was additionallly pointed out that iron is a part of the composition of the mussel shell, and reasoning from the basis that it is known to be an important constituent of animal and vegetable pigments, it was suggested that the deeper tints of nacreous color in the headwaters was due by some similar process to the inclusion of greater amounts of Fe_2O_3 in the shell, especially since the water in the tributaries has a greater degree of oxygenation (due to greater rapidity of the current), whence the transition from carbonate to ferric oxide might be affected. In L. Erie, the nacreous colors of shells seemed more closely related to the greater degree of alkalinity of the water.

3. Further down stream, the reaction of the Humic acid upon the ever increasing amount of lime may produce CO_2. This or other available CO_2 may attact the iron oxides producing Fe_2CO_3. Under the conditions present, this latter compound may remain stable, since oxygenation, (slower current) is less, light is less due to increasing amounts of silt, and organic matter is more. Now it is also known that organic matter at times may mask the red or yellow iron oxides in clay, giving the latter a bluish, greenish or bluish, greenish or even other colors. Provided then that Fe_2CO_3 is the iron compound available downstream for mussel shells, and that there is a greater inclusion of organic matter at such localities, plausible explanation for the changes or fading out of nacreous color is found.

Much of the above may be made to apply to the problem of epidermal color also when the following is born in mind. It has been shown that the change in epidermal color is opposite to that reported for nacreous color. Under the conditions, 2 groups of factors acting separately or jointly may produce such an effect, representing as they do natural and unnatural environments of the shell.

1. In connection with the natural group, it may be pointed out that the amount of silt as well as the darkening of the epidermis increases going down stream. Further, the mussel shell is subject to constant erosion from CO_2 or other chemicals in the water

*For a full discussion of Humic acid and its relation to iron compounds see Pirsson, L. F. and Schuchert, C. S., "A Textbook of Geology."

and from the current itself, especially when the latter carries suspended matter. Darkening then might be due to the use of minute particles of the silt in the shell building activities of the animal or to their external deposition on the shell. This general proposition, that the silt is indirectly or indirectly responsible for the blackening of the shell, is borne out by the fact that in L. Erie where there is relatively less silt, the shells are lighter and clearer in epidermal colors.

If we now endeavor to relate the facts stated to those seemingly furnishing a reasonable hypothesis for the change in nacreous color, we may tentatively suggest that shells are yellow or yellowish green upstream and in the tributaries on account of the yellow oxide of iron (Fe_2O_3) they may contain. Downstream the inclusion of greater amounts and variety of organic matter in the silt darkens them as organic matter darkens clay. That the degree of pigmentation seems to depend largely on the environment colors. There appeared to be no regular sequence of development of epidermal color beyond the fact that most shells are yellowish when young, and with age become blackish or brownish. A shell from a given locality may have old age colors when it is still comparatively young, while another locality may show shells retaining juvenile colors to an advanced maturity. We have also noted that shells darken with age in the tributaries and headwaters, that is, quite independent of their geographical locality. A fair reason is presented when we combine the time element with the factors stated above, and take into consideration the physical characters of the shells. While the water in the tributaries is swifter, erosion of the shells may be slowed down, for such characters as greater compression there, (as has been confirmed by many investigators) enable it to present less surface to the eroding waters, and while silt is present it is not in abundance and variety as is the case further down stream. If silt plays any part in the coloration of the epidermis, it is evident that a longer time will be required to affect the shell, and it follows, that age for age, colors will be lighter in the tributaries than further down stream. A convenient analogy here is that applying to the bark of certain trees. The cork will become black more quickly in an industrial community under the influence of smoke or chemicals in the air, than it will in the virgin forest, but ultimately it becomes black in either locality. As the shells were first thoroughly scrubbed before making color comparisons, it might be fairly assumed that any remaining coloration, making allowance for the possible effects of stream pollution was characteristic for the shell at the locality. Finally, the natural conditions of the Upper Ohio are also largely true of the streams draining into L. Erie, and similar explanations may be advanced for the shells living them.

2. The pollution of streams by sewage and industrial wastes presents a most unnatural factor affecting the epidermal color of shells.* While as Ortmann and Baker have independently pointed out, pollution from either source may be so extensive as to ultimately kill the animals, for the purposes of our problem we may only consider their possible relations to epidermal color. Sewage is largely organic matter and would seem first hand to be most largely concerned with the amount of silt in the stream. According to Prof. Earl Phelps of the U. S. Public Health Service, the industrial wastes are largely sulfuric acid and sulfate of iron. Where the former chemical is present in sufficient abundance it would burn the organic matter, (conchiolin) of the shell black and thus be partly responsible for darker colors, while the sulfate of iron might form discoloring deposits. As it happens that the pollution of the water by these wastes increases going down stream, undoubtedly some of the change of color indicated is due to it, at least in the lower stretches of the Allegheny and the Monongahela as conditions now stand. This deposit of iron is frequently so tenacious as to require acid to dissolve it.

The fact that each drainage leaves its own imprint on the shells collected from it is well known to experienced collectors. In view of the data previously presented with regard to the great uniformity in epidermal color determinable at a given locality, such seems readily referable to peculiar stages in the development of the environmental conditions outlined. Similarly, causes underlying conclusion 5 may be sought for. The rays of the epidermis may disappear with age on account of the darkening of the epidermis due to the causes suggested. The rays have their widest distribution in small rivers and creeks, where of course, silt is not in its greatest variety and abundance. The conclusion as stated that age has no relation to a regular sequence of epidermal color change somewhat bears out the opinion ventured concerning the greater effect of the

* The localities from which my material was collected gave evidence of pollution at the time, and a large number of them are now completely barren.

environment in determining what the epidermal color shall be. In the case of brighter hues of nacreous colors in females, such a finding with regard to the epidermal color may also be safely regarded as a "metabolic accident."

VIII.—Relative Variation in Epidermal Color in Species Dealt With.

The shells were so unevenly distributed with regard to localities that it was impossible to determine those places where the greatest amount of variation in epidermal color took place. Some idea may be obtained from Pl. III, when such is studied from the standpoint of any great body of water as a whole. In an effort to make a partially balanced determination of the relative variability of epidermal color among them, a rough and arbitrary comparison was taken by dividing the number of "relative colors" observed in each shell by the number of that species examined. From this data, it seems that within the limits of this investigation that the larger number of shells is apparently associated with less variation in epidermal color. At the same time the results are hardly fair for those species represented by a small number of specimens. Results from this method show the relative variability of the shells to be as indicated in the following table. The small numerals following the name of each species indicate its order in range of variation of nacreous color similarly determined. (4). and from it a convenient comparison of the relative variability of epidermis and nacre may be taken.

Species	*No. Relative Colors taken*	*No. of Shells*	*Factor Calculated.*
1. Eurynia recta (1)	45	54	.83
2. Proptera alata (2)	42	55	.76
3. Anodont. ferussacianus (6)	45	69	.65
4. Paraptera fragilis (3)	33	58	.56
5. Anodonta grandis (7)	54	119	.43
6. Symphynota costata (11)	31	63	.41
7. Lampsilis ovata (9)	62	214	.28
8. Amblema plicata (5)	59	185	.27
9. P. obliquum coccin. (4)	59	263	.22
10. Lampsilis luteola (12)	63	289	.21
11. Fusconaja flava (8)	42	275	.11
12. Elliptio dilatatus (10)	65	561	.11

If, in view of difficulties the reader will comprehend were encountered in organizing this type of data, 2, (or in some cases 3) ranks in the above table on Relative Variation of Color is allowed for inaccuracy of color determination, it will be seen that variability in epidermal color is closely associated with that of nacreous color.

Sources of Error.

The Ridgeway Color Nomenclature was used with careful consideration of the directions given in it. It may well be urged that the sense of color is so varied in its development among humanity that results of this kind may not have the same significance for all interested in such problems. But the same criticism could be applied to the ornithologist who uses the Nomenclature continually. The writers confidence in his own observations is largely based on the fact that U. S. Army Tests have shown his vision to be normal in every way.

It is also true that at times, the mussels migrate from place to place in the same stream, and probably from the rivers into the tributaries. Where a small number of shells were used in making comparisons this might have some effect on the results obtained, but as the evidence of most observers is that migration is comparatively rare among them, this can hardly have any effect on the general impressions this paper hopes to convey, indeed, they might be held to account for discrepancies which will be observed here and there. Finally, pollution of streams by sewage, industrial waste, erosion by gravel and water etc., may be so extensive as to produce a color in some cases thoroughly unnatural to the animal. A check which covered most of these cases was the primary color taken which part being usually buried in the mud, would be more immune to such influences, and apt to show its truest tints.

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Observations on Some Marine Plants of the Iowa Devonian, with Descriptions of New Genera and Species.

BY CLEMENT L. WEBSTER, M. SC.

INTRODUCTION.

In most divisions of the rocks of the Iowa Devonian, there occur at certain horizons from a few to great numbers of fossil marine plants, nearly all of them apparently referable to the "seaweeds." But little attention has thus far been paid to these most interesting forms of ancient plant life by the workers in this field, and but little reference to them has so far appeared in the literature of Iowa Devonian geology.

So far as certainly known, not a single species of any of these plant forms occurring in the lower and middle Devonian of Iowa, appears in the upper Devonian or Hackberry group. In all these divisions various species of this or other class of plant life occur, and sometimes the strata are crowded with their fossil remains. One of these localities of special interest is that at Bloody Run in Floyd County, where several genera and species occur in the rocks of the middle Devonian. Another horizon especially rich in these remains is that of the lower beds of the Upper Devonian or Hackberry group, where certain strata are crowded with them.

A critical study of these forms as they occur in the rocks of this age in Iowa, reveals much of special interest as certain of the ancient conditions existing at that time are revealed. A quite exhaustive study of these forms has for many years been conducted by me, and the results to be published in the form of a well illustrated report on them. But few if any of the forms found in the Iowa Devonian are with certainty known to occur in rocks elsewhere outside this region, and which adds great interest to this subject.

MARINE FOSSIL PLANTS.

Genus **ZEARAMOSUS**. N. Gen.

Fossil sea plants or sea weeds, attaining a medium to quite large size; main plant occurring in quite large rounded dense bunches or clusters with short rounded heavy succulent stems more or less bifurcating. From this plant springs a peculiar long and heavy compound central stalk resembling somewhat in general structure and appearance a "bunch" of celery; character of the termination of the middle portion of this central compound stalk is unknown having been broken away, but surrounding this central portion and springing from the base, are two or more heavy rounded succulent stalks 3½—5 inches or more in length terminated by 3-4 large heavy elongated lobes giving to the same a unique appearance.

Zearamosus elleria. N. Sp.

This species is based upon the new Genus Zearamosus, of this paper, which is perhaps a sufficient description of the species. It is gregarious in habit. This species covers the upper surface of a 1-2 inch bed of hard limestone low down in the stratum at Bloody Run, Iowa, three miles southeast from Charles City. There is considerable doubt as to just what sort of a sea plant or sea weed this may have been, as it appears to stand alone as to its peculiar form and structure. In this same stratum, both above and below this interesting horizon, great numbers of "fucoids" sometimes occur.

This species is named in honor of Mrs. Ella E. Webster, who is the discoverer of this unique plant form.

Now in the author's collection.

Buthotrephis thomasia. N. Sp.

Fossil plant composed of thick succulent stems springing from a common "root"; stems branching; branches divergent; bifurcating; from about half an inch to three-fourths inch in height; growing singly, or in dense bunches three to four inches in diameter, and often in places covering the surface of a certain thin bed of hard limestone.

Position and locality: Central portion of the middle Devonian ("Cedar Valley") at St. Ansger, West Mitchell, Osage, Charles City, etc., in north-central Iowa. This is a prominent and really remarkable species of sea weed in the rocks. This species is named in honor of Mr. A. O. Thomas, Professor of Geology in the Iowa State University.

Now in the author's collection.

Genus **GRACILERECTUS.** N. Gen.

Fossil sea plants or seaweeds, attaining a small to medium size; stems simple, succulent, cylindrical or sometimes compressed; broadly or sharply curved, but sometimes straight; generally distantly branched, branches sometimes opposite; surface smooth or at times irregular; terminations sharp to rounded; root of medium size, flattened or subcircular, generally constricted above, surface smooth or marked by elongated elevations.

Gracilerectus Hackberryensis. N. Sp.

Stem of this seaweed simple, surface nearly even, cylindrical or sometimes compressed, surface smooth so far as known; broadly curved; distantly branched, branches sometimes opposite. Terminations round to pointed. Diameter 1-4 to 3-4 inch; length apparently six inches to two feet or more.

This fossil, in its usual aspect, presents the appearance of numerous linea stems, often extending half a foot to two feet or more in length, and always appears in the form of casts.

Position and locality: Often crowding the strata of the lower portion of the Lower Hackberry Group (the lower part of Fenton's "Cerrogordo Sub-stage"; at Mason City, Iowa, and other points. So far as known this species is restricted to the Hackberry Group.

Now in the author's collection.

Genus **FRUTICRISTATUM.** N. Gen.

Stems of this seaweed rounded, not known to attain a greater diameter than one fourth inch or slightly more, stems terminated by a tuft of long, rounded succulent branches equal in diameter to the main stem, and these branches sometimes bifurcate; surface of main stem smooth, usually straight but sometimes bent.

Fruticristatum iowense. N. Sp.

Stems of this remarkable seaweed or "fucoid," round, three-sixteenths to one-fourth inch or slightly more in diameter, three and a half to four or more inches in length. Stem terminated by a tuft of long, rounded succulent branches equal in diameter to the main stem. These branches sometimes bifurcate. Main stem smooth, usually straight but sometimes bent.

The large slab of limestone before me and whose upper face is crowded with this really strange form, is so massed as to make a description of the species especially difficult, and may be somewhat modified when isolated forms are procured enabling this to be done. I know of no other fossil marine plant approaching this in form or general appearance.

Position and locality: Covering the surface of a certain bed of hard limestone below the two nodular Stromatopora beds of the upper part of the middle Devonian ("Cedar Valley"), at Bloody Run, Floyd County, Iowa, and so far as known restricted to this horizon and locality.

Now in the author's collection.

Fruticristatum noraense. N. Sp.

Stem of this seaweed or "fucoid" small and slender; circular; broadly to sharply curved or bent; solitary; gradually and gracefully tapering from the base; termination sharp to rounded; generally from one-eighth to one-fourth inch in diameter near the base; varying in length from one and one half to six inches; surface apparently smooth; known only in the form of casts.

Position and locality: Occurs in considerable numbers in narrow bands of crinoidal limestone at Nora Springs, Bumgardner's quarry, at Rock Grove, at John Turner's quarry, Rockford, and other localities in the north-central part of Iowa, in the central part of the middle Devonian.

Now in the author's collection.

Fruticristatum pervetus. N. Sp.

Stem compressed to sub-circular; strong and robust; quite strongly curved; surface uneven, and not otherwise marked; length unknown but apparently attaining six to eight inches; sending out strong lateral branches at intervals of an inch and a half; diameter six-eighth to three-fourths inch; root medium large, flattened or sub-circular, smooth or marked by elongated elevations, sharply constricted above; known only in the form of casts.

Position and locality: Found associated almost everywhere with *F. noraese,* and is quite abundant.

Now in the author's collection.

Birds Observed at Brookland, D. C. from Aug. 19 to Sept. 7, 1920.

BY BROTHER ALPHONSUS, C. S. C.

NAME OF BIRD	When was it first seen?	About how many?	When was it next seen?	When did it become common?	When was it last seen?	REMARKS
Blackbird, Red-winged						No Records
Bluebird	Aug. 20	5	Aug. 21	Aug. 20	Sept. 5	Eight Records
Bobolink	Aug. 25	1	Aug. 26		Sept. 7	Seven records
Cardinal	Aug. 20	3	Aug. 21	Aug. 20	Sept. 7	Sixteen records
Catbird	Aug. 20	1	Aug. 21	Aug. 20	Sept. 7	Fourteen records
Chickadee	Aug. 22	1	Aug. 25	Aug. 25	Sept. 7	Seven records
Cowbird						No records
Crow	Aug. 20	4	Aug. 21	Aug. 20	Sept. 6	Thirteen records
Cuckoo, Yellow-billed	Aug. 27	1	Aug. 31		Sept. 2	Three records
Cuckoo, Black-billed						No records
Flicker	Aug. 24	1	Aug. 25	Aug. 28	Sept. 6	Eleven records
Flycatcher, Acadian						No records
Flycatcher, Crested	Aug. 29	1	Sept. 2		Sept. 2	Two records
Flycatcher, Least						No records
Flycatcher, Yellow-bellied						No records
Gnatcatcher						No records
Goldfinch	Aug. 25	1	Aug. 27		Sept. 1	Six records
Grackle, Purple	Aug. 20	3	Aug. 21	Aug. 20	Sept. 6	Thirteen records
Grosbeak, Rose-breasted						No records
Hummingbird						No records
Jay, Blue	Aug. 19	3	Aug. 20	Aug. 19	Sept. 7	Eighteen records
Kingbird	Aug. 22	1	Sept. 2		Sept. 2	Two records
Martin, Purple	Aug. 22	1	Aug. 23		Aug. 28	Three records
Meadowlark	Aug. 20	3	Aug. 21	Aug. 22	Sept. 6	Five records
Mockingbird	Sept. 2	4				One record
Nighthawk						No records
Nuthatch, White-breasted	Aug. 21	1	Aug. 22	Aug. 23	Sept. 5	Nine records
Oriole, Baltimore	Aug. 21	1	Aug. 22		Aug. 27	Four records
Oriole, Orchard						No records
Ovenbird	Aug. 24	1	Aug. 25		Sept. 5	Five records
Pewee, Wood	Aug. 19	3	Aug. 20	Aug. 19	Sept. 7	Eighteen records
Phoebe	Aug. 27	1				One record
Redstart	Aug. 19	4	Aug. 24	Aug. 25	Sept. 6	Five records
Robin	Aug. 19	3	Aug. 20	Aug. 19	Sept. 6	Seventeen records
Shrike, Loggerhead						No records
Sparrow, Chipping	Aug. 22	3	Aug. 26		Aug. 26	Two records
Sparrow, Field	Aug. 22	1	Aug. 27		Aug. 27	Two records
Sparrow, Grasshopper						No records
Sparrow, Savanna						No records
Sparrow, Song	Aug. 22	1	Aug. 22	Aug. 22	Sept. 5	Seven records
Sparrow, Vesper						No records
Starling						No records
Swallow, Eaves	Aug. 21	1	Aug. 22		Sept. 4	Four records
Swift, Chimney	Aug. 23	4	Aug. 28		Sept. 1	Four records
Tanager, Scarlet						No records
Thrasher, Brown	Aug. 21	1	Aug. 22		Sept. 3	Eight records
Thrush, Wood	Aug. 27	3	Aug. 27	Aug. 31	Sept. 6	Five records
Titmouse, Tufted	Aug. 26	1	Aug. 31	Aug. 31	Sept. 5	Four records
Towhee	Aug. 21	1	Aug. 24	Aug. 25	Sept. 7	Ten records
Vulture, Turkey						Fifteen records
Vireo, Philadelphia	Aug. 31	1				One record
Vireo, Red-eyed	Aug. 20	6	Aug. 21	Aug. 20	Sept. 6	Fourteen records
Vireo, Warbling						No records
Vireo, Yellow-throated	Aug. 20	4	Aug. 21		Sept. 1	Six records
Warbler, Blackthroated Green						No records
Warbler, Canadian	Aug. 31	1				One record
Warbler, Connecticut	Sept. 1	1				One record
Warbler, Magnolia	Sept. 3	2	Sept. 4		Sept. 5	Four records
Warbler, Black and White	Aug. 24	1	Aug. 25		Aug. 31	Three records
Warbler, Pine	Aug. 24	1	Aug. 25	Aug. 25	Sept. 3	Three records
Warbler, Yellow						No records
Waxwing, Cedar						No records
Whip-poor-will						No records
Woodpecker, Downy	Aug. 21	1	Aug. 25		Sept. 6	Five records
Woodpecker, Hairy	Aug. 27	1	Sept. 2		Sept. 6	Three records
Woodpecker, Red-headed	Aug. 22	3	Aug. 26		Sept. 7	Eleven records
Wren, House	Aug. 20	1	Aug. 21	Aug. 21	Sept. 2	Seven records
Wren, Carolina						No records
Yellowthroat, Maryland	Sept. 2	1	Sept. 3		Sept. 3	Two records
Dove, Mourning						Several records
Hawk, Sparrow	Sept. 5	1				One record

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NOTE

Contributions on general and midland natural history will be gladly received. Papers on botany and allied subjects, zoology, geology and physical geography, should be addressed to the editor.

Matters relating to advertisements are to be taken up with the secretary of the University.

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