NOTES ON EPHEMEROPTERA AND AQUATIC DIPTERA OF WESTERN NORTH CAROLINA

By Thelma Howell

INTRODUCTION

The mayfly fauna of North Carolina was relatively unknown until the monumental work of Traver (1932a, 1932b, 1933, 1937), who recorded twenty-seven genera and about one hundred and fifty species. Two of the genera, Oreianthus and Stenonema, and approximately one-third of the species were new.

During the summers of 1938–40, the writer collected aquatic insects from one hundred stations in Western North Carolina.* Many of the records obtained for mayflies represent the first since Traver described the species; in other cases the records indicate greatly extended ranges. For these reasons certain mayfly collections are listed in this paper. Grateful acknowledgment is made of the help of Dr. Jay R. Traver who identified the specimens. Duplicate specimens are deposited at Duke University.

The most recent authoritative treatment of aquatic Diptera is that of Johannsen (1934 and 1935), who pointed out their economic importance and presented keys for the determination of the larvae and pupae of North American aquatic Diptera. In connection with some stream and lake surveys made for private individuals interested in fish culture and re-stocking projects, the writer collected aquatic Diptera representing nine families. Since many of the species collected are not reported by Brimley (1938), they are included in this paper. All specimens were identified by Dr. J. Speed Rogers, to whom grateful acknowledgment is made. Duplicate specimens are deposited at Duke University.

GEOGRAPHICAL AREA TREATED

The mountain plateau of North Carolina, lying between the Blue Ridge and the Great Smoky Mountains, has an area of approximately 6000 square miles. Numerous cross ranges connecting the two moun-

* The collections reported in this paper were made while holding a Duke University scholarship to the Sam T. Weyman Memorial Laboratory, Highlands, North Carolina, and while using the Duke University space there in 1939–40.

tain ranges create basins which preserve an altitude of 2000–2700 feet (Kerr, 1875). At the bottom of each basin there is a mountain tributary of the Tennessee River. These tributaries form parts of five great drainage basins: the New River Basin, the Watauga River Basin, the French Broad River Basin, the Little Tennessee River Basin, and the Hiwassee River Basin (Saville and Smith, 1925).

The records of aquatic insects from the mountain plateau as reported by Brimley (1938) indicate that a large part of the collecting was done in the streams making up the New, Watauga, and French Broad River basins. The stations referred to in this paper are located primarily on the Little Tennessee, Nantahala, and Tuckaseegee rivers and their tributaries, which, with the Cheowah River, make up the North Carolina part of the Little Tennessee River Drainage Basin. This drainage basin is located in the counties of Macon, Jackson, Swain, and Graham.

The Little Tennessee River, the largest west of the Blue Ridge, rises on the north slope of the Blue Ridge in Rabun County, Georgia, and flows northerly across Macon and a portion of Swain Counties. From the town of Franklin to the Tennessee line the river has a fall of over 900 feet (Kerr, 1875). From this point it takes a westerly course and crosses the Smoky Mountains in a narrow gorge of 4000 feet depth. The Nantahala and Cheowah rivers also join the Little Tennessee and contribute to give it a drainage area of 1881 square miles (Swain *et al.*, 1899).

The Tuckaseegee River rises on the northern slope of the Blue Ridge in the southern part of Jackson County, and throughout most of its course flows in a general northwesterly direction in a narrow, rocky channel. It has a drainage area of 833 square miles, 418 of which lie almost wholly in Jackson County (Swain *et al.*, 1899). The Oconalufty River, which rises in the Great Smoky Mountains, is the largest tributary of the Tuckaseegee.

The headwaters of the Nantahala River are in the extreme southwestern portion of Macon County, where the Nantahala and Valley River Mountains meet the Blue Ridge. It flows in a general northerly direction, traversing a deep basin from one to two thousand feet deep in places. Its drainage area is 184 square miles (Swain *et al.*, 1899).

STATIONS

The stations considered in this report are listed in a previous paper (Howell, 1939). With the exception of those stations mentioned below, they are located in the Little Tennessee River Basin.

The Savannah River Drainage Basin receives the waters from the streams draining the southern slopes of the Highlands Plateau (Saville and Smith, 1925). The following stations located in that basin are referred to in this paper: Clear Creek, Edwards Creek, Klines Lake, Overflow Creek, Chattooga River, Fowlers Creek, Greens Creek, Norton Mill Creek, High Hampton Lake, Toxaway River, and Lake Sapphire.

CLIMATIC FACTORS

From the establishment of the stations to 1930, inclusive, complete weather data are available from the United States Weather Bureau for only three stations in the Little Tennessee Drainage Basin: Cullowhee,

TABLE 1

*Average Monthly and Annual Temperature from the Establishment of the Station to 1940 Inclusive**

STATION	ALTITUDE	LENGTH OF RECORD	JAN.	FEB.	MCH.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
	feet	*yrs.*													
Cullowhee..	2100	21	39.5	41.5	47.6	55.5	62.7	70.2	73.1	72.4	68.4	57.7	46.0	39.8	56.2
Highlands..	3350	32	34.4	35.4	42.0	49.6	57.9	64.2	66.5	65.7	60.6	52.3	42.5	35.1	50.5
Rock House	3100	38	38.3	39.0	46.4	53.7	61.8	68.0	70.5	70.0	65.8	55.9	46.6	39.6	54.6

* From "Climatic Summary of the United States," Section 95—Western North Carolina. United States Department of Agriculture Weather Bureau.

Highlands, and the Rock House, near Highlands (Tables 1, 2). Since 1935 additional stations have been established by the Tennessee Valley Authority for recording rainfall data, but the length of the record is too short for definite conclusions. (Table 3). That local topography and differences in elevations affect the climate of the mountain plateau is well-known.

PHYSICAL FACTORS

During the course of this investigation water analyses were made on many of the streams. In all determinations the principles of the United States Bureau of Fisheries (Hazzard, 1935; Davis, 1938) were followed, and the chemical methods of the American Public Health Association

TABLE 2

*Average Monthly and Annual Precipitation in Inches and Hundredths from the Establishment of the Station to 1930 Inclusive**

STATION	ALTITUDE	LENGTH OF RECORD	JAN.	FEB.	MCH.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
	feet	*yrs.*													
Cullowhee	2100	21	3.98	3.69	4.75	3.14	3.68	3.98	4.27	3.63	3.44	2.75	2.39	4.26	43.96
Highlands	3350	24	6.91	7.49	7.81	6.45	5.40	7.14	8.46	7.08	6.43	5.61	5.47	7.45	81.73
Rock House	3100	40	6.71	6.78	7.46	6.04	6.00	7.66	8.85	8.06	6.73	5.46	5.03	7.69	82.47

* From "Climatic Summary of the United States," Section 95—Western North Carolina. United States Department of Agriculture Weather Bureau.

TABLE 3

*Annual Precipitation Little Tennessee River Basin**

STATION	COUNTY	ELEV.	ANNUAL PRECIPITATION				
			1935	1936	1937	1938	1939
		feet					
Jack Cove	Jackson	2,100	—	—	—	—	44.06
Dicks Creek	"	3,151	—	61.08	57.62	54.07	46.26
Erastus	"	3,500	—	78.53	61.95	50.76	58.32
Owens Gap	"	4,100	—	—	—	65.14	70.44
Haywood Gap	"	5,250	—	—	—	60.89	51.31
Franklin	Macon	2,002	38.24	64.06	46.93	45.96	40.19
Nantahala	"	2,100	47.32	65.56	56.04	62.82	49.49
Otto	"	2,300	—	73.19	53.98	52.01	50.60
Raven Mt.	"	4,500	—	66.47	67.42	54.93	45.99
Wayah Bald	"	5,330	—	74.90	74.30	70.47	58.91
Needmore	Swain	1,770	—	59.18	50.10	45.59	45.98
Proctor	"	2,400	—	68.13	61.03	58.69	49.85
Spruce Mt.	"	4,800	—	—	—	59.37	—
Clingmans Dome	"	6,400	—	—	88.28	86.65	61.58
Tapoca	Graham	1,112	51.23	61.86	58.93	64.78	—
Stecoah	"	2,350	—	69.85	67.61	57.67	47.30
Teyahalee Bald	"	4,750	—	—	—	68.40	58.61

* From "Climatological Data." N. C. Section U. S. Weather Bureau. Raleigh, N. C., 1935–40.

(1936) were employed. The results for several streams of particular interest are shown in Table 4.

The data for the Nantahala River and its tributaries—Wine Spring, White Oak, Cold Spring, and Choga creeks—may have greater significance at a future date because these streams will soon become a part of a large lake due to the construction of a dam by the Nantahala Power Company. The data may be of value as a basis of comparison with records of chemical and thermal characteristics of the impounded waters.

The Sam T. Weyman Memorial Laboratory, located on Lake Ravenel, Highlands, North Carolina, has been the headquarters for many investigators (Coker, 1939), but as far as is known no previous water

TABLE 4

Physical Factors in Waters near Highlands, N. C.

STATION	DATE	ALTITUDE	TEMP.		pH	FREE CO_2	M. O. ALKALINITY	PHEN. ALK.	O_2
			Air	Water					
		feet	°*C.*	°*C.*		*p.p.m.*	*p.p.m.*	*p.p.m.*	*p.p.m.*
Wine Spring Creek	9/ 5/40	3,080	29.0	15.0	6.8	0.50	12.00	0.00	9.32
Junc. White Oak and Cold Sp. Creeks	9/ 5/40	3,180	22.0	16.0	6.8	0.50	12.00	0.00	8.26
Choga Creek	9/ 5/40	2,900	26.0	17.0	7.0	—	—	—	9.60
Nantahala River	9/ 5/40	2,860	24.0	18.8	7.2	0.50	32.00	0.00	8.26
Lake Ravenel	5/30/40	3,820	20.0	21.0	6.8	1.00	20.00	0.00	7.85
Norton Mill Creek	6/ 1/40	2,860	24.5	17.0	6.8	1.00	20.00	0.00	8.77

analyses have been made on this lake. For that reason the records are reported here (Table 4).

Norton Mill Creek, which rises under the cliffs of Whiteside Mountain, has furnished many new records of aquatic insects for North Carolina (Howell, 1939). The results of water analyses made there and reported in this paper (Table 4) are the first records for that creek.

ORDER EPHEMEROPTERA—The Mayflies

Unless otherwise stated the specimens are nymphs.

Family EPHEMERIDAE

Sub-family EPHEMERINAE

Hexagenia carolina Traver

Macon County: July 1939, female subimago, Primeval Forest, Highlands, N. C.

Jackson County: July 20, 1939, West Fork Tuckaseegee River.

Hexagenia sp.
Jackson County: May 25, 1939, female subimago, High Hampton Lake. Note by Dr. Jay R. Traver "... it is too dark for most of the typical southern species....".

Sub-family NEOEPHEMERINAE

Oreianthus purpureus Traver
Macon County: July 26, 1939, Burningtown Creek.
Jackson County: March 20, 1939, Norton Mill Creek; June 18, 1939, Tuckaseegee River.

Family HEPTAGENIIDAE

Stenonema carolina Banks
Macon County: August 15, 1938, Primeval Forest, Highlands, N. C.; May 26, 1939, Cullasaja River; June 20, 1939, Big Creek; June 26, 1939, Burningtown Creek; July 28, 1939, Buck Creek.
Jackson County: June 13, 1939, East Fork Tuckaseegee River.
Swain County (Great Smoky Mountains National Park): August 16, 1939, Deep Creek.

Stenonema pudicum Hagen
Macon County: May 29, 1938, Cullasaja River; August 24, 1938, Big Creek; May 26, 1939, female subimago, Cullasaja River; May 20, 1939, Jarrett Creek and Nantahala River; June 20, 1939, Big Creek; June 27, 1939, White Oak Creek; July 26, 1939, Matlock Creek; July 28, 1939, Buck Creek.
Jackson County: August 8, 1938, Norton Mill Creek; August 11, 1938, Cullowhee Creek; March 20, 1939, Fowlers Creek and Norton Mill Creek; June 13, 1939, East Fork Tuckaseegee River.

Stenonema varium Traver?
Macon County: May 25, 1938, Cullasaja River; August 16, Wayah Creek; August 25, 1938, Overflow Creek; August 26, 1938, Edwards Creek; July 5, 1938, Chattooga River.

Stenonema vicarium Walker
Macon County: June 6, 1939, Highlands, N. C.

Stenonema sp. No. 1
Macon County: May 29, 1938, Cullasaja River.

Stenonema sp. No. 3
Macon County: August 15, 1938, Cullasaja River; June 20, 1939, Big Creek; July 4, 1939, near Highlands: July 26, 1939, Caler Fork Creek.
Jackson County: August 8, 10, 14, 28, 1938, Norton Mill Creek; August 17, 1938, Greens Creek; August 18, 1938, Fowlers Creek; July 20, 1939, Knob Creek.
Swain County (Great Smoky Mountains National Park): July 11, 1939, Indian Creek; August 13, 1939, female subimago, Forney Creek.
Transylvania County: June 5, 1939, Toxaway River.

Heptagenia aphrodite McDunnough
Jackson County: August 26, 1938, Chattooga River.

Heptagenia juno McDunnough
Jackson County: June 16, 1939, male subimago, East Fork Tuckaseegee River.
Heptagenia thetis Needham
Macon County: August 16, 1938, Wayah Creek; May 30, 1939, Junction Ball and Shope Creeks, Nantahala River; July 5, 1939, Tessentee Creek.
Jackson County: August 19, 1938, Fowlers Creek; June 12, East Fork Tuckaseegee River; July 20, 1939, West Fork Tuckaseegee River.
Swain County (Great Smoky Mountains National Park): August 13, 1939, Forney Creek; August 16, 1939, Deep Creek.
Rithrogena fasciata Traver?
Jackson County: July 20, 1939, Knob Creek and West Fork Tuckaseegee River.
Rithrogena fuscifrons Traver
Macon County: June 27, 1939, Wine Spring, White Oak, Otter, and Choga Creeks; June 24, 1939, Cullasaja River.
Swain County (Great Smoky Mountains National Park): July 11, 1939, Indian Creek; August 13, 1939, Forney Creek.
Rithrogena sp. No. 3
Macon County: June 27, 1939, Cold Spring Creek.
Iron subpallidus Traver
Macon County: June 3, 1938, June 20, 1939, Big Creek; July 28, 1939, Buck Creek.
Jackson County: June 13, 1939, East Fork Tuckaseegee River.
Swain County (Great Smoky Mountains National Park): July 11, 1939, Deep Creek.
Iron sp. No. 4
Macon County: June 27, 1939, Wine Spring and Choga Creeks.

Family BAETIDAE

Sub-family SIPHLONURINAE

Ameletus sp.
Jackson County: March 20, 1939, Fowlers Creek and Norton Mill Creek.
Isonychia aurea Traver?
Macon County: August 24, 1938, Big Creek; August 26, 1938, Edwards Creek.
Jackson County: August 1, 3, 10, 1938, Norton Mill Creek; August 19, 1938, Fowlers Creek; June 5, 1939, Rock Creek; July 6, 1939, Tennessee Creek; July 12, 1939, High Hampton Lake; July 20, 1939, Knob Creek and West Fork Tuckaseegee River.
Isonychia notata Traver
Jackson County: August 11, 1938, Cullowhee Creek.
Isonychia serrata Traver?
Macon County: July 28, 1939, Buck Creek.

Isonychia similis Traver?
Macon County: July 26, 1939, Matlock Creek.
Jackson County: August 10, 1938, Norton Mill Creek; August 11, 1938, Cullowhee Creek; July 6, 1939, Tennessee Creek.
Isonychia thalia Traver?
Macon County: July 26, 1939, Burningtown Creek.
Jackson County: July 6, 1939, Tennessee Creek.

Sub-family LEPTOPHLEBIINAE

Paraleptophlebia adoptiva McDunnough
Jackson County: March 20, 1939, Fowlers Creek and Norton Mill Creek.
Swain County (Great Smoky Mountains National Park): July 20, 1939, Bradley Fork.
Paraleptophlebia debilis Walker
Jackson County: July 12, 1939, feeder stream of High Hampton Lake, Cashiers.
Paraleptophlebia guttata McDunnough
Macon County: July 26, Burningtown Creek; September 5, 1940, male imagoes, Jarrett Creek.
Jackson County: August 17, 1938, Greens Creek.
Blasturus sp.
Macon County: May 31, 1940, Cullasaja River.
Jackson County: March 20, 1939, Norton Mill Creek.
Habrophlebia sp.
Macon County: May 26, 1939, Cullasaja River.
Jackson County: June 1, 1940, female imago, Norton Mill Creek.

Sub-family BAETISCINAE

Baetisca thomsenae Traver?
Transylvania County: June 5, 1939, Toxaway River.

Sub-family EPHEMERELLINAE

Ephemerella cherokee Traver
Macon County: July 26, 1939, Burningtown Creek.
Ephemerella conestee Traver
Macon County: August 25, 1938, Big Creek; August 25, 1938, Overflow Creek; August 26, 1938, Edwards Creek; June 27, 1939, Choga Creek; July 5, 1939, Buckeye Branch; July 26, 1939, Beasley Creek; July 28, 1939, Buck Creek.
Jackson County: August 11, 1938, Cullowhee Creek; August 18, 1938, Fowlers Creek; July 20, 1939, Knob Creek.
Swain County (Great Smoky Mountains National Park): August 13, 1939, Forney Creek.
Ephemerella doris Traver
Jackson County: June 8, 1939, Lake Sapphire, near Cashiers, N. C.

Ephemerella funeralis McDunnough?
Macon County: May 26, 1931, Cullasaja River; June 6, 1939, Highlands.
Jackson County: June 13, 1939, East Fork Tuckaseegee River.
Ephemerella inconstans Traver
Jackson County: March 20, 1939, Fowlers Creek, Norton Mill Creek.
Ephemerella longicornis Traver
Macon County: June 3, 1938, Big Creek; May 30, 1938, Dirty John Creek, Nantahala River; June 27, 1939, Wine Spring, Cold Spring, White Oak, Otter, and Choga Creeks; June 27, 1939, Nantahala River; July 28, 1939, Buck Creek.
Jackson County: June 12, 1939, East Fork Tuckaseegee River; June 18, 1939, Tuckaseegee River; July 6, 1939, Tennessee Creek; July 20, 1939, Knob Creek.
Swain County (Great Smoky Mountains National Park): July 11, 1939, Indian Creek.
Ephemerella rotunda Morgan
Jackson County: March 20, 1939, Fowlers Creek.
Ephemerella wayah Traver
Macon County: June 20, 1939, Cullasaja River; June 27, 1939, Cold Spring and Choga Creeks.
Jackson County: July 1, 1939, Chattooga River. Note by Dr. Jay R. Traver, "... with occipital spines ...".

Sub-family BAETINAE

Pseudocloeon carolina Banks
Swain County (Great Smoky Mountains National Park): July 2, 1939, Oconalufty River.
Acentrella sp.?
Macon County: August 24, 1938, Big Creek; August 25, 1938, Overflow Creek.
Jackson County: August 29, 1938, Chattooga River.
Cloeon sp.
Jackson County: June 1, 1940, male imago, Norton Mill Creek.

ORDER DIPTERA

Family TIPULIDAE

Sub-family LIMONIINAE

Limonia (*D*) *pudicoides* (Alex.)
Jackson County: June 12, 1939, adult, East Fork Tuckaseegee River.
Limonia (*D*) *stulta* (O.S.)
Jackson County: June 12, 1939, adult, East Fork Tuckaseegee River.
Antocha opalizans O.S.?
Macon County: June 1, 1938, larva, Big Creek; May 30, 1939, larva, Jarrett Creek.

Molophilus fultonensis
Jackson County: June 4, 1939, adult, Norton Mill Creek.
Limnophila sp.
Macon County: June 20, 1939, larva, Big Creek.
Hexatoma (*E*) *aurata* (Doane)
Jackson County: August 19, 1938, larva, Fowlers Creek.
Hexatoma (*E*) *brachycera* O.S.
Macon County: May 30, 1939, larva, Nantahala River; June 22, 1939, larva, Cullasaja River.
Jackson County: July 20, 1939, larva, Knob Creek.
Hexatoma (*E*) *fuliginosa* (O.S.)
Jackson County: June 12, 1939, adult, East Fork Tuckaseegee River; July 20, 1939, larva, West Fork Tuckaseegee River.
Hexatoma (*E*) *fultonensis* (Alex.)?
Macon County: July 26, 1939, larva, Burningtown Creek.
Hexatoma (*E*) *spinosa* (O.S.)
Macon County: August 26, 1938, larva, Edwards Creek.
Hexatoma megacera (O.S.)
Macon County: May 26, 1939, female, headwaters Cullasaja River.
Dicranota (*A*) *flaveola* (O.S.)
Jackson County: June 4, 1939, female, Norton Mill Creek; June 12, 1939, adult, East Fork Tuckaseegee River.
Dicranota (*Rhaphidolabis*) *cayuga* (Alex.)?
Macon County: May 30, 1939, larva, Junction Ball and Shope Creeks.
Jackson County: June 13, 1939, larva, East Fork Tuckaseegee River.
Pedicia (*T*) *inconstans* (O.S.)
Jackson County: June 4, 1939, female, Norton Mill Creek.
Pedicia albivitta (Walker)
Jackson County: March 21, 1939, larva, Norton Mill Creek.

Sub-family TIPULINAE

Dolichopeza americana Need.
Jackson County: June 12, 1939, adult, East Fork Tuckseegee River.
Longurio minimus Alex.?
Jackson County: July 6, 1939, larva, Tennessee Creek. The larva of *Longurio minimus* is unknown. This identification was by elimination. Specimen given to Dr. J. Speed Rogers.
Longurio testaceus Loew
Macon County: July 1938, female, Highlands.
Jackson County: July, August 1938, larvae, Whiteside Cove, near Norton Mill Creek.

Family CULICIDAE

Sub-family DIXINAE

Paradixa sp.
Macon County: June 6, 1939, larva, Highlands.

Family SIMULIIDAE

Simulium pictipes Hagen

Jackson County: June 5, 1939, larvae, Cashiers; June 28, 1939, larvae, Norton Mill Creek.

Transylvania County: June 5, 1939, larvae, Toxaway Falls.

Simulium venustum Say

Macon County: May 26, 1939, larva, Highlands; June 20, 1939, larva, Skittles Creek; June 27, 1939, larva, Choga Creek.

Jackson County: June 2, 1939, pupa, near Cashiers; June 5, 1939, larva, Luptons Lake, near Cashiers.

Haywood County: June 18, 1939, larvae, near Balsam.

Family BLEPHAROCERIDAE

Blepharocera tenuipes (Walker)

Macon County: June 20, 1939, larvae, Big Creek; June 27, 1939, larvae and pupae, Choga Creek.

Jackson County: June 2, 1939, larvae and pupae, Cashiers; June 18, 1939, pupa, near Balsam.

Swain County (Great Smoky Mountains National Park): July 2, 1939, larvae and pupae, Oconalufty River; July 11, 1939, larvae and pupae, Indian Creek.

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LITERATURE CITED

American Public Health Association
1936 Standard Methods for Water Analysis. 8th. Ed., New York.

BRIMLEY, C. S.
1938 Insects of North Carolina. North Carolina Dept. Agr., Division of Entomology.

COKER, W. C.
1939 Opportunities for Biological Work at Highlands and Report of Progress. The Highlands Museum and Biological Laboratory. Publication No. 4.

DAVIS, H. S.
1939 Instructions for Conducting Stream and Lake Surveys. United States Bureau of Fisheries, Circular No. 26.

HAZZARD, A. S.
1938 Instructions for Stream and Lake Survey Work. United States Bureau of Fisheries. (Mimeographed).

HOWELL, THELMA
1939 Extended Ranges of Some Aquatic Insects in North Carolina. Jour. Elisha Mitchell Scientific Society **55**, No. 2.

JOHANNSEN, O. A.

1934 Aquatic Diptera. Part I: Nemocera, Exclusive of Chironomidae and Ceratopogonidae. Cornell University Agr. Exp. Station, Memoir 164.

1935 Aquatic Diptera. Part II: Orthorrhapha-Brachycera and Cyclorrhapha. Cornell University Agr. Exp. Station. Memoir 177.

KERR, W. C.

1875 Report of the Geological Survey of North Carolina. Vol. I, Raleigh.

SAVILLE, T., AND G. W. SMITH

1925 Discharge Records of North Carolina streams. North Carolina Dept. Conservation and Development. Bull. No. 34.

SWAIN, G. E., J. A. HOLMES, AND E. W. MYERS

1899 Papers on the Water Power in North Carolina. Part III. North Carolina Geol. Survey. Bull. No. 8.

Traver, Jay R.

1932a Mayflies of North Carolina. Jour. Elisha Mitchell Scientific Society **47,** No. 1.

1932b Mayflies of North Carolina. Jour. Elisha Mitchell Scientific Society **47,** No. 2.

1933 Mayflies of North Carolina. Jour. Elisha Mitchell Scientific Society **48,** No. 2.

1937 Notes on the Mayflies of the Southeastern States (Ephemeroptera). Jour. Elisha Mitchell Scientific Society **53,** No. 1.