Fisheries Game and Forest Commission

Compliments of
William F. Fox,
Supt. State Forests.

Fourth Annual Report

of the

Commissioners of Fisheries, Game and Forests

of the

State of New York.

WYNKOOP HALLENBECK CRAWFORD CO.,
PRINTERS,
NEW YORK AND ALBANY.
1899

MALLARD DUCK.
(ANAS BOSCHAS.) Male

Fourth Annual Report

of the

Commissioners of Fisheries, Game and Forests.

Albany, N. Y., January 20, 1899.

Hon. Samuel F. Nixon,

Speaker of the Assembly, Albany, N. Y.:

Sir:—We have the honor to submit herewith, as required by law, the official Report of this Board for the year ending September 30, 1898.

We are, Sir,

Very truly yours,

Barnet H. Davis,
President.

William R. Weed,

Charles H. Babcock,

Edward Thompson,

Hendrick S. Holden,

Commissioners of Fisheries, Game and Forests.

State of New York.

Commissioners of Fisheries, Game and Forests.

Barnet H. Davis, President,	Palmyra, N. Y.
Hendrick S. Holden, Commissioner,	Syracuse, N. Y.
William R. Weed, "	Potsdam, N. Y.
Charles H. Babcock, "	Rochester, N. Y.
Edward Thompson, "	Northport, L. I., N. Y.
Charles A. Taylor, Assistant Secretary,	Albany, N. Y.

Standing Committees.

Executive,	Messrs. Holden, Babcock, Davis.
Forest Preserve and State Lands,	Messrs. Weed, Holden, Davis.
Hatcheries, Fish Culture and Game,	Messrs. Babcock, Thompson, Davis.
Shellfish, Licenses and Permits,	Messrs. Thompson, Holden, Davis.
Legislation,	Messrs. Davis, Weed, Babcock.

State Fish Culturist.

A. Nelson Cheney,	Glens Falls, N. Y.

Superintendent of Hatcheries.

James Annin, Jr.,	Caledonia, N. Y.

Superintendent of Forests.

William F. Fox,	Albany, N. Y.

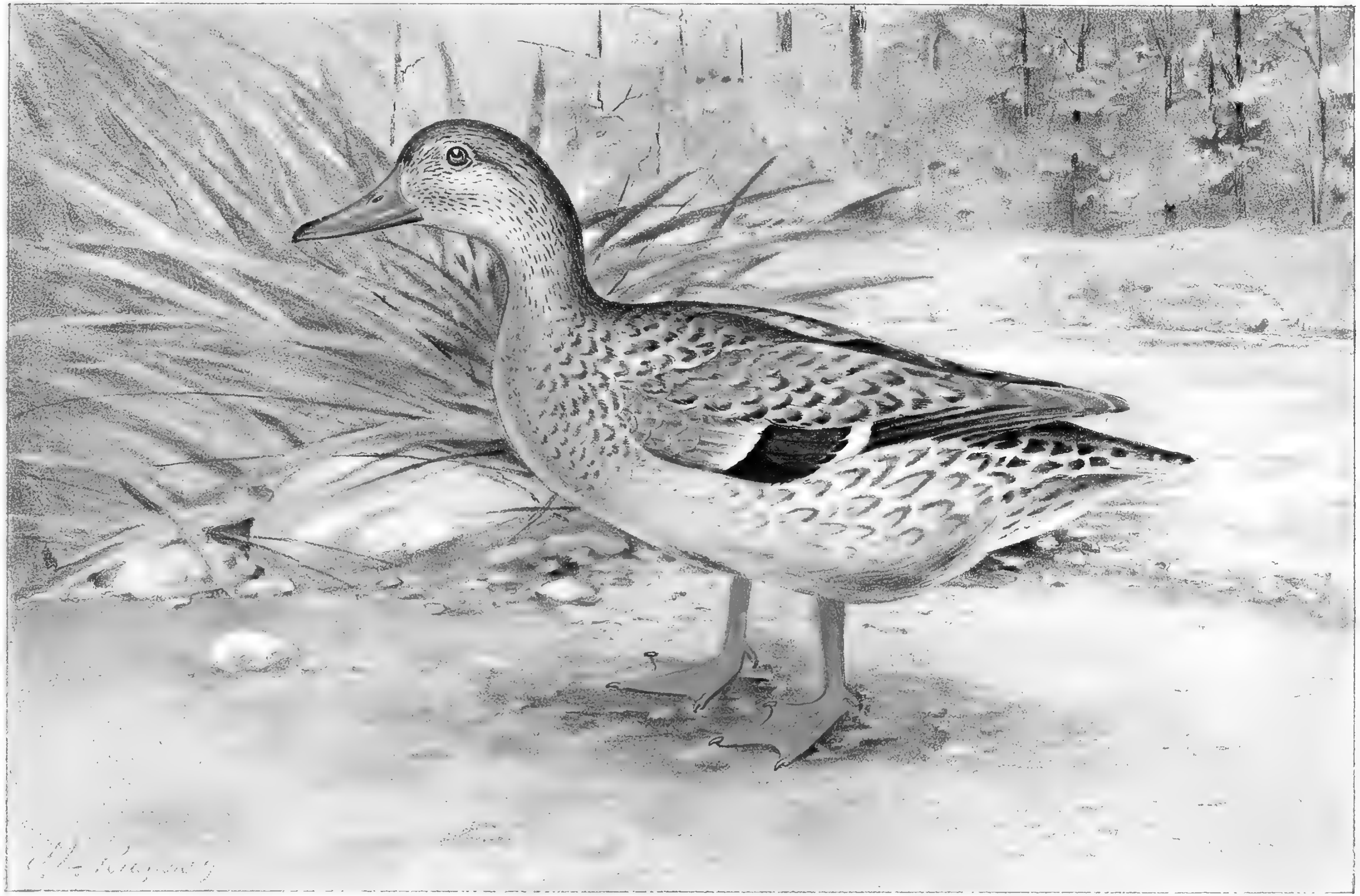
Chief Game Protector and Forester.

J. W. Pond,	Albany, N. Y.
William Wolf, Clerk,	Waterford, N. Y.

Assistant Chief Game Protectors and Foresters.

John E. Leavitt,	Johnstown, N. Y.
Mannister C. Worts,	Oswego, N. Y.

A. J. Mulligan, Audit and Pay Clerk,	Albany, N. Y.
A. B. Strough, Special Agent,	Albany, N. Y.
M. C. Finley, Special Agent,	Palmyra, N. Y.
J. J. Fourqurean, Stenographer,	Albany, N. Y.



MALLARD DUCK.
(ANAS BOSCHAS.) Female.

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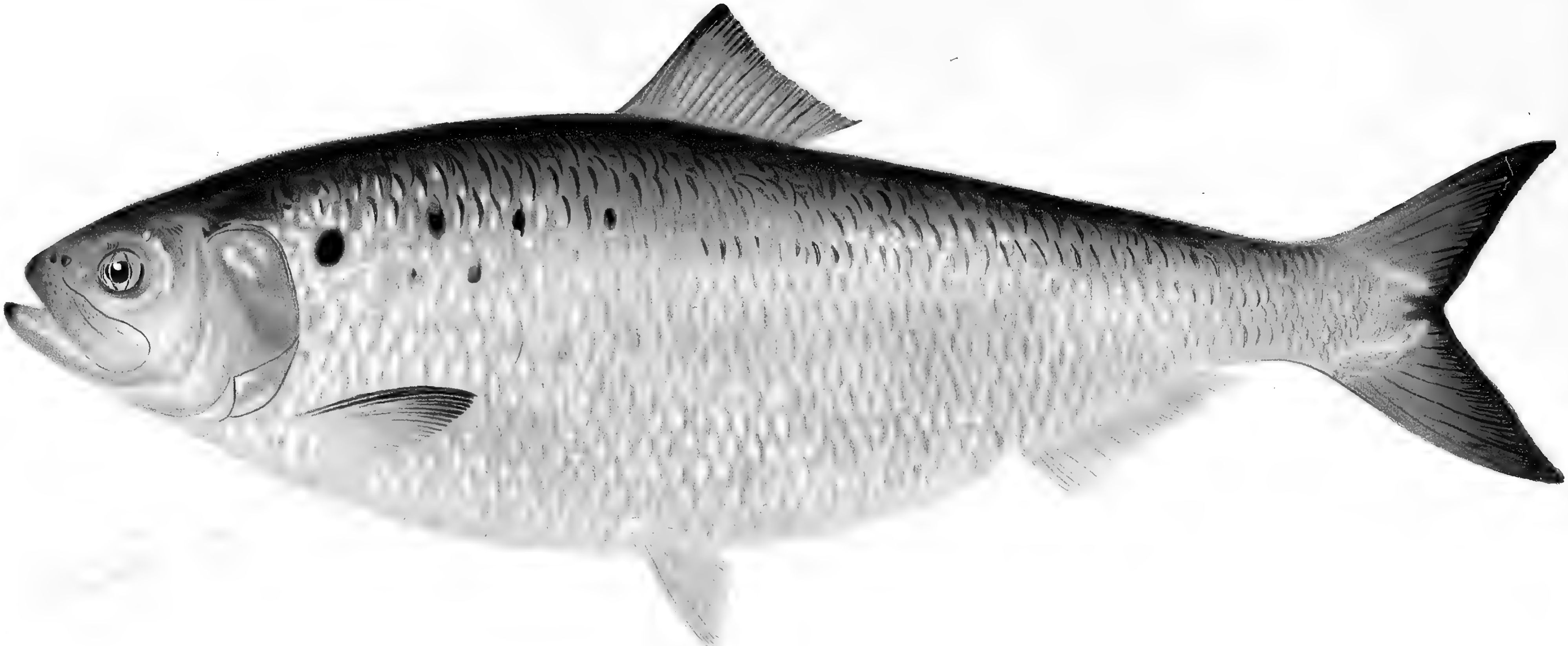


THE SHAD. (CLUPEA SAPIDISSIMA.)

List of Illustrations.

THE PRINTING OF THIS ENTIRE BOOK, INCLUDING THE COLORED ILLUSTRATIONS, HALFTONES AND TEXT, WAS EXECUTED BY

WYNKOOP HALLENBECK CRAWFORD CO.

ART PRINTING WORKS,

NEW YORK AND ALBANY.

A SAD SIGHT.

PREFACE.

"JIGGING" MACKEREL.

To those who are familiar with department work no explanation is necessary for the delay in the appearance of this publication. For the information of others it seems proper to say that the State printer takes up the report of each department in the order in which it was received; and that the preparation of a volume like the one here offered to the public requires so much time and care that it is apt to be among the last to reach the printing office.

The Commissioners desire to acknowledge here their indebtedness to Prof. E. P. Felt, State Entomologist, Dr. B. E. Fernow, Director State College of Forestry, Dr. E. L. Trudeau, of the Adirondack Sanitarium, Mr. Overton W. Price, of the United States Forestry Division, at Washington, D. C., and Prof. John Gifford, of Cornell University, for the valuable, instructive articles which these eminent specialists kindly contributed.

While it is readily conceded that, as a general rule, a department report should be confined strictly to statements relating to work actually performed or contemplated, it has seemed advisable to include, also, some articles from well-known authorities conveying information on forestry matters of a special nature. The people of our State are already so well informed as to forestry in general that there is no further need of any propaganda for that purpose. It is the details of forest administration that are now under discussion. The annual reports of this department seem to furnish a good medium for imparting knowledge in relation to these topics; and, for ascertaining in reply, through the comments of the public press, the opinion of the people as to the particular subjects under discussion. It has long since become evident that the forestry movement in this country is dependent wholly on public sentiment; and, that the State can go only so far in these matters as it has the people behind it.

The Commissioners further desire to acknowledge their indebtedness to Dr. Bashford Dean, of Columbia University, New York, for the exhaustive article on the dogfish, with colored drawings prepared for it under the author's personal supervision; to Prof. H. A. Surface, of the Pennsylvania State College, for the article on the lake lamprey; to the Commissioner of Fish and Fisheries of the United States for fish eggs, fry and older fish furnished to this Commission for planting in State waters, and to the railroads of the State and also to lake transportation companies for the free transportation of the State fish car, messengers from the hatcheries, fish cans and egg crates. Not only do the railroads of the State furnish free transportation in fish distribution, but the employees of the transportation companies render every possible assistance to hatchery messengers when they are moving fish.

The trout in the ponds mentioned by Dr. Calkins all died, practically of the parasite disease he investigated, but the ponds were deepened, cleaned and generally purified, and new stock fish introduced which are now in a healthy condition, as we are informed. The fish affected did not belong to the State, but the ponds were in the vicinity of some of the State breeding and stock ponds, and it was deemed best to investigate the trouble as a precautionary measure.

THE COMMISSIONERS.

REPORT

of the

Commissioners of Fisheries, Game and Forests.

To the Honorable, the Legislature of the State of New York:

HOW IS THIS FOR A PAIR?

IN accordance with section 8 of chapter 395 of the Laws of 1895, we have the honor to submit herewith a report of the official operations of this department for the fiscal year ending September 30, 1898.

The following rules and regulations, which were adopted by the Commission May 29, 1895, have been observed in the transaction of the business of the department during the year:

1. Regular meetings of the Board shall be held on the second Tuesday of January, April, July and October, at the office of the Commission, in Albany, and at such other times and places as the same may be called.

2. Special meetings of the Board may be called at any time by the President, or, in case of his disability, by the Executive Committee, or upon the written request of any three Commissioners. Written notice of all special meetings must be given at least twenty-four hours previous thereto.

3. A majority of the Board shall constitute a quorum for the transaction of business, and all questions shall be determined by a majority of those present, a quorum voting.

4. The presiding officer and all other members present shall vote upon all questions unless excused by the Board.

5. The presiding officer shall determine all questions of order; and, in case of an appeal, a majority present may overrule his decision.

6. The President shall preside at all meetings when present. In the absence of the President, the Board shall elect one of their number to preside.

7. The order of business of the Board shall be:

(1) Roll-call.
(2) Reading and correction of minutes of last meeting.
(3) Report of Shellfish Commissioner.
(4) Report of State Fish Culturist.
(5) Report of Engineer (Superintendent of Forests).
(6) Report of Chief Protector.
(7) Secretary's report.
(8) Report of Auditing and Pay Clerk.
(9) Reports of Standing Committees.
(10) Reports of Special Committees.
(11) Miscellaneous and unfinished business.

8. The following standing committees of three each, of which the President shall be one, shall be appointed by the President:

Committee on Forest Preserve and State Lands.
Committee on Hatcheries, Fish Culture and Game.
Committee on Licenses, Permits and Shellfishery.
Executive Committee.
Committee on Legislation.

9. It shall be the duty of the Committee on Forest Preservation and State Lands to consider and report upon all matters of land purchase and business incidental thereto, including the examination of offers which may be submitted, questions of land value, the extent and nature of timber-thieving and measures which should be adopted to suppress it; also, to consider and suggest plans for the better organization of the Firewarden system, and other matter arising out of the business connected with the forest and State lands in the care and custody of the Commission.

10. It shall be the duty of the Committee on Hatcheries, Fish Culture and Game to have charge of all matters pertaining to the hatching, culture and distribution of fish; repairs and improvements to hatcheries; also, to look after the business and interests of the Commission in reference to the protection and preservation of fish and game.

11. The Committee on Licenses, Permits and Shellfish shall formulate and submit the rules for licensing net-fishing, as provided by law, and also for granting permits; and shall from time to time examine all licenses and permits granted, and ascertain whether the terms and conditions of the same have been abused or violated. They shall also have general charge of matters pertaining to the shellfish department not specially delegated to the Shellfish Commissioner by law.

12. The Executive Committee shall examine and audit all accounts, bills and payrolls, and endorse the same with their approval when passed; and no bills or accounts shall be paid until so approved; examine and check all books and accounts; examine and check all regular and special reports of employees as often as once in each month and report the result of such examination to the Commission at its first meeting thereafter. They shall also have a general supervision of the business of the Commission and care and control of its interests when the Board is not in session.

13. The Committee on Legislation shall look after the necessary legislation of the Commission; shall examine and consider all proposed amendments or changes in the fish, game and forestry laws or new laws affecting these interests, and shall submit to this Board their opinion upon matters which, in their judgment, require legislative action.

14. The foregoing rules may be altered or amended by vote of a majority of the Commission, upon ten days' notice being given, which notice may be in open meeting and entered on the minutes or by serving written notice.

Standing Committees.

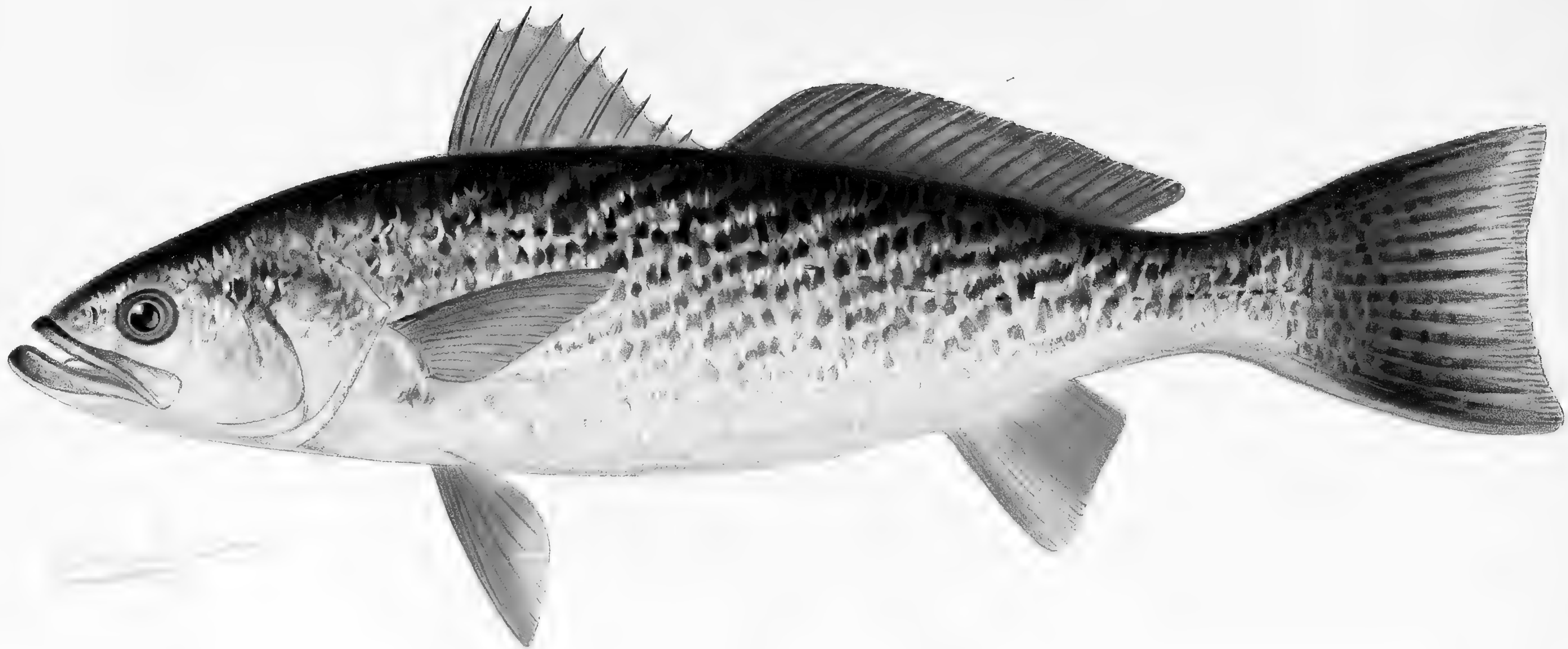
Forest Preserve and State Lands.—William R. Weed, Hendrick S. Holden, Barnet H. Davis.

Executive.—Hendrick S. Holden, Charles H. Babcock, Barnet H. Davis.

Hatcheries, Fish Culture and Game.—Charles H. Babcock, Edward Thompson, Barnet H. Davis.

Legislation.—Barnet H. Davis, William R. Weed, Charles H. Babcock.

The following is a statement of the financial transactions of the Commission for the fiscal year:



WEAK-FISH OR SQUETEAGUE.
(CYNOSCION REGALE)

Financial Statement

For the Fiscal Year Ending September 30, 1898.

GENERAL MAINTENANCE ACCOUNT.

RECEIPTS.

Balance October 1, 1897,	$22,807 70	
Appropriation, Chapter 306, Laws of 1897:		
For maintenance of hatcheries and hatching stations and the collection and distribution of fish and fry,	61,500 00	
Salaries and expenses of Fish and Game Protectors and Foresters,	40,300 00	
Salaries and expenses of officials,	24,000 00	
Clerical Force,	6,000 00	
Stationery, printing and office expenses,	5,000 00	
Shellfish Department,	6,750 00	
		$166,357 70

DISBURSEMENTS.

For maintenance of hatcheries and hatching stations and the collection and distribution of fish and fry,	Schedule "A,"	$55,012 15	
Fish and Game Protectors and Foresters,	" "B,"	38,733 81	
Official salaries and expenses,	" "C,"	21,259 42	
Clerical Force,	" "D,"	6,099 84	
Stationery, printing and office expenses,	" "E,"	2,874 21	
Shellfish Department,	" "F,"	3,878 73	
			$127,858 16
Lapsed to State Treasury,			650 29
Balance September 30, 1898,			37,849 25
			$166,357 70

Schedule "A."

Summary of Expenditures on Account of Hatcheries and Hatching Stations, Collection and Distribution of Fish and Fish Eggs and Fry, for Fiscal Year Ended Sept. 30th, 1898:

Adirondack	Hatchery,	Saranac Lake, Franklin Co.,	$7,668 53
Beaverkill	"	Rockland, Sullivan Co.,	3,166 59
Caledonia	"	Caledonia, Livingston Co.,	11,373 11
Cold Spring	"	Cold Spring Harbor, Suffolk Co.,	8,142 09
Fulton Chain	"	Old Forge, Herkimer Co.,	4,493 40
Pleasant Valley	"	Taggart, Steuben Co.,	4,240 46
Sacanadaga	"	Speculator, Hamilton Co.,	2,592 43
Oneida	"	Constantia, Oswego Co.,	1,243 99
Clayton	Station,	Clayton, Jefferson Co.,	1,607 44
Canandaigua	"	Canandaigua Lake,	1,352 61
Chautauqua	"	Chautauqua Lake,	878 65
Catskill	"	Catskill, Greene Co.,	1,169 92
Collecting lake trout eggs, Lake Michigan,			338 02
Construction of house for fish-car "Adirondack," Caledonia,			382 45
Improvement to water supply, McKay Pond, at Caledonia,			1,169 42
Legal expenses,			853 67
James Annin, Jr., Supt., salary			2,499 96
" " traveling expenses,			582 83
Expenses of Superintendent's office, Caledonia, N. Y.,			980 77
Kendrick Brown & Co., fish cans,			9 81
James H. Lamphere, removing fish from Erie Canal,			89 00
E. I. Brooks, " " "			96 00
States Prison Agent, merchandise,			46 00
F. D. Devine, one boat and oars,			35 00
		Total,	$55,012 15

Hatchery Accounts.

1897.	Adirondack Hatchery:			
Oct.	Charles Millar & Son,	iron pipe,	$76 61	
	Milo Otis,	labor,	52 50	
	M. A. Roberts,	"	57 00	
	A. W. Marks,	oars and repairing fireplace,	6 50	
	John G. Roberts,	freight, postage, salary, etc.,	117 75	
				$310 36
			Forward,	$310 36

1897.		Brought forward,		$310 36
Nov.	F. and C. Crittenden & Co.,	liver,	$5 00	
	Walton Stark & Co.,	hardware, etc.,	55 25	
	Armour & Co.,	liver,	18 00	
	Joseph Otis, Jr..	labor,	10 50	
	A. W. Marks,	"	24 70	
	M. A. Roberts,	"	58 90	
	Milo Otis,	"	58 90	
	John G. Roberts,	expenses, belts, postage, salary,	108 00	
	Upper Saranac Association,	sand, lumber, etc.,	48 36	
	American Net & Twine Co.,	pound net,	103 24	
				490 85
Dec.	M. A. Roberts,	labor,	$57 00	
	A. W. Marks,	"	57 00	
	Milo Otis,	"	57 00	
	Joseph Otis, Jr.,	"	24 00	
	Henry Snyder,	"	13 50	
	John G. Roberts,	expenses, freight, salary, etc.,	112 65	
				321 15
1898.				
Jan.	American Net & Twine Co.,	netting, etc.,	$30 92	
	A. H. Collins,	tags,	3 50	
	O. S. Lawrence,	oats,	36 00	
	M. A. Roberts,	labor,	38 00	
	William Ames,	labor and expenses,	18 25	
	A. W. Marks,	" "	60 15	
	L. W. Noble,	hay,	42 12	
	Milo Otis,	labor,	59 15	
	Henry A. Snyder,	"	46 75	
	John G. Roberts,	expenses, freight, salary, etc.,	100 75	
				435 59
Feb.	Walton Starks & Co.,	rope, hardware, etc.,	$9 12	
	William Ames,	labor and notary fee,	6 25	
	Henry A. Swinyer,	labor,	58 90	
	Milo Otis,	"	58 90	
	M. A. Roberts,	"	20 90	
	John G. Roberts,	expenses and salary,	94 77	
	Upper Saranac Association,	sand, lumber, etc.,	27 75	
				276 59
Mch.	J. C. Annin,	brown trout eggs,	$25 00	
	F. and C. Crittenden & Co.,	liver,	9 38	
	M. A. Roberts,	labor,	53 20	
	Milo Otis,	"	53 20	
	Henry A. Swinyer,	"	53 20	
	John G. Roberts,	expenses, freight, salary, etc.,	94 64	
				288 62
		Forward,		$2,123 16

1898.		Brought forward,		$2,123 16
April	Scheeler's Sons,	copper screen,	$36 40	
	W. D. Austin,	labor,	7 50	
	L. Dukett,	team, hire and labor,	8 00	
	Paul LaClare,	labor,	6 00	
	Joseph Jafoy,	"	5 25	
	Charles Otis,	"	7 50	
	A. W. Marks.	"	19 00	
	Charles Millar & Son,	iron pipe and valve,	961 58	
	William Ball,	expenses and labor,	27 69	
	Milo Otis,	labor,	58 90	
	Henry A. Swinyer,	"	58 90	
	M. A. Roberts,	"	58 90	
	John G. Roberts,	freight, expenses, labor, salary,	118 78	
				1,374 40
May	F. and C. Crittenden,	liver,	$3 08	
	Mrs. Charles McCaffrey,	meals,	4 00	
	F. and C. Crittenden,	liver,	6 26	
	Walton Stark & Co.,	rope, tools, etc.,	28 32	
	Joseph Lajoy,	labor,	4 50	
	W. D. Austin,	"	9 00	
	William Ball,	labor and expenses,	39 95	
	George Otis,	" "	12 00	
	Charles Otis,	" "	12 00	
	Israel Dukett,	" "	12 00	
	Charles McCaffrey,	" "	12 00	
	Lewis Parrott,	" "	12 00	
	Milo Otis,	labor,	57 00	
	L. Dukett,	"	12 00	
	Paul LaClare,	"	9 00	
	Henry A. Swinyer,	"	58 75	
	M. A. Roberts,	labor and expenses,	64 25	
	John G. Roberts,	expenses, freight, salary, etc.,	100 19	
				456 30
June	Walter N. Thayer,	wheelbarrows,	$4 50	
	Charles Millar & Son,	pipe valve and auger,	90 47	
	Henry A. Swinyer,	labor and expenses,	59 50	
	William Ball,	labor,	84 50	
	L. Dukett,	labor and expenses,	19 50	
	Israel Dukett,	labor,	14 25	
	L. H. Austin,	"	6 00	
	W. D. Austin,	"	38 25	
	R. Swinyer,	"	10 00	
	Paul LaClare,	"	37 50	
	Milo Otis,	"	58 90	
	Lewis Parrott,	"	36 75	
		Forward,	$460 12	$3,953 86

1898.		Brought forward,	$460 12	$3,953 86
June	M. A. Roberts,	labor and expenses,	68 40	
	John G. Roberts,	freight, expenses, salary, etc.,	108 29	
	Upper Saranac Association,	sand, lumber, etc.,	99 34	
				736 15
July	Scheeler's Sons,	brass wire,	$22 50	
	Charles W. Blackman,	meat cutter,	7 25	
	Charles C. Kellogg & Sons,	lumber,	124 06	
	Walton Stark & Co.,	paint and hardware,	22 79	
	Henry A. Swinyer,	labor,	49 40	
	Milo Otis,	"	57 00	
	M. A. Roberts,	"	57 00	
	Paul LaClare,	"	39 00	
	Lewis Parrott,	"	39 00	
	W. D. Austin,	"	39 00	
	R. Swinyer,	"	17 00	
	Eben Blakeman,	"	45 00	
	F. and C. Crittenden,	liver,	19 86	
	John G. Roberts,	expenses, freight, salary, etc.,	107 79	
	William Ball,	labor and expenses,	88 45	
				735 10
Aug.	Charles Millar & Son,	tar and pipe,	$332 62	
	" "	pipe valves and angles,	97 17	
	Job Malone,	laying stone,	17 50	
	Charles C. Kellogg & Son,	lumber,	200 15	
	Joseph Otis,	team work,	17 50	
	Richard Reid,	wagon,	36 50	
	R. Swinyer,	labor,	46 00	
	William Ball,	labor and expenses,	78 70	
	H. A. Swinyer,	labor,	57 00	
	Eben C. Blakeman,	"	46 50	
	M. A. Roberts,	"	58 90	
	Milo Otis,	"	58 90	
	L. Parrott,	"	37 50	
	Paul LaClare,	"	34 50	
	W. D. Austin,	"	36 00	
	Thompson Bros.,	cement,	14 00	
	John G. Roberts,	expenses, freight, salary, etc.,	150 65	
	Upper Saranac Association,	lumber,	153 59	
	F. and C. Crittenden & Co.,	liver,	14 89	
				1,488 57
Sept.	H. H. Lounsley,	cement and paper,	$20 80	
	American Net & Twine Co.,	nets,	22 00	
	L. Dukett,	team work,	7 50	
	Charles Millar & Son,	pipe,	12 05	
	Joseph Otis,	team work,	14 00	
	William Ball,	labor and expenses,	85 32	
		Forward,	$161 67	$6,913 68

1898.			Brought forward,	$161 17	$6,913 68
Sept.	Felix Fleury,	labor,		8 75	
	Richard Roberts,	"		22 50	
	Lewis Parrott,	"		27 75	
	Milo Otis,	"		58 90	
	Eben Blakeman,	"		46 50	
	Henry A. Swinyer,	"		20 90	
	M. A. Roberts,	"		55 10	
	W. D. Austin.	"		39 75	
	Charles Otis,	team work,		9 00	
	Paul LaClare,	labor,		39 75	
	R. Swinyer,	"		50 00	
	John G. Roberts,	expenses, salary, etc.,		138 30	
	Upper Saranac Association,	lumber, etc.,		41 09	
	Thompson Bros.,	cement and paper,		19 75	
	F. and C. Crittenden & Co.,	liver,		15 14	
					754 85
	Total Adirondack Hatchery,				$7,668 53

Beaverkill Hatchery:

1897.				
Oct.	30 days' labor at $1.75 per day,		$52 25	
	25 two cent stamps,		50	
				$52 75
Nov.	James F. Wood,	tubs,	$3 45	
	M. R. Dodge,	livery	18 00	
	Johnston & Albee,	hardware,	14 90	
	E. A. Dodge,	labor,	16 50	
	George H. Lawson,	labor and expenses,	28 60	
	Ahira Green,	board and cartage.	11 80	
	Charles B. Laraway,	labor and expenses,	59 73	
	A. E. Shaver,	" "	21 94	
	Willis Twiss,	" "	16 50	
	W. D. Marks,	" "	44 35	
	American Net & Twine Co.,	net, etc.,	19 89	
				255 66
Dec.	Charles B. Laraway,	labor and expenses,	$62 80	
	W. D. Marks,	labor,	66 00	
	William White,	"	18 00	
	George H. Lawson,	"	60 00	
	E. A Dodge,	"	27 00	
	M. R. Dodge,	livery,.	26 00	
	S. Hammond,	trout eggs and board,	289 65	
	A. E. Shaver,	board of men, etc.,	38 47	
	Willis Twiss,	labor,	36 00	
				623 92
			Forward,	$932 33

1898.		Brought forward,		$932 33
Jan.	Russell K. Gage,	labor,	$12 00	
	William Ball,	labor and expenses,	37 29	
	Charles Millar & Son,	pipe and fittings,	184 67	
	James Fitzgerald,	coal,	10 88	
	Albert Hallenbeck,	labor,	9 00	
	Willis Twiss,	"	12 00	
	John Hallenbeck,	"	9 00	
	S. Hammond,	trout eggs and board,	266 90	
	William White,	labor,	9 00	
	George Lawson,	"	40 00	
	J. T. Watson,	lumber,	24 44	
	Gilbert Kinch,	team work	8 00	
	W. D. Marks,	labor and expenses,	50 25	
	A. E. Shaver,	trout eggs and board,	401 58	
	M. R. Dodge,	labor,	31 50	
	Charles B. Laraway,	labor and expenses,	58 36	
	E. A. Dodge,	labor,	29 32	
				1,194 19
Feb.	Oliver Greene,	board and cartage,	$20 60	
	Scheeler's Sons,	fine wire,	20 54	
	M. R. Dodge,	livery,	8 00	
	Isaac T. Watson,	lumber,	3 50	
	James Fitzgerald,	coal,	5 45	
	George Weiss,	spikes and net frames,	3 75	
	E. A. Dodge,	labor,	28 50	
	Charles B. Laraway,	labor and expenses,	59 40	
				149 74
Mch.	J. C. Annin,	brown trout eggs,	$25 00	
	E. A. Dodge,	labor,	42 00	
	Charles B. Laraway,	labor and expenses,	52 40	
				119 40
April	James Fitzgerald,	coal,	$14 01	
	M. R. Dodge,	carting and sawdust,	5 30	
	Johnston & Albee,	hardware,	10 33	
	E. A. Dodge,	labor,	46 50	
	Charles B. Laraway,	labor and expenses,	62 50	
				138 64
May	M. R. Dodge,	cartage,	$13 00	
	E. A. Dodge,	labor and expenses,	46 00	
	Charles B. Laraway,	" "	75 50	
				134 50
June	Alvira Green,	cartage,	$11 20	
	M. R. Dodge,	"	21 00	
	E. A. Dodge,	labor,	51 00	
	Charles B. Laraway,	"	69 65	
				152 85
		Forward,		$2,821 65

1898.			Brought forward,		$2,821 65
July	C. W. Blackman,	meat chopper,		$7 25	
	P. J. Menges,	liver,		8 64	
	J. W. Wood,	"		6 93	
	E. A. Dodge,	labor,		45 00	
	Charles B. Laraway,	labor and expenses,		65 10	
					132 92
Aug.	E. A. Stewart,	flag pole,		$10 00	
	Johnston & Albee,	hardware,		8 90	
	Isaac T. Watson,	lumber,		5 49	
	Frederick Sheeley,	labor,		4 50	
	E. A. Dodge,	"		24 00	
	M. R. Dodge,	livery,		10 00	
	P. J. Menger,	liver,		7 73	
	Charles B. Laraway,	labor and expenses,		63 00	
	James Field Company,	American flag,		9 00	
					142 62
Sept.	James Field Company,	flag pole and fixtures,		$4 75	
	Charles B. Laraway,	labor and expenses,		64 65	
					69 40
	Total Beaverkill Hatchery,				$3,166 59

Caledonia Hatchery:

1897.				
Oct.	Frank Redband,	salary and expenses,		$91 80
	George Stewart,	labor and expenses,		56 40
	George H. Lawson,	labor,		60 00
	John A. Upton,	labor and expenses,		82 95
	William Johnson,	labor,		52 50
	Sylvester Selleck,	"		52 50
	H. R. Cotchefer,	"		52 50
	M. G. Craft,	"		49 50
	Addison Kingsbury,	"		39 00
	Charles Boehm,	"		36 75
	Cornelius Cooper,	"		46 38
	William Mastin,	"		39 00
	Alexander Amond,	"		35 25
	Grant Christie,	labor and expenses,		46 55
	W. Palmer Babcock,	labor,		34 50
	William McNaughton,	carpenter,		10 00
	William Ball,	"		13 75
	F. and C. Crittenden & Co.,	fish food,		32 53
	C. Klinck,	"		70 20
	J. E. Harvey, Agent,	repairs fish cans,		5 80
	A. P. Campbell,	sundries,		6 49
			Forward,	$914 35

1897.		Brought forward,	$914 35	
Oct.	DeLancey A. Cameron,	lumber and cement,	391 39	
	Charles C. Kellogg & Sons Co.,	"	114 00	
	U. S. Express Co.,	express,	17 45	
	Jamie C. Annin,	carting,	25 30	
	R. Pullybank, Sr.,	"	4 00	
				1,466 49
Nov.	Frank Redband, foreman,	labor and expenses,	$110 32	
	George Stewart,	" "	54 75	
	George H. Lawson,	labor,	36 00	
	John A. Upton,	"	62 00	
	William Johnson,	"	54 25	
	H. R. Cotchefer,	"	51 63	
	M. G. Craft,	"	54 25	
	Addison Kingsbury,	"	39 00	
	Charles Boehm,	"	36 68	
	Peter P. Campbell,	"	17 07	
	Cornelius Cooper,	"	17 25	
	William Mastin,	"	36 53	
	Alexander Amond,	"	36 68	
	Grant Christie,	"	44 25	
	W. Palmer Babcock,	"	34 58	
	William McNaughton,	"	62 75	
	George Johnson,	"	15 00	
	William Champ,	"	15 88	
	James Gill,	"	31 50	
	Robert McArthur,	sand, etc.,	18 25	
	P. Klinck,	fish food,	77 10	
	F. and C. Crittenden & Co.,	"	37 49	
	McCabe Bros.,	"	9 47	
	R. Pullybank, Jr.,	carting,	14 00	
	W. F. Lawson,	"	1 50	
	J. M. Matteson & Co.,	hardware,	73 92	
	A. Beekman,	lumber,	78 21	
	James Field Company,	twine,	1 34	
	Silver Lake Ice Co.,	ice,	32 63	
	American Express Co.,	express,	10 30	
	U. S. Express Co.,	"	18 02	
	Sylvester Selleck,	labor,	54 25	
				1,236 85
Dec.	Frank Redband, foreman,	salary and expenses	$101 70	
	George Stewart,	labor,	52 50	
	John A. Upton,	labor and expenses,	62 00	
	William Johnson,	labor,	52 50	
	H. R. Cotchefer,	"	52 50	
	M. G. Craft,	"	52 50	
		Forward,	$373 70	$2,703 34

1897.			Brought forward,	$373 70	$2,703 34
Dec.	Addison Kingsbury,	labor,		39 00	
	Charles Boehm,	"		5 03	
	Alexander Amond,	labor and expenses,		10 18	
	Grant Christie,	" "		72 55	
	W. Palmer Babcock,	" "		5 63	
	William McNaughton,	carpenter,		12 50	
	William Ball,	"		15 00	
	Sylvester Selleck,	labor,		52 50	
	Jamie C. Annin,	carting,		12 10	
	W. F. Lawson,	"		6 50	
	R. Pullybank, Jr.,	"		9 07	
	C. Klinck,	fish food,		72 70	
	F. and C. Crittenden & Co.,	"		37 28	
	William Nicholls,	repairing tools,		14 95	
	J. E. Harvey, agent,	repairing fish cans,		4 66	
	U. S. Express Co.,	express,		19 87	
	American Express Co.,	"		26 64	
	Henry Boehm,	one load fertilizer,		2 00	
	Robert McArthur,	dirt and fertilizer,		13 00	
	Salter Bros.,	florists,		10 31	
	C. Dorflinger & Sons,	Chase hatching jars,		56 80	
	Ross McKay,	13 cords of stone,		39 00	
	DeLancey A. Cameron,	lumber,		175 14	
	Wilson & Moore,	paints, etc.,		19 26	
					1,105 37
1898.					
Jan.	John A. Upton,	labor and expenses		$38 90	
	Grant Christie,	" "		31 80	
	Sylvester Selleck,	" "		56 30	
	Herbert R. Cotchefer,	" "		61 70	
	William Johnson,	" "		54 25	
	M. C. Craft,	" "		60 59	
	George H. Lawson,	" "		24 75	
	George Stewart,	" "		55 25	
	Addison Kingsbury,	" "		40 50	
	Jamie C. Annin,	" "		14 70	
	William McNaughton,	" "		32 40	
	Alexander Amond,	" "		14 95	
	Charles Boehm,	" "		34 50	
	James D. Christie,	" "		3 85	
	Henry Thurlow,	" "		11 00	
	Charles Roberts,	" "		3 20	
	Richard Reid,	labor and material,		6 95	
	United States Express Co.,	express,		17 47	
	A. H. Collins,	tags,		6 50	
			Forward,	$569 56	$3,808 71

1898.		Brought forward,	$569 56	$3,808 71
Jan.	Scheelers' Sons,	wire screens,	2 13	
	F. and C. Crittenden & Co.,	fish food,	37 55	
	C. Klinck,	"	65 00	
	Burt Pullybank,	cartage,	8 00	
	Frank Redband, foreman,	salary and expenses,	93 46	
				775 70
Feb.	Frank Redband, foreman,	salary and expenses,	$94 35	
	George Stewart,	labor " "	56 80	
	George H. Lawson,	"	62 00	
	William Johnson,	"	54 25	
	H. R. Cotchefer,	"	54 25	
	M. G. Craft,	"	54 25	
	Addison Kingsbury,	"	39 00	
	Sylvester Selleck,	"	45 50	
	Grant Christie,	"	22 75	
	William McNaughton,	"	14 00	
	Alexander Mullin, Jr.,	"	4 80	
	C. Klinck,	fish food,	62 50	
	F. and C. Crittenden & Co.,	"	34 53	
	McCabe Bros.,	"	7 08	
	R. Pullybank, Jr.,	carting,	4 50	
	W. F. Lawson,	"	2 50	
	J. E. Harvey, agent,	repairing cans,	48 55	
	Blackford's,	20 new cans,	42 00	
	Scheeler's Sons,	wire cloth,	38 48	
	J. M. Matteson & Co ,	hardware,	75 15	
	U. S. Express Co.,	express,	24 59	
				841 83
Mch.	Frank Redband, foreman,	salary and expenses,	$94 30	
	George Stewart,	labor,	49 00	
	George H. Lawson,	" and expenses,	63 85	
	William Johnson,	"	49 00	
	H. R. Cotchefer,	" and expenses,	52 50	
	M. G. Craft,	"	49 00	
	Addison Kingsbury,	"	36 00	
	Sylvester Selleck,	"	35 00	
	Grant Christie,	" and expenses,	69 18	
	Grant E. Winchester,	" "	55 47	
	Randall R. Brown,	" "	76 82	
	A. P. Campbell,	sundries,	6 50	
	J. C. Annin,	trout eggs and carting,	27 00	
	R. Pullybank, Jr.,	carting,	14 00	
	B. Pullybank,	"	27 50	
	W. F. Lawson,	"	9 00	
	C. Klinck,	fish food,	60 00	
		Forward,	$774 12	$5,426 24

1898.		Brought forward,	$774 12	$5,426 24
Mch.	F. and C. Crittenden & Co..	fish food,	27 64	
	U S. Express Co.,	express,	14 45	
				816 21
April	Frank Redband, foreman,	salary and expenses,	$110 09	
	George Stewart,	labor and expenses,	66 75	
	George H. Lawson,	"	62 00	
	William Johnson,	"	54 25	
	H. R. Cotchefer,	" and expenses,	59 00	
	M. G. Craft,	" " "	56 00	
	Addison Kingsbury,	" " "	42 25	
	Sylvester Selleck,	"	54 25	
	Grant Christie,	" and expenses,	79 57	
	Grant E. Winchester,	" " "	70 40	
	Randall R. Brown,	" " "	59 00	
	Alexander Amond,	" " "	31 35	
	F. E. Daley,	board of two men,	29 00	
	J. C. Annin,	carting,	11 25	
	W. F. Lawson,	"	10 25	
	R. Pullybank, Jr.,	"	14 00	
	B. Pullybank,	"	19 50	
	F. and C. Crittenden & Co.,	fish food,	34 77	
	C. Klinck,	"	67 20	
	McCabe Bros.,	"	7 33	
	Scheeler's Sons,	wire cloth,	6 00	
	U. S. Express Co.,	express,	18 20	
				962 41
May	Frank Redband, foreman,	salary and expenses,	$101 37	
	George Stewart,	labor " "	70 20	
	George H. Lawson,	" " "	60 00	
	William Johnson,	"	52 50	
	H. R. Cotchefer,	" and expenses,	76 90	
	M. G. Craft,	" " "	53 40	
	Sylvester Selleck,	" " "	54 16	
	Addison Kingsbury,	" " "	39 00	
	P. D. Campbell,	"	21 90	
	Frank Kingsbury,	6 yards muck,	9 00	
	Andrew Guthrie,	rent of brook, land, etc., 1897,	100 00	
	R. Pullybank, Jr.,	carting,	5 75	
	W. F. Lawson,	"	8 75	
	B. Pullybank,	"	7 25	
	C. Klinck,	fish food,	65 00	
	F. and C. Crittenden & Co.,	"	32 43	
	U. S. Express Co..	express,	17 10	
				774 71
			Forward,	$7,979 57

1898.			Brought forward,		$7,979 57
June	Frank Redband, foreman,	salary and expenses,		$97 56	
	George Stewart,	labor and expenses,		62 35	
	George H. Lawson,	"		62 00	
	William Johnson,	"		54 25	
	H. R. Cotchefer,	" and expenses,		54 75	
	M. G. Craft,	"		54 25	
	Sylvester Selleck,	"		54 25	
	Addison Kingsbury,	" and expenses,		44 70	
	Peter P. Campbell,	"		26 25	
	John D. Campbell,	"		10 50	
	Grant Christie,	" and expenses,		42 29	
	Alexander Amond,	" " "		6 80	
	J. C. Annin,	carting,		10 50	
	R. Pullybank, Jr.,	"		10 05	
	B. Pullybank,	"		11 25	
	W. F. Lawson,	"		3 75	
	U. S. Express Co.,	express,		18 40	
	Scheeler's Sons,	wire cloth,		6 67	
	J. M. Matteson & Co.,	hardware,		55 63	
	Joseph D. Donohue,	bbls. of salt,		16 50	
	F. and C. Crittenden & Co.,	fish food,		32 01	
	C. Klinck,	"		65 00	
	McCabe Bros.,	"		10 23	
					809 94
July	Frank Redband, foreman,	salary and expenses,		$93 10	
	George Stewart,	labor " "		56 20	
	George H. Lawson,	"		00 00	
	William Johnson,	"		52 50	
	H. R. Cotchefer,	"		52 50	
	M. G. Craft,	"		52 50	
	Sylvester Selleck,	"		52 50	
	Addison Kingsbury,	" and expenses,		39 84	
	W. Palmer Babcock,	"		33 38	
	John D. Campbell,	"		6 00	
	Alexander Amond,	" and expenses,		35 80	
	J. F. Ward,	florist,		64 42	
	Robert McArthur,	dirt, sod, etc.,		15 25	
	Cornelius Cooper,	drawing flint, etc.,		32 50	
	J. C. Annin,	carting, labor, etc.,		31 65	
	R. Pullybank, Jr.,	"		8 50	
	B. Pullybank,	"		10 75	
	C. Klinck,	fish food,		67 10	
	F. and C. Crittenden & Co.,	"		30 64	
	U. S. Express Co.,	express,		16 25	
			Forward,	$811 38	$8,789 51

1898.		Brought forward,	$811 38	$8,789 51
July	Silver Lake Ice Co.,	ice,	29 03	
	James Field Co.,	American flag,	12 00	
				852 41
Aug.	Frank Redband, foreman,	salary and expenses,	$91 38	
	George Stewart,	labor,	54 25	
	George H. Lawson,	"	62 00	
	William Johnson,	"	54 25	
	H. R. Cotchefer,	"	54 25	
	M. G. Craft,	"	54 25	
	Sylvester Selleck,	"	54 25	
	Addison Kingsbury,	" and expenses,	39 25	
	Alexander Amond,	"	28 50	
	W. Palmer Babcock,	"	37 50	
	McCabe Bros.,	fish food,	13 58	
	F. and C. Crittenden & Co.,	"	33 02	
	C. Klinck,	"	72 80	
	R. Pullybank, Jr.,	carting,	8 25	
	P. R. McKay,	repairing fish car,	11 25	
	U. S. Express Co.,	express,	16 55	
	J. M. Matteson & Co.,	hardware,	52 75	
	A. P. Campbell,	sundries,	4 42	
	Salter Bros.,	flower seeds,	4 96	
	Chamberlin's rubber store,	rubber hose,	3 50	
	Scheeler's Sons,	wire cloth,	9 60	
	Richard Reid,	repairs for fish car,	4 25	
	Holden & Sons,	coal,	86 47	
				851 28
Sept.	Frank Redband, foreman,	salary and expenses,	$100 59	
	George Stewart,	labor,	54 25	
	George H. Lawson,	"	62 00	
	William Johnson,	"	54 25	
	H. R. Cotchefer,	"	54 25	
	Sylvester Selleck,	"	54 25	
	Addison Kingsbury,	" and expenses,	46 50	
	Grant Christie,	" " "	84 30	
	W. Palmer Babcock,	"	40 50	
	William Sickles,	"	33 75	
	T. B. Tuttle,	loads of flint,	2 90	
	Silver Lake Ice Co.,	car of ice,	27 34	
	C. Klinck,	fish food,	85 60	
	F. and C. Crittenden & Co.,	"	35 89	
	R. Pullybank, Jr.,	carting,	8 75	
	W. F. Lawson,	"	5 25	
	E. Pullybank,	"	8 00	
	J. C. Annin,	"	6 75	
		Forward,	$765 12	$10,493 20

1898.		Brought forward,	$765 12	$10,493 20
Sept.	United States Express Co.,	express,	17 25	
	De Lancey A. Cameron,	lumber,	37 04	
	M. G. Craft,	labor,	45 50	
	O'Neil & Hale,	insurance on hatchery,	15 00	
				879 91
	Total Caledonia Hatchery,			$11,373 11

Fulton Chain Hatchery:

1897.				
Oct.	American Net & Twine Co.,	twine and corks,	$26 45	
	Matthews & Boucher,	locks,	4 50	
	Field & Co.,	rope,	3 80	
	William Ball,	carpenter expense,	10 37	
	T. C. Pullman,	lime, cement, etc.,	36 79	
	F. and C. Crittenden & Co.,	liver,	17 28	
	N. Ginther,	teaming, express and freight,	35 59	
	Adam Tennis,	dynamite and labor,	50 42	
	L. White,	labor,	45 00	
	William H. Burke,	hatchery work,	57 50	
	F. C. Mark,	" "	57 25	
	H. J. Kendall,	" "	52 50	
	H. E. Annin,	salary and expenses,	99 50	
				496 95
Nov.	Armour & Co.,	liver,	$17 14	
	American Net & Twine Co.,	small seine,	6 29	
	Charles Kellogg & Sons,	lumber, etc.,	133 22	
	N. Ginther,	cartage and express,	32 50	
	J. C. Pullman,	lime, cement, etc.,	54 27	
	F. and C. Crittenden & Co.,	liver,	12 51	
	William V. Smith,	stone and brick laying,	80 75	
	Adam Tennis,	labor, etc.,	40 50	
	L. White,	"	35 50	
	F. C. Marks,	"	57 00	
	William H. Burke,	"	59 15	
	H. B. Kendall,	"	54 25	
	H. E. Annin,	salary and expenses,	98 90	
				681 98
Dec.	Dodge & Snyder,	turpentine, etc.,	$4 52	
	J. E. Harvey,	nails, etc.,	9 90	
	Sabine & Harvey,	level nails,	10 06	
	George Deis & Son,	lumber,	32 81	
	James C. Pullman,	labor, lumber, etc.,	18 72	
		Forward,	$76 01	$1,178 93

1897.		Brought forward,	$76 01	$1,178 93
Dec.	N. Ginther,	express and cartage,	17 65	
	Mrs. Frederick Hess,	board,	29 64	
	George Goodsell,	extra labor,	14 00	
	William H. Burke,	labor and expenses,	58 08	
	H. B. Kendall,	" "	59 58	
	F. C. Marks,	" "	57 00	
	H. E. Annin,	salary and expenses,	107 93	
				419 89
1898.				
Jan.	Milo E. Bull,	teaming,	$8 00	
	N. Ginther,	" and express,	13 00	
	H. B. Kendall,	labor,	54 25	
	William H. Burke,	"	58 90	
	F. C. Marks,	"	58 90	
	H. E. Annin, foreman,	salary and expenses,	105 80	
	F. and C. Crittenden & Co.,	liver,	6 88	
				305 73
Feb.	F. and C. Crittenden & Co.,	liver,	$3 63	
	N. Ginther,	express and cartage,	5 80	
	J. E. Harvey,	kerosene, etc.,	11 00	
	H. B. Kendall,	labor at hatchery,	54 25	
	William H. Burke,	" "	58 90	
	F. C. Marks,	" "	58 90	
	H. E. Annin, foreman,	salary and expenses,	98 32	
				290 80
Mch.	F. and C. Crittenden & Co.,	liver,	$5 39	
	Milo E. Bull,	teaming,	6 00	
	Adam Tennis,	labor and wood,	19 20	
	N. Ginther.	express and delivery,	3 45	
	F. C. Marks,	labor at hatchery,	53 20	
	William H. Burke,	" "	53 20	
	H. B. Kendall,	" "	49 00	
	H. E. Annin, foreman,	salary and expenses,	92 00	
				281 44
April	F. and C. Crittenden & Co.,	liver,	$5 31	
	N. Ginther,	express and cartage,	8 59	
	William Ball,	labor and expenses,	19 59	
	William H. Burke,	" "	59 40	
	H. B. Kendall,	" "	54 25	
	F. C. Marks,	" "	58 90	
	H. E. Annin, foreman,	salary and expenses,	95 00	
				301 04
May	Richard E. Tollett,	expenses,	$13 12	
	Dodge & Snyder,	white lead, oil, etc.,	16 25	
	George Deis & Son,	lumber,	15 31	
		Forward,	$44 68	$2,777 83

1898.		Brought forward,	$44 68	$2,777 83
May	Sabine & Harvey,	hardware,	4 12	
	Charles Millar & Son,	iron, pipe, etc.,	19 64	
	N. Ginther,	cartage, express, etc.,	16 85	
	F. and C. Crittenden & Co.,	liver,	7 26	
	Scheeler's Sons,	wire,	4 29	
	William Ball,	labor and expenses,	26 62	
	F. C. Marks,	" "	57 00	
	H. B. Kendall,	" "	54 00	
	William H. Burke,	" "	66 75	
	H. E. Annin, foreman,	salary and expenses,	100 61	
				401 82
June	J. C. Pullman,	lumber,	$2 83	
	L. White,	labor,	8 00	
	N. Ginther,	cartage, etc.,	22 95	
	William H. Burke,	labor and expenses,	70 30	
	F C. Marks,	" at hatchery,	58 90	
	H. B. Kendall,	" and expenses,	65 75	
	H. E. Annin, foreman,	salary " "	95 70	
				324 40
July	F. and C. Crittenden & Co,	liver bill, May,	$31 25	
	N. Ginther,	teaming and express, June,	33 33	
	J. E. Harvey,	mdse,	10 99	
	E. F. Abbott,	"	3 30	
	William H. Burke,	labor,	57 00	
	F. C. Marks,	"	57 00	
	H. B. Kendall,	"	52 50	
	L. White,	labor,	14 00	
	H. E. Annin, foreman,	salary and expenses,	95 25	
				354 62
Aug.	F. and C. Crittenden & Co.,	liver,	$23 12	
	N. Ginther,	cartage and express,	18 25	
	William H. Burke,	labor,	58 90	
	F. C. Marks,	"	58 90	
	H. B. Kendall,	"	54 25	
	H. E. Annin, foreman,	salary and expenses,	96 60	
	James C. Bigelow,	flowers,	5 00	
				315 02
Sept.	George Deis & Sons,	lumber,	$11 42	
	N. Ginther,	express and teaming,	13 50	
	H. B. Kendall,	labor,	54 25	
	William H. Burke,	" and expenses,	61 85	
	F. C. Marks,	"	58 90	
	H. E. Annin, foreman,	salary, etc.,	99 45	
	F. and C. Crittenden & Co.,	liver,	20 34	
				319 71
	Total Fulton Chain Hatchery,			$4,493 40

Cold Spring Hatchery:

1897.				
Oct.	M. Abrams,	fish food,	$113 40	
	J. C. Totten,	freight,	20 50	
	E. B. Dusenbury, Jr.,	supplies for horse,	8 54	
	James T. DeMilt,	" "	14 30	
	John A. Bersenger,	braces for new ponds,	26 40	
	A. P. Dodge,	sundries,	9 99	
	E. Abrams,	"	6 57	
	William R. Bingham,	cartage,	88 00	
	James Wheeler,	"	60 00	
	Shepard Keene,	labor,	22 50	
	Richard Cronin,	"	36 75	
	Peter Gorman,	"	52 50	
	E. A. Cooper,	"	59 43	
	John T. Mahan,	"	52 50	
	F. Van Ausdall,	"	52 50	
	O. V. Rogers,	"	52 50	
	C. H. Walters,	salary and expenses,	93 00	
				$769 38
Nov.	M. Abrams,	fish food,	$113 40	
	J. C. Totten,	express on fish food,	20 35	
	W. Wilton Wood,	steps and screens,	11 13	
	William R. Bingham,	cartage,	92 00	
	James Wheeler,	"	33 75	
	Richard Cronin,	labor,	20 25	
	Shepard Keene,	"	12 00	
	O. V. Rogers,	"	54 25	
	E. A. Cooper,	"	54 25	
	Peter Gorman,	"	54 25	
	F. Van Ausdall,	"	54 25	
	John T. Mahan,	"	54 25	
	C. H. Walters,	salary and expenses,	94 55	
				668 68
Dec.	M. Abrams,	fish food,	$121 80	
	J. C. Totten,	freight,	21 45	
	American Net & Twine Co.,	nets,	24 34	
	J. F. O'Neil,	coal for hatchery,	46 00	
	Bingham & Brush,	bedding for horse,	7 25	
	Andrus Titus,	hay for horse,	21 36	
	J. T. DeMilt,	oats,	9 50	
	William H. Stayle,	sundries,	10 40	
	Peter Gorman,	labor and travel,	63 19	
	E. A. Cooper,	" "	61 63	
	F. Van Ausdall,	"	52 50	
		Forward,	$439 42	$1,438 06

1897.		Brought forward,	$439 42	$1,438 06
Dec.	J. T. Mahan,	labor,	52 50	
	O. V. Rogers,	"	52 50	
	C. H. Walters,	salary and expenses,	93 65	
				638 07
1898.				
Jan.	M. Abrams,	fish food,	$75 60	
	J. C. Totten,	freight,	22 80	
	W. Peper & Bro.,	use in hatchery,	4 56	
	William T. Lockwood,	sundries,	6 40	
	J. M. Matteson & Co.,	new cans,	47 50	
	Frederick E. Gardiner,	labor,	36 00	
	Peter Gorman,	travel and labor,	133 65	
	E. A. Cooper,	labor,	121 72	
	F. Van Ausdall,	"	54 25	
	J. T. Mahan,	"	54 25	
	O. V. Rogers,	"	54 25	
	C. H. Walters,	salary and expenses,	94 40	
				705 38
Feb.	M. Abrams,	fish food,	$88 20	
	J. C. Totten,	freight,	15 20	
	J. T. DeMilt,	horse feed,	10 40	
	W. Wilton Wood,	screens and doors,	13 73	
	Peter Gorman,	travel and labor,	82 75	
	E. A. Cooper,	" "	69 66	
	Frederick E. Gardiner,	labor,	46 50	
	J. T. Mahan,	"	54 25	
	F. Van Ausdall,	"	54 25	
	O. V. Rogers,	"	54 25	
	C. H. Walters,	salary and expenses,	99 28	
				588 47
Mch.	M. Abrams,	fish food,	$52 15	
	J. C. Totten,	expressage,	20 45	
	J. C. Totten,	cartage,	22 80	
	William Bingham,	filling ice house,	68 00	
	William T. Lockwood,	sundries,	11 74	
	F. T. O'Neil,	heating hatchery room,	11 50	
	Frederick Brown,	labor,	4 00	
	Frederick E. Gardiner,	"	36 00	
	Peter Gorman,	travel and labor,	115 65	
	E. A. Cooper,	" "	107 06	
	J. T. Mahan,	" "	64 53	
	F. Van Ausdall,	labor,	49 00	
	O. V. Rogers,	"	49 00	
	C. H. Walters,	salary and expenses,	117 37	
		Forward,	$729 25	$3,369 98

1898.		Brought forward,	$729 25	$3,369 98
Mch.	Sylvester Selleck,	labor and expenses,	23 00	
	Grant Christie,	" "	30 59	
				782 84
April	M. Abrams,	fish food,	$53 38	
	J. C. Totten,	express on fish food,	10 80	
	W. L. Gilbert,	spawn,	270 00	
	Samuel J. Smith,	collecting spawn,	24 00	
	S. D. Tillotson,	sundries,	4 60	
	L. I. Publishing Co.,	shipping tags,	3 50	
	Peter Gorman,	travel and labor,	108 07	
	E. A. Cooper,	" "	98 39	
	J. T. Mahan,	" "	88 64	
	F. Van Ausdall,	" "	54 25	
	O. V. Rogers,	" "	54 25	
	C. H. Walters,	salary and expenses,	102 71	
				872 59
May	M. Abrams,	fish food,	$73 50	
	J. C. Totten,	freight,	14 30	
	J. T. DeMilt,	horse food,	16 10	
	William R. Bingham,	cartage,	36 00	
	William R. Bingham,	sundries,	22 27	
	E. A. Cooper,	travel and labor,	120 08	
	Peter Gorman,	" "	91 05	
	J. T. Mahan,	" "	87 17	
	F. Van Ausdall,	" "	52 50	
	O. V. Rogers,	" "	52 50	
	C. H. Walters,	salary and expenses,	98 95	
				664 42
June	M. Abrams,	fish food,	$88 20	
	J. C. Totten,	freight,	24 75	
	American Net & Twine Co.,	collecting shad eggs,	16 10	
	W. Peper & Bro.,	collecting lobster eggs,	24 02	
	W. H. Stayle,	hatching lobster eggs,	15 39	
	William T. Lockwood,	cleaning ponds,	6 10	
	T. Nostrand & Sons,	horse feed,	22 00	
	J. T. DeMilt,	" "	1 20	
	David Baldwin,	improving grounds,	6 00	
	E. A. Cooper,	labor,	54 25	
	Peter Gorman,	travel and labor,	114 73	
	O. V. Rogers,	labor,	14 00	
	F. Van Ausdall,	"	54 25	
	J. T. Mahan,	"	54 25	
	C. H. Walters,	salary and expenses,	96 25	
				591 49
			Forward,	$6,281 32

1898.			Brought forward,		$6,281 32
July	M. Abrams,	fish food,	$81 90		
	J. C. Totten,	freight,	22 25		
	Gas, Power & Engine Co.,	collecting lobsters,	6 35		
	Thompson & Tyler,	hatching and shad spawn,	94 00		
	W. Milton Wood,	repairs,	12 24		
	Joseph S. Doty,	improving grounds,	16 50		
	William R. Bingham,	" "	16 00		
	Steamer Port Chester,	towing,	5 00		
	J. T. Mahan,	travel and labor,	126 03		
	Peter Gorman,	" "	119 37		
	E. A. Cooper,	" "	70 74		
	O. V. Rogers,	" "	21 00		
	F. Van Ausdall,	" "	52 50		
	Daniel J. Gardiner,	labor,	15 00		
	C. H. Walters,	salary and expenses,	102 92		
					761 80
Aug.	M. Abrams,	fish food,	$81 90		
	J. C. Totten,	freight,	14 95		
	Elwood Abrams,	painting launch,	6 82		
	A. D. Dodge,	freight,	14 00		
	William R. Bingham,	hatching lobsters,	16 01		
	Adolphus L. Ford,	lobster spawn,	10 00		
	William T. Lockwood,	sundries,	10 75		
	Peter Gorman,	collecting lobster spawn,	17 50		
	J. T. Mahan,	hatching lobsters,	54 25		
	O. V. Rogers,	" "	54 25		
	E. A. Cooper,	travel and labor,	56 25		
	F. Van Ausdall,	feeding fish,	54 25		
	C. H. Walters,	salary and expenses,	93 50		
					484 43
Sept.	M. Abrams,	fish food,	$101 15		
	J. C. Totten,	freight,	23 45		
	Captain Elias Beeler,	hatching lobsters,	10 00		
	Captain Peter Morton,	" "	20 00		
	F. Nichols,	" "	3 30		
	William H. Stayle,	repairing fish cans,	6 50		
	A. P. Dodge,	sundries,	9 89		
	Joseph Doty,	improving grounds,	27 75		
	William R. Bingham,	cartage,	36 00		
	O. V. Rogers,	labor,	54 25		
	E. A. Cooper,	"	54 25		
	J. T. Mahan,	"	54 25		
	F. Van Ausdall,	feeding fish,	54 25		
	Daniel J. Gardiner,	labor,	66 00		
	C. H. Walters,	salary and expenses,	93 50		
					614 54
	Total Cold Spring Hatchery,				$8,142 09

Pleasant Valley Hatchery:

1897.				
Oct.	Grant Christie,	labor and expenses,	$35 75	
	Thomas Toogood,	pheasants' eggs,	8 00	
	Frederick C. Hunniston,	labor,	52 50	
	Herbert Hunniston,	"	30 00	
	Brownell & Co.,	hardware, etc.,	6 10	
	O. S. Johnson,	labor,	42 00	
	F. and C. Crittenden & Co.,	fish food,	58 81	
	R. Cotchefer,	salary and expenses,	117 06	
				$350 22
Nov.	Herbert Hunniston,	labor,	$31 00	
	F. and C. Crittenden & Co.,	fish food,	48 95	
	Frederick C. Hunniston,	labor,	54 25	
	R. Cotchefer,	salary and expenses,	112 53	
				246 73
Dec.	R. R. Flynn & Co.,	salt and glass,	$9 93	
	Frederick C. Hunniston,	labor,	52 50	
	Herbert Hunniston,	"	30 00	
	O. S. Johnson,	"	19 50	
	F. and C. Crittenden & Co.,	fish food,	41 10	
	R. Cotchefer,	salary and expenses,	115 60	
				268 63
1898.				
Jan.	Brownell & Co.,	hardware,	$6 65	
	Frederick C. Hunniston,	labor,	54 25	
	Herbert Hunniston,	"	31 00	
	Alonzo Adams,	cartage,	7 50	
	R. R. Flynn & Co.,	salt,	19 20	
	F. and C. Crittenden & Co.,	fish food,	35 88	
	Grant Christie,	labor and expenses,	59 95	
	R. Cotchefer,	salary and expenses,	110 97	
				325 40
Feb.	Grant Christie,	labor and expenses,	$41 75	
	Brownell & Co.,	hardware, etc.,	14 82	
	Frederick C. Hunniston,	labor,	54 25	
	Herbert Hunniston,	"	31 00	
	John W. Kirkham,	lumber and labor,	7 60	
	R. Cotchefer,	salary and expenses,	110 15	
				259 57
Mch.	Frederick C. Hunniston,	labor,	$49 00	
	Herbert Hunniston,	"	28 00	
	O. S. Johnson,	"	42 00	
	F. and C. Crittenden & Co.,	fish food,	59 79	
	Simon W. Dixon,	furnishing ice,	62 00	
	R. Cotchefer,	salary and expenses,	99 90	
				340 69
			Forward,	$1,791 24

1898.			Brought forward,	$1,791 24
April	Frederick C. Hunniston,	labor,	$54 25	
	Herbert Hunniston,	"	31 00	
	O. S. Johnson,	"	40 50	
	Grant Christie,	labor and expenses,	27 10	
	F. and C. Crittenden & Co.,	fish food,	45 23	
	Alonzo Adams,	cartage,	14 00	
	R. Cotchefer,	salary and expenses,	119 87	
				331 95
May	Grant Christie,	labor and expenses,	$78 50	
	Frederick C. Hunniston,	labor,	52 50	
	Herbert Hunniston,	"	30 00	
	Alonzo Adams,	cartage,	6 00	
	F. and C. Crittenden & Co.,	fish food,	55 82	
	R. Cotchefer,	salary and expenses,	125 22	
				348 04
June	Frederick C. Hunniston,	labor,	$54 25	
	Herbert Hunniston,	"	31 00	
	O. S. Johnson,	"	46 50	
	Clarence Rosenbauer,	"	37 50	
	Verner de Guise,	pheasants,	51 00	
	C. W. Blackman,	meat cutter,	7 25	
	Eugene F. Parker,	insurance,	30 00	
	Grant Christie,	labor and expenses,	43 85	
	Alexander Arnold,	" "	36 71	
	R. Cotchefer,	salary "	114 84	
				452 90
July	Grant Christie,	labor and expenses,	$68 40	
	Alexander Amond,	" "	15 75	
	Van Scoter,	flowers, plants,	28 02	
	R. R. Flynn & Co.,	salt and dishes,	13 40	
	Frederick C. Hunniston,	labor,	57 00	
	Herbert Hunniston,	"	30 00	
	Alonzo Adams,	cartage,	23 00	
	F. and C. Crittenden & Co.,	fish food,	127 71	
	R. Cotchefer,	salary and expenses,	119 63	
	Professor Tarlton H. Beab,	expert, services,	90 20	
				573 11
Aug.	R. R. Flynn & Co.,	salt and dishes,	$37 40	
	James Field Co.,	American flag,	12 00	
	Frederick C. Hunniston,	labor,	58 90	
	Herbert Hunniston,	"	31 00	
	Alonzo Adams,	cartage,	4 00	
	Grant Christie,	labor and expenses,	72 92	
	F. and C. Crittenden & Co.,	fish food,	65 51	
	R. Cotchefer,	salary and expenses,	118 30	
				400 03
			Forward,	$3,897 27

1898.		Brought forward,		$3,897 27
Sept.	Frederick C. Hunniston,	labor,	$58 90	
	Herbert Hunniston,	"	31 00	
	O. S. Johnson,	"	46 50	
	R. R. Flynn & Co.,	salt,	12 00	
	F. and C. Crittenden & Co.,	fish food,	68 81	
	R. Cotchefer,	salary and expenses,	125 98	
				343 19
	Total Pleasant Valley Hatchery,			$4,240 46

Sacandaga Hatchery:

1897.				
Oct.	F. and C. Crittenden & Co.,	liver,	$7 00	
	William A. Foote,	steel roofing,	70 40	
	F. and C. Crittenden & Co.,	liver,	6 39	
	Ostrander & Cofine,	hardware,	11 75	
	John F. Boyce,	blacksmith work,	3 93	
	M. B. Hosley & Sons,	grain,	13 40	
	William Ball,	labor and expenses,	8 11	
	Lewis Wilbur,	"	36 75	
	George H. Fister,	"	60 00	
	E. F. Boehm,	salary and expenses,	106 54	
				$324 27
Nov.	Ostrander & Cofine,	hardware,	$3 58	
	Leman Slack,	mason work,	5 50	
	Lewis Wilbur,	labor,	9 00	
	George H. Fister,	"	62 00	
	E. F. Boehm,	salary and expenses,	97 90	
				177 98
Dec.	F. and C. Crittenden & Co.,	liver,	$6 56	
	" " "	"	3 64	
	M. B. Hosley & Sons,	grain,	10 42	
	Lewis Wilbur,	labor,	36 75	
	George H. Fister,	"	60 00	
	E. F. Boehm,	salary and expenses,	95 65	
				213 02
1898.				
Jan.	John F. Boyce,	sleigh and shoeing,	$26 20	
	Isaac Brasser,	cartage,	12 00	
	Lewis Wilbur,	labor,	39 00	
	George H. Fister,	"	62 00	
	E. F. Boehm,	salary and expenses,	112 85	
				252 05
			Forward,	$967 32

1898.		Brought forward,		$967 32
Feb.	F. and C. Crittenden & Co.,	liver,	$2 01	
	Scheeler's Sons,	wire cloth,	11 25	
	William Holleran,	grain,	15 70	
	Ostrander & Cofine,	hardware,	2 23	
	George H. Fister,	labor,	62 00	
	E. F. Boehm,	salary and expenses,	98 92	
	C. A. Healy,	insurance,	15 00	
				207 11
Mch.	J. M. Matteson,	fish cans,	$30 40	
	F. and C. Crittenden & Co.,	liver,	1 88	
	Wilbur Brothers,	cutting wood,	26 00	
	George H. Fister,	labor,	56 00	
	E. F. Boehm,	salary and expenses,	91 50	
				205 78
April	M. B. Hosley,	grain,	$8 80	
	F. and C. Crittenden & Co.,	liver,	4 25	
	John F. Boyce,	blacksmith work,	5 70	
	C. Dorflinger & Sons,	Chase hatching jars,	2 25	
	George H. Fister,	labor,	62 00	
	E. F. Boehm,	salary and expenses,	101 25	
				184 25
May	F. and C. Crittenden & Co.,	liver,	$3 43	
	George H. Fister,	labor,	60 00	
	E. F. Boehm,	salary and expenses,	98 45	
				161 88
June	M. B. Hosley & Sons,	grain,	$19 03	
	James Boyce,	horse hire,	16 00	
	John L. Boyce,	blacksmith,	2 35	
	Addison McIntyre,	labor,	30 00	
	George H. Fister,	labor and expenses,	67 00	
	E. F. Boehm,	salary and expenses,	106 35	
				240 73
July	Ostrander & Cofine,	hardware,	$8 75	
	M. B. Hosley & Sons,	grain,	10 60	
	F. and C. Crittenden & Co.,	liver,	17 97	
	George H. Fister,	labor,	60 00	
	E. F. Boehm,	salary and expenses,	98 05	
				195 37
Aug.	Asa Aird,	lumber,	$14 72	
	F. and C. Crittenden & Co.,	liver,	9 73	
	John F. Boyce,	blacksmith,	3 15	
	Addison McIntyre,	labor,	6 75	
	George H. Fister,	"	62 00	
	E. F. Boehm,	salary and expenses,	97 00	
				193 35
			Forward,	$2,355 79

1898.		Brought forward,		$2,355 79
Sept.	Hugh Campbell,	harness,	$20 00	
	M. B. Hosley,	grain,	7 94	
	John F. Boyce,	buckboard wagon and repairs,	50 85	
	George H. Fister,	labor,	62 00	
	E. F. Boehm,	salary and expenses,	95 85	
				236 64
	Total Sacandaga Hatchery,			$2,592 43

Oneida Hatchery:

1897.				
Oct.	Edgar Johnston,	3 net poles, 6 net blocks, etc.,	$11 75	
				$11 75
Nov.	Daniel C. King,	labor and expenses, catching bass,	$11 40	
				11 40
1898.				
Mch.	F. C. Howlett,	2 pairs of rubber gloves,	$3 00	
	American Net & Twine Co.,	nets,	5 04	
	Smith, Van Horne & Co.,	hardware,	13 49	
				21 53
April	Jonathan Mason,	labor and express,	$87 60	
	William Marcellus,	labor,	43 50	
	Charles Marcellus,	"	64 00	
	Daniel King,	"	19 90	
	Sanford Woodward,	carting,	6 50	
	William B. Dobson,	labor with teams,	8 40	
	John D. Black,	labor and expenses,	3 62	
	" "	oils and paints,	4 76	
	J. E. Marsh,	labor and expenses,	8 75	
	F. S. Beede,	hardware,	6 11	
	E. F. Whiting,	hardware, coal, etc.,	7 28	
	Willis Wright,	labor,	7 95	
	W. H. Richards,	labor with team,	5 10	
	James Coey,	labor and expenses,	4 50	
	Sanford Woodward,	carting,	5 10	
	William B. Dobson,	labor,	8 10	
	William Marcellus,	"	13 50	
	Charles Marcellus,	"	8 00	
	Daniel King,	" and expenses,	31 14	
	W. J. Jones,	" "	31 67	
	J. E. Marsh,	" "	21 67	
	J. & M. O'Connor,	crushed stone,	10 52	
				407 67
		Forward,		$452 35

1898.		Brought forward,		$452 35
May	George F. Scriba,	labor and expenses,	$70 20	
	Frank Dobson,	" "	6 20	
	Frank Rode,	" "	13 90	
	Edward Seifert,	" "	4 00	
	Arthur Brown,	" "	12 40	
	Charles Penoyer,	" "	11 20	
	Frank McCann,	" "	6 60	
	Walter McCann,	" "	6 25	
	Darius Getman,	" "	8 20	
	John Williams,	" "	12 20	
	David Wines,	" "	6 20	
	John Hendricks,	" "	11 60	
	Ben Phillips,	" "	20 10	
	Homer York,	" "	5 47	
	Nelson Van Antwerp,	" "	23 85	
	Lewis Johnston,	" "	11 40	
	Daniel M. Sullivan,	" "	7 00	
	Henry Marcellus,	" "	12 20	
	Samuel Stratton,	" "	12 60	
	Charles Whipple,	" "	11 40	
	J. Annin, Jr.,	disbursements,	40 75	
	M. B. Hill,	labor and expenses,	84 50	
	James Penoyer,	" "	15 87	
				414 09
June	George F. Scriba,	labor and expenses,	$59 26	
	Grant Christie,	" "	34 83	
	Alexander Amond,	" "	32 50	
	Jonathan Mason,	" "	12 50	
	James Penoyer,	" "	2 75	
	George F. Scriba,	" "	47 50	
	Frank McCann,	"	16 05	
	J. Annin, Jr.,	disbursements,	5 75	
				211 14
July	George F. Scriba,	labor and expenses,	$49 00	
	Frank McCann,	"	12 60	
	J. Annin, Jr.,	disbursements,	2 61	
	Charles Boehm,	3,650 brook trout, yearlings,	102 20	
				166 41
	Total Oneida Hatchery,			$1,243 99

Clayton Hatchery:

1897.				
Nov.	M. B. Hill,	labor and expenses,	$236 75	
	William A. Hill,	team,	2 00	
				$238 75
Dec.	M. B. Hill,	labor and expenses,	$96 50	
	Norman B. Hill,	" "	26 16	
	Captain James H. Hanes,	trips with sailboat,	36 00	
	" " "	14 qts. of spawn,	8 00	
	Lester Nugent,	white fish and ciscoe eggs,	12 50	
	Frank Horton,	labor with boat,	7 00	
	William Graves,	ciscoe eggs,	14 25	
	Simon Failing,	"	26 25	
	Schuyler Collins,	"	46 50	
	John C. Barber,	white fish eggs, etc.,	41 40	
	W. E. Hall,	board of men,	9 75	
	J. Grant Miller,	carting,	18 25	
	George C. Putnam,	carting, etc.,	40 50	
	Maher & Fitzgerald,	coal,	12 00	
				395 06
1898.				
Jan.	M. B. Hill,	labor,	$77 50	
	Lyn Bass,	"	33 00	
	Norman B. Hill,	"	12 00	
				122 50
Feb.	M. B. Hill,	labor,	$77 50	
	Maher & Fitzgerald,	coal,	14 40	
				91 90
Mch.	M. B. Hill,	labor,	$70 00	
	Norman B. Hill,	"	21 00	
				91 00
April	M. B. Hill,	labor,	$67 50	
	Norman B. Hill,	"	22 50	
	Alton Wright,	carting,	9 00	
	J. Grant Miller,	"	90 20	
				189 20
July	M. B. Hill,	labor and expenses,	$65 50	
	Norman B. Hill,	" "	22 50	
	Watson D. Hill,	" "	30 00	
	Grant Christie,	" "	73 81	
	Alexander Amond,	" "	37 15	
	Grant E. Winchester,	" "	55 90	
				284 86
Aug.	M. B. Hill,	labor,	$27 50	
	Norman B. Hill,	"	15 00	
		Forward,	$42 50	$1,413 27

1898.		Brought forward,	$42 50	$1,413 27
Aug.	Watson D. Hill,	labor,	16 50	
	Alexander Amond,	" and expenses,	24 58	
	Grant E. Winchester,	" "	38 70	
	Grant Christie,	" "	71 89	
				194 17
	Total Clayton Hatchery,			$1,607 44

Expenses incurred collecting fish eggs at Canandaigua Lake:

1897.				
Nov.	Randall R. Brown,	labor and expenses,	$86 56	
	E. Monroe Arnold,	" "	38 42	
	Wayne Brown,	" "	42 42	
	Grant E. Winchester,	" "	43 98	
	C. D. Miles,	labor,	24 00	
	Mrs. Ida Brown,	expenses,	13 42	
	Albert E. Fletcher,	carting,	8 50	
	Murray Bros.,	provisions,	27 07	
	John Gartland,	"	9 62	
	E. Saxton,	hardware,	9 29	
	A. S. Cooley & Co.,	"	7 44	
	Alexander Davidson,	paint, etc.,	28 36	
	Parrish & Van Norman,	plumbing,	7 33	
	J. M. Matteson & Co.,	pipe and labor,	47 67	
	James Field Company,	oars, etc.,	6 60	
	American Net & Twine Co.,	pound net,	105 53	
				$506 21
Dec.	Randall R. Brown,	labor and expenses,	$99 71	
	C. D. Miles,	"	62 00	
	Frank L. Hubbard,	" and expenses,	6 98	
	Grant E. Winchester,	" "	72 72	
	Jay Brown,	" with horse,	55 50	
	George W. Brown,	"	62 00	
	Mrs. Ida Brown,	"	12 86	
	A. E. Cooley & Co.,	hardware,	12 22	
	Alexander Davidson,	coal,	6 11	
	John Gartland,	provisions,	15 42	
	Murray Bros.,	"	26 66	
	E. Monroe Arnold,	labor and expenses,	60 62	
				492 80
1898.				
Jan.	Randall R. Brown,	labor, expenses, etc.,	$90 85	
	Jonathan Mason,	" "	33 80	
		Forward,	$124 65	$999 01

1898.		Brought forward,	$124 65	$999 01
Jan.	C. D. Miles,	labor, ...	36 00	
	Jay Brown,	labor with horse, ...	27 00	
	Frank L. Hubbard,	labor and expenses, . .	32 98	
	G. W. Brown,	" "	46 62	
	Grant E. Winchester,	" "	46 62	
	Mrs. Ida Brown,	" "	13 19	
	John Gartland,	beef, pork, ham, etc., . .	6 89	
	Murray Brothers,	groceries, ...	19 65	
				353 60
	Total Canandaigua Lake,	. . . .		$1,352 61

Expenses incurred collecting fish eggs at Chautauqua Lake:

1898.				
April	Randall R. Brown,	labor and expenses, . . .	$32 90	
	E. Monroe Arnold,	labor, ...	12 00	
	G. W. Brown,	"	26 00	
	Grant E. Winchester,	"	10 00	
	C. C. Fisher,	poles, ...	19 10	
	L. B. Warner,	lumber, ...	27 12	
	Scheeler's Sons,	wire cloth, ...	45 86	
				$172 98
May	Randall R. Brown,	labor and expenses, . . .	$87 48	
	Grant E. Winchester,	labor, ...	60 00	
	G. W. Brown,	"	60 00	
	E. Monroe Arnold,	"	60 00	
	Elmer Brown,	"	60 00	
	M. J. Daniels,	"	17 50	
	W. C. Haskins,	"	40 25	
	James Seymour,	hardware, ...	26 69	
	W. H. Sprague,	oars and rowlocks, . . .	4 50	
				416 42
June	Randall R. Brown,	labor and expenses, . . .	$55 40	
	Grant E. Winchester,	" "	65 15	
	E. Monroe Arnold,	" "	47 20	
	G. W. Brown,	labor, ...	42 00	
	W. C. Haskin,	"	19 25	
	M. J. Daniels,	"	5 25	
	Elmer Brown,	"	42 00	
	Jotham Bemus,	rent of hatchery site and pond,	13 00	
				289 25
	Total Chautauqua Lake,	. . . .		$878 65

Expenses incurred at Catskill Shad Hatchery:

1898.				
June	Jonathan Mason,	labor and expenses,	$53 32	
	O. V. Rogers,	" "	41 26	
	A. Hart,	"	38 00	
	E. H. Hallenbeck,	"	38 00	
	John J. Pindar,	13 nights' fishing,	260 00	
	Lincoln S. Hart,	board of men,	9 10	
	Vernon E. Ford,	provisions,	21 16	
	W. Kortz,	cot bed, mattress, etc.,	7 00	
	Day & Holt,	hardware,	4 30	
	Catskill & Hudson Steam Ferry Co.,	delivering packages, etc., to Catskill hatchery,	3 25	
				$475 39
July	Jonathan Mason,	labor and expenses,	$68 78	
	E. H. Hallenbeck,	use of boat and labor,	53 00	
	A. Hart,	labor,	56 00	
	O. V. Rogers,	" and expenses,	47 88	
	Captain John J. Pindar,	18 nights' fishing,	360 00	
	Catskill & Hudson Steam Ferry Co., limited,	delivering mail, etc.,	4 40	
	V. E. Ford,	provisions for men,	29 47	
	Board of Water Commissioners,	water supply,	75 00	
				694 53
	Total Catskill Hatchery,			$1,169 92

Expenses incurred collecting lake trout eggs at Lake Michigan:

1897.		
Oct.	Paid S. M. Rose, Charlevoix, Michigan:	
	Steamboat fare to St. James,	$1 00
	" " Charlevoix,	1 00
	" " St. James,	1 00
	Freight and dockage on boxes,	35
	Steamboat fare to Charlevoix,	1 00
	To 11 days' labor at $2.50 per day,	27 50
	Cook & Cook, for counsel and copy of Act No. 151, regarding fish laws of Michigan,	2 00
	Notary fees,	25
	To 20 yds. of cotton at .05 per yard,	1 00
	Board of James Gibson, 2 weeks at $4.00 per week,	8 00
	Board of Daniel Galligher, 10 days at $4.00 per week,	5 75
	Boats taking spawn, 5 days at $2.00 per day,	10 00
	Board for Thomas Boyle, 6 days at $4.00 per week,	3 45
	Forward,	$62 30

1897.	Brought forward,	$62 30
Nov.	Board for Thomas Boyle, 10 days at $4.00 per week,	5 72
	" " Philip Beaudeain, 2 weeks and 2 days at $4.00 per week,	9 14
	" " 3 weeks for S. M. Rose, at $5.00 per week,	15 00
	Freight on boxes from Charlevoix to St. James,	2 60
	Dockage on fish eggs from Charlevoix,	1 00
	Charlevoix Hardware Co., bolts, tacks,	1 80
	Lake freight and dockage from St. James to Charlevoix,	4 50
	Charlevoix Lumber Co., making spawn boxes and furnishing material for same,	7 52
	Steamboat fare to St. James,	1 00
	" " Charlevoix,	1 00
	Pan, 15c.; dipper, 25c.,	40
	Steamboat fare to St. James,	1 00
	" " Charlevoix,	1 00
	Notary fees for acknowledging the men's papers at St. James,	1 00
	Cartage on eggs, boxes,	75
	Railroad to Grand Rapids from Charlevoix,	5 72
	Supper at White Cloud,	50
	Railroad Grand Rapids to Detroit,	4 58
	Lunch at Grand Rapids,	25
	Breakfast at Jackson, Mich,	50
	Railroad Detroit to Buffalo,	7 00
	Supper and lodging at Buffalo,	1 25
	Railroad Buffalo to Batavia,	72
	Railroad Batavia to Caledonia,	50
	1¼ days' board at Spring Creek Hotel, Caledonia,	2 50
	Railroad Caledonia to Buffalo,	1 22
	Dinner at Buffalo,	50
	Railroad Buffalo to Detroit,	7 00
	Supper, lodging and breakfast, Detroit,	1 50
	Railroad Detroit to Grand Rapids,	4 58
	Dinner, supper, lodging and breakfast, Grand Rapids,	2 00
	Railroad Grand Rapids to Charlevoix,	5 72
	Sixteen days' labor at $2.50 per day,	40 00
	James Gibson, labor taking spawn,	28 25
	Phillip Beaudeain, labor taking spawn,	32 00
	Thomas Boyle, labor taking spawn,	32 00
	John A. Dahlmer, men and use of tug,	10 00
	Willie Gibson, labor,	14 00
	Daniel T. Galligher,	20 00

Total Lake Michigan, ... $338 02

Expenditures for construction of house for fish car "Adirondack," at Caledonia, N. Y.:

1898.				
Jan.	N. Y. C. & H. R. R.R. Co., labor and material,	$91 02		
	Delancey Cameron, lumber "	189 65		
	William McNaughton, labor "	35 50		
	Alexander Amond, "	14 03		
	Alexander Mullin, Jr., "	6 20		
	F. D. Woolett, shellac, etc.,	50		
	John E. Harvey, labor,	11 50		
	J. M. Matteson, material,	34 05		
	Total Caledonia,		$382 45	

Expenses of Superintendent's office at Caledonia, N. Y.:

1897.			
Oct.	Delivery of telegrams,	$1 30	
	Jonathan Mason, expenses from Spencerport to Caledonia and return, in consultation,	2 44	
	R. M. Myers & Co., application books,	15 00	
	Telephone to Rochester,	30	
	Office supplies, Scranton, Wetmore & Co.,	2 05	
	Western Union Telegraph Co., for Sept.,	8 69	
	F. W. Blakeslee, services,	10 50	
	J. M. Skinner,	40 00	
			$80 28
Nov.	P. O. Box rent to Jan. 1, 1898,	$0 25	
	Office supplies,	1 00	
	Registered letter to Lake Pleasant,	08	
	Messenger boy,	20	
	250 two cent postage stamps,	5 00	
	Delivery of two messages,	20	
	Telephone to Rochester,	30	
	Messenger boy,	40	
	Express on package from Rochester,	25	
	Telephone to Rochester,	30	
	Street car in Rochester,	05	
	Office supplies,	50	
	F. W. Blakeslee, services,	18 00	
	Telephone to Rochester,	30	
	J. M. Skinner, services,	32 00	
	Western Union Telegraph account,	7 29	
			66 12
Dec.	Delivery of telegram,	$0 10	
	Express on package to Rochester,	25	
	Delivery of package,	10	
	Forward,	$0 45	$146 40

1897.	Brought forward,	$0 45	$146 40
Dec.	Delivery of telegrams,	1 10	
	Scranton, Wetmore & Co., copy books, etc.,	3 65	
	200 two cent and 25 four cent stamps,	5 00	
	Bottle red ink,	05	
	" "	10	
	Small receipt book,	10	
	Wyckhoff, Seaman & Benedict, typewriter ribbons,	3 50	
	Photograph Constantia Hatchery,	40	
	Western Union Telegraph account,	6 22	
	F. W. Blakeslee, services,	21 50	
	J. M. Skinner, "	32 00	
			74 07
1898.			
Jan.	R. M. Myers, stationery,	$19 00	
	Delivery of telegrams,	80	
	250 two cent postage stamps,	5 00	
	Scranton, Wetmore & Co., office supplies,	1 50	
	Six photographs of Fulton Chain Hatchery, new ponds,	3 00	
	250 two cent postage stamps,	5 00	
	Western Union Telegraph Co.,	2 56	
	F. W. Blakeslee, services,	23 50	
	J. M. Skinner, "	40 00	
			100 36
Feb.	P. O. Box, three months' rent to April 1st,	$0 25	
	Scranton, Wetmore & Co., letter files,	2 00	
	Telegrams,	66	
	One year's subscription to R. R. Guide,	2 00	
	Delivery of telegrams,	20	
	Postage stamps,	10 00	
	One lamp for office,	1 50	
	R. M. Myers & Co., 500 blank sheets,	60	
	Scranton, Wetmore & Co.,	2 30	
	H. L. Carpenter, photographs,	6 40	
	F. W. Blakeslee, services,	27 00	
	J. M. Skinner, "	32 00	
			84 91
Mch.	Telegrams,	$1 18	
	Delivery of telegrams,	65	
	Matches,	10	
	Telephone to Rochester,	60	
	Postage stamps,	6 00	
	Ball linen twine,	25	
	Messenger delivering specimens to Rochester University,	25	
	Western Union Telegraph account,	5 78	
	Forward,	$14 81	$405 74

1898.	Brought forward,	$14 81	$405 74
Mch.	F. W. Blakeslee, services,	34 50	
	J. M. Skinner, "	32 00	
			81 31
April	500 two cent postage stamps,	$10 00	
	Bottle red ink,	05	
	Delivery of telegrams,	2 00	
	Paper boxes,	10	
	Telephone message to Rochester,	30	
	A. H. Collins, 1,000 circulars,	3 50	
	Telephone to Buffalo,	40	
	Scranton, Wetmore & Co., office supplies,	2 15	
	Postage stamps,	10 00	
	Telephone to Rochester,	30	
	Express to Rochester,	25	
	Telephone to Rochester,	30	
	Scranton, Wetmore & Co., office supplies,	4 50	
	" " blank book,	40	
	Framing photographs of new ponds,	6 00	
	Western Union Telegraph account,	11 25	
	C. E. Deichman, coal for office,	3 23	
	F. W. Blakeslee, services,	33 50	
	J. M. Skinner, services,	40 00	
			128 23
May	P. O. box rent for quarter,	$0 35	
	Delivery of telegrams,	1 20	
	Scranton, Wetmore & Co., letter copying book,	5 50	
	Postage stamps,	10 00	
	Telegram to Bath, via Erie Railroad wire,	25	
	Telephone to Rochester,	30	
	Railroad Guide,	10	
	Western Union Telegraph account for April,	5 00	
	C. E. Deichman, coal for office,	3 28	
	F. W. Blakeslee, services,	30 00	
	J. M. Skinner, "	32 00	
			87 98
June	Delivery of telegrams,	$1 30	
	Express on package to Catskill,	25	
	Scranton, Wetmore & Co., office supplies,	3 30	
	Wyckoff, Seaman & Benedict, typewriter ribbons,	3 50	
	Postage stamps,	5 00	
	Three pen holders,	14	
	Pads,	06	
	Western Union Telegraph Co.,	7 97	
	F. W. Blakeslee, services,	15 00	
	J. M. Skinner, "	32 00	
			68 52
		Forward,	$771 78

1898.		Brought forward,	$771 78
July	Delivery of telegrams,	$1 10	
	Postage stamps,	5 00	
	Scranton, Wetmore & Co., rubber bands,	20	
	Express on package to Clayton,	25	
	" jars from Catskill,	1 00	
	" package from Catskill,	25	
	" box and keg (plants and water),	2 10	
	Western Union Telegraph Co., for June,	8 30	
	F. W. Blakeslee, services,	18 50	
	J. M. Skinner, "	40 00	
			76 70
Aug.	Postage stamps,	$4 97	
	P. O. Box rent,	35	
	Telegram to Clayton,	50	
	Express on package from Clayton and revenue stamp,	26	
	Revenue stamps,	44	
	Delivery of telegram,	10	
	Supper for two mechanics from Rochester inspecting fish car,	1 00	
	F. W. Blakeslee, services,	25 50	
	J. M. Skinner, "	32 00	
			65 12
Sept.	Delivery of telegrams and messenger service,	$0 90	
	Basket,	08	
	Expressage,	4 56	
	Two cent revenue stamps,	22	
	Telephone to Rochester,	75	
	Dinner for inspector of fish car "Adirondack,"	50	
	Western Union Telegraph Co., for August,	3 16	
	F. W. Blakeslee, services,	17 00	
	J. M. Skinner, "	40 00	
			67 17
	Total Caledonia office expenses,		$980 77

Legal services:

1898.			
Aug.	M. E. Lewis, legal services and expenses,	$166 22	
	Hubbell & McGuire, " "	165 25	
	Otto Kelsey,	222 20	
	W. F. Rathbone,	300 00	
			$853 67

Expenditures for improvement of water supply, McKay Pond, Caledonia Hatchery:

1898.				
Sept.	R. W. Matteson,	overseer services,	$48 00	
	Alexander Amond,	labor,	43 50	
	John Hackett,	"	16 47	
	John Lee, Sr.,	"	14 37	
	A. C. Bryant,	"	13 88	
	Alfred Gordon,	"	9 38	
	James Ezard,	"	15 72	
	William Curphy,	"	15 72	
	J. M. Smith,	"	14 29	
	William Buckley,	"	17 97	
	James Melbourne,	"	23 07	
	Charles Espie,	"	9 34	
	James Tygart,	"	18 23	
	John Lee, Jr.,	"	14 44	
	Robert Laidlaw,	"	15 72	
	John Buckley,	"	8 44	
	William Austin,	"	23 07	
	George Henderson,	"	26 82	
	Patrick Kerwick,	"	32 48	
	Joseph Bartlett,	"	26 29	
	George Bradburn,	"	29 03	
	Samuel Bellew,	"	8 15	
	Patrick Bellew,	"	4 50	
	George Davis,	"	32 07	
	Warner Sutherland,	"	29 07	
	Daniel Mullin,	"	27 42	
	Howard Laidlaw,	"	4 50	
	William McCombs,	"	27 57	
	A. Kallmiere,	"	24 49	
	Roy McWilliams,	"	27 79	
	Lester Brownell,	"	26 82	
	Harlan Woodruff,	"	29 82	
	Edward Johnston,	"	30 49	
	E. H. Smith,	"	32 07	
	William Hogg,	"	12 00	
	George Johnson,	"	37 43	
	J. Annin, Jr.,	freight on lumber,	5 60	
	Thomas Reed,	loads of sand,	18 00	
	Ross McKay,	team work, posts, stone,	47 80	
	Buffalo Hardwarde Lumber Co.,	lumber,	22 43	
	W. B. Morse & Sons,	lumber,	53 77	
	Delancey Cameron,	"	174 40	
	J. M. Matteson & Co.,	hardware,	57 00	
	Total,			$1,169 42

Schedule "B."

SUMMARY OF SALARIES AND EXPENSES PAID FISH, GAME, AND OYSTER PROTECTORS FOR FISCAL YEAR ENDING SEPTEMBER 30, 1898.

PROTECTORS AND FORESTERS.	SALARY.	EXPENSES.	TOTAL.
J. W. Pond, Chief Protector,	$2,000 00	$999 92	$2,999 92
John E. Leavitt, Assistant Chief,	1,200 00	682 34	1,882 34
M. C. Worts, " "	1,200 00	750 00	1,950 00
William Wolf, Clerk to Chief,	1,200 00	21 42	1,221 42
M. C. Finley, Special Agent,	999 96	163 01	1,162 97
John L. Ackley,	332 91	316 46	649 37
W. J. Alfred,	60 39	21 01	81 40
F. S. Beede,	500 00	442 93	942 93
E. I. Brooks,	426 08	384 75	810 83
George Carver,	500 00	448 22	948 22
Thomas Carter,	249 96	225 00	474 96
Thomas H. Donnelly,	333 36	301 84	635 20
L. S. Emmons,	500 00	442 90	942 90
Spencer Hawn,	500 00	450 00	950 00
George W. Harmony,	249 96	225 00	474 96
N. A. Hazen,	500 00	389 80	889 80
James Holmes,	500 00	457 36	957 36
Carlos Hutchins,	500 00	437 45	937 45
Robert S. Jones,	390 89	358 82	749 71
Willett Kidd,	370 79	352 20	722 99
James H. Lamphere,	500 00	449 66	949 66
J. D. Lawrence,	125 06	70 53	195 59
Harry Lippman,	156 21	......	156 21
J. W. Littlejohn,	116 73	104 29	221 02
E. J. Lobdell,	500 00	450 00	950 00
B. H. McCollum,	500 00	450 00	950 00
D. H. McKinnon,	158 48	124 24	282 72
Joseph Northup,	500 00	438 67	938 67
F. M. Potter,	500 00	423 39	923 39
Samuel Piersall,	194 42	171 71	366 13
Daniel Pomeroy,	208 38	186 62	395 00
Wallace L. Reed,	500 00	439 07	939 07
R. M. Rush,	138 49	96 77	235 26
Barnard Salisbury,	500 00	285 41	785 41
N. A. Scott,	83 32	41 86	125 18
Nicholas Shaul,	97 28	87 50	184 78
J. F. Shedden,	500 00	450 00	950 00
George B. Smith,	500 00	450 00	950 00
Forward,	$18,292 67	$12,590 15	$30,882 82

Protectors and Foresters.	Salary.	Expenses.	Total.
Brought forward,	$18,292 67	$12,590 15	$30,882 82
S. J. Tefft,	317 21	256 43	573 64
Albert Warren,	500 00	450 00	950 00
H. L. Wait,	388 45	321 81	710 26
Alvin Winslow,	500 00	460 74	960 74
A. A. Wyckoff,	332 91	341 96	674 87
Oyster Protectors.			
Edgar Hicks,	1,000 00	750 00	1,750 00
Selah T. Clock,	1,200 00	343 52	1,543 52
John Ferguson, Assistant,	485 00	202 96	687 96
Total,	$23,016 24	$15,717 57	$38,733 81

Schedule "C."

Official Salaries and Expenses.

	Salary.	Expenses.	Total.
Barnet H. Davis, President,	$3,000 00	$800 00	$3,800 00
William R. Weed, Commissioner,	2,500 00	800 00	3,300 00
Charles H. Babcock, "	2,500 00	800 00	3,300 00
Edward Thompson, "	2,500 00	938 35	3,438 35
H. S. Holden, "	2,500 00	800 00	3,300 00
A. N. Cheney, State Fish Culturist,	3,000 00	863 44	3,863 44
William F. Fox, Supt. State Forests,	208 34	49 29	257 63
Total,	$16,208 34	$5,051 08	$21,259 42

Schedule "D."

Salaries and Expenses.—Clerical Force.

	Salary.	Expenses.	Total.
Charles A. Taylor, Assistant Secretary,	$1,800 00	$199 92	$1,999 92
A. J. Mulligan, Auditor and Pay Clerk,	1,500 00	......	1,500 00
A. B. Strough, Special Agent,	1,399 92	......	1,399 92
J. J. Fourqurean, Stenographer,	1,200 00	......	1,200 00
Total,	$5,899 92	$199 92	$6,099 84

Schedule "E."

Office Expenses.

Brandow Printing Co.,	stationery and printing,	$561 16
Hudson Valley Paper Co.,	"	123 77
A. H. Clapp,	"	22 45
James B. Lyon,	"	20 00
C. M. Ward,	file cases,	23 25
George E. McClellon,	stationery,	7 50
Thomas J. Cowell,	"	10 40
Meyrowitz Bros.,	"	1 25
Smith Premier Co.,	"	4 50
S. G. Speir,	"	7 50
Albany News Co.,	"	10 63
Charles A. Taylor.	postage,	520 99
Western Union Telegraph Co.,	telegrams,	242 70
Postal Telegraph Co.,	"	23 65
M. Knapp,	"	32 39
J R. Weston,	"	32 56
A. E. Morgan,	"	75 90
Hudson Valley Telephone,	rental, etc.,	211 39
American Express Co.,		118 56
National Express Co.,		42 56
A. E. Morgan,	expressage,	31 34
R. K. Palmer,	painting sign,	3 25
Frazer & Kelly,	freight and cartage,	2 98
C. A. Hotailing,	books, etc.,	2 70
Albany Hardware Co ,	locks, etc.,	4 60
H. D. Keefer,	books, etc.,	10 80
Joseph McDonough,	"	26 85
Irene A. Liston,	typewriting,	75 00
Charles A. Taylor,	spring water, etc.,	13 90
R. B. Hough,	books,	7 50
Wynkoop, Hallenbeck, Crawford Co.,	freight and packing-boxes, cartage 1895 reports,	393 00
T. A. Fraine,	mounting fish,	12 50
"The Argus,"	subscription,	7 50
"Forest and Stream,"	"	4 00
Lang Stamp Works,	rubber stamps,	11 55
M. J. Carley,	services,	18 86
W. H. Semple,	sundries,	2 75
Sampson, Murdock Co.,	directory,	3 00
William F. Rathbone,	legal services,	50 00
James B. Lyon,	game law,	75 00
A. B. Strough,	expenses,	24 92

Total office expenses, ... $2,874 21

Schedule "F."

EXPENDITURES ON ACCOUNT OF SHELLFISH DEPARTMENT.—NEW YORK OFFICE.

F. B. Mitchell, confidential clerk,	salary 6 months,	$900 00
C. B. Kansier, cashier,	. . . .	635 71
C. A. Taylor,	postage,	40 00
Brandow Printing Co.,	printing,	124 09
Star Publishing Co.,	advertising,	28 00
Henry A. Reeves,	"	23 00
Metropolitan Insurance Co.,	rent, etc.,	1,050 53
Western Union Telegraph Co.,	telegrams,	41 76
H. C. Leman,	stationery,	31 90
O. B. Booth,	typewriting,	4 39
James Mahony,	washing towels,	6 00
American Express Co.,	expressage,	14 31
American District Telegraph Co.,	services,	12 75
New York Telephone Co.,	rent and tolls,	131 95
United States Express Co.,	expressage,	30
Long Island Express Co.,	services,	1 15
John Moriarity & Co.,	furniture,	53 00
Kolish Pharmacy,	brushes, etc.,	2 30
New York Transfer Co.,	services,	1 20
Griffith Sons,	insurance,	15 00
A. M. Donaldson,	posting lease notices,	2 00
Walter Marshall,	" " "	1 00
J. H. Heatherington,	" " "	10 04
J. A. Cady,	" " "	3 00
E. B. Meyrowitz,	thermometer,	1 00
J. H. Elsworth,	posting lease notices,	3 00
H. C. Leman,	cabinet, etc.,	34 29
Weed, Parsons Printing Co.,	one book,	1 00
Gray & Powell,	service,	1 00
W. J. Sloan,	carpets,	47 51
Edward Thompson,	one key,	35
" "	one map,	1 50
" "	freight on furniture,	6 41
" "	one dozen hooks,	1 15
J. W. Mead, Prison Agent,	furniture,	58 00
Edward Thompson,	freight on furniture,	1 55
Smith Premier Co.,	typewriter,	140 00
J. A. Mayes,	services,	50
Edward Thompson,	notary public,	25
" "	money order,	15
"	two tumblers,	15
	Forward,	$3,431 19

		Brought forward,	$3,431 19	
County Clerk,		filing notary certificate,	10 00	
New York Directory Co.,			3 00	
A. H. Gusman,		repairing chairs,	5 00	
	Total New York office,			$3,449 19

NAPHTHA LAUNCH EXPENSES.

1897.				
Oct.	W. De Hart,	naphtha,	$10 76	
	Standard Oil Co.,	"	10 84	
				$21 60
Nov.	Edgar Seaton,	services on launch,	$10 00	
				10 00
1898.				
Mch.	T. J. Conroy,	revolver and club for launch,	$12 15	
				12 15
April	D. F. Simonson,	blankets for launch,	$3 90	
	John Neill,	storage,	20 00	
	M. E. Wygant,	paints, varnish, etc.,	9 05	
				32 95
May	Standard Oil Co.,	naphtha,	$5 85	
	Gas Engine and Power Co.,	repairs,	5 71	
	E. Hicks,	one large sponge,	60	
	" "	one bucket,	25	
	Propeller "Vigilant,"	towing,	10 00	
				22 41
June	E. Hicks,	expressage,	$0 50	
	Lawson Hardware Co.,	brushes,	75	
	Charles McKay,	grapnell,	3 00	
	Delancy & Colvin,	repairing brush hook,	1 75	
	R. B. Wing & Co.,	naphtha and rope,	11 57	
	Standard Oil Co.,		4 82	
	F. C. Howlett,	naphtha,	90	
	Standard Oil Co.,		5 90	
	Pilot Syracuse to Three Rivers,		2 50	
	" Three Rivers to Oak Orchard,		3 00	
	" Oak Orchard to South Bay,		4 00	
	Buelly & Settle,	naphtha,	6 25	
	E. Milton,	pilot Brewerton to Syracuse,	5 00	
	Standard Oil Co.,	naphtha,	4 82	
	R. B. Wing & Son,	"	5 15	
	James Flannigan,	services as pilot,	32 00	
	Assistance through sixteen locks,		2 00	
	" at Catskill,		1 50	
	E. Hicks,	one gallon machine oil,	50	
		Forward,	$94 91	$99 11

1898.		Brought forward,	$94 91	$99 11
June	Assistant at Hudson,		1 00	
	Gas Engine and Power Co.,	repairs to engine,	71 41	
	Watchman at Albany,		1 50	
				168 82
July	Charles McKay,	painting and repairs,	$44 00	
	James H. Flannigan,	services as pilot,	20 00	
	Standard Oil Co.,	naphtha,	10 60	
	George Koehler,	services,	4 50	
	A. E. Doeble,	"	12 00	
				91 10
Aug.	A. E. Doeble,	services,	$9 00	
	Standard Oil Co.,	naphtha,	17 93	
	Long Island Railroad,	freight,	1 00	
	John H. Ferris,	naphtha,	9 59	
	John Johnson,	services,	1 00	
	J. D. Cannon,	"	1 00	
	Frank Reilly,	"	1 00	
	Long Island Express Co.,	expressage,	25	
	Willett Kidd,	naphtha,	29 74	
				70 51

Total launch expenses,	$429 54
Total Shellfish Department,	$3,878 73

Summary of Expenditures from Special Appropriations during Fiscal Year Ending September 30, 1898.

Forest Preserve Account,	Schedule "G,"	$1,942 80	
State Reservation on the St. Lawrence River,	" "H,"	15,273 84	
New York State Fair Exhibit,	" "I,"	391 78	
Examination of Ulster county lands, preliminary to transfer to the State,	" "J,"	361 91	
Construction of weirs and traps at Cayuga Lake,	" "K,"	215 14	
Payment of claims arising under former Commissions,	" "L,"	710 76	
Payments of Firewarden claims and rebates due towns on account of forest fires,	" "M,"	5,346 18	
Extermination of billfish in Black Lake,	" "N,"	120 00	
Construction of fish hatchery at Inland Lake,	" "O,"	5,749 47	
Acquiring land and water rights at Caledonia Hatchery,	" "P,"	4,980 00	
Services and disbursements of counsel in proceedings brought under chapter 392, Laws of 1898,	" "Q,"	15,000 00	
			$50,091 88

Schedule "G."

Forest Preserve Account.

		Disbursements.		
1897.				
Oct.	G. H. West, special agent,	salary,	$100 00	
	" " "	expenses,	34 89	
	A. B. Strough,	traveling expenses,	60 76	
	F. R. Smith, custodian Lake George Islands,	salary and expenses,	60 15	
	William F. Fox,	traveling expenses,	8 18	
				$263 98
Nov.	William F. Fox,	traveling expenses,	$27 48	
	John A. Cole,	advertising,	6 75	
	J. T. Cosgrave,	map,	5 00	
				39 23
Dec.	Reuben Lawrence,	repairs to John Brown Homestead,	$132 93	
	F. M. Swift,	surveying,	87 29	
	G. A. McCoy,	"	107 50	
	Silas Page,	"	22 50	
	D. E. Call,	"	7 50	
	Isaiah Perkins,	"	62 50	
	Davis Sturges,	"	18 25	
	Albert McCoy,	"	6 00	
	A. Wilbur,	"	18 00	
	Clarence McCoy,	"	49 00	
	W. C. Brown,	"	11 00	
	N. A. Page,	"	37 50	
	C. R. Maynard,	"	27 50	
	A. B. Strough,	traveling expenses,	27 19	
	E. W. Robbins,	printing law case,	201 50	
	J. Greene, custodian Lake George Islands,	one year's salary,	250 00	
				1,066 16
1898.				
Jan.	G. W. F. Smith,	map,	$10 00	
	W. F. Fox,	traveling expenses,	84 59	
	"	" "	29 07	
				123 66
April	W. F. Fox,	traveling expenses,	$27 85	
	E. M. Merrill,	surveying,	49 70	
	A. B. Strough,	traveling expenses,	24 29	
				101 84
May	M. A. Hall,	maps,	$36 00	
				36 00
			Forward,	$1,630 87

1898.		Brought forward,		$1,630 87
June	W. F. Fox,	traveling expenses,	$38 92	
	E. Hathway,	repairs John Brown house,	12 50	
	Walton & Stark,	bricks, etc., " "	6 95	
				58 37
July	George A. McCoy,	surveying,	$146 50	
	A. B. Strough,	traveling expenses,	33 86	
				180 36
Aug.	A. B. Strough,	traveling expenses,	$31 28	
	W. F. Fox,	" "	41 92	
				73 20
	Total,			$1,942 80

Schedule "H."

St. Lawrence Park Reservation.

1897.		Disbursements.		
Dec.	Westminster Park Association,	land on Mary's Island,	$5,000 00	
1898.				
Jan.	A. B. Strough,	traveling expenses,	100 15	
April	J. J. Delaney,	land on Grandstone Island,	4,200 00	
	M. J. Phillips,	land on Cedar Island,	3,000 00	
May	C. A. Taylor,	expenses recording papers,	4 34	
	George Kring,	land on Goose Bay,	2,300 00	
July	C. A. Taylor,	expenses examining lands,	297 86	
Aug.	C. A. Taylor,	" " "	57 06	
	Rathcelder Sons,	sign boards,	133 00	
	Lewis Wright,	painting signs,	75 00	
	Joseph Northup,	placing signs in position,	106 43	
	Total,			$15,273 84

Schedule "I."

New York State Fair Exhibit.

1898.		Disbursements.		
Aug.	A. B. Strough,	traveling expenses,	$36 14	
Sept.	N. Y. C. & H. R. R.R.,	freight,	36 28	
	Strough & Brooks,	labor and material,	52 80	
	B. T. Scott,	services,	15 00	
	H. H. Judd & Son,	cartage,	4 45	
	Western Union Telegraph Co.,		6 54	
	P. R. Quinlan,	decorating exhibit,	25 00	
	M. C. Craft,	labor and expenses,	16 60	
	A. N. Keech,	" "	31 45	
	A. B. Strough, traveling and hotel expenses collecting and supervising exhibit,		167 52	
	Total,			$391 78

Schedule "J."

INVESTIGATION AND EXAMINATION OF FOREST LANDS IN ULSTER COUNTY, PRELIMINARY TO PURCHASE BY THE STATE, AS PER CHAPTER 791, LAWS OF 1897.

		Disbursements.		
1898.				
Sept.	William F. Fox,	traveling, livery and hotel expenses,	$216 21	
	Charles A. Taylor,	" " " .	145 70	
	Total,	. . . .		$361 91

Schedule "K."

ERECTION AND MAINTENANCE OF EEL WEIRS AND TRAPS AT CAYUGA LAKE, AS PER CHAPTER 790, LAWS OF 1897.

		Disbursements.		
1897.				
Nov.	Prof. H. A. Surface,	rent of house, ...	$15 00	
	" " "	assistant collecting fishes, . .	10 00	
1898				
April	" " "	wire material and expenses constructing weirs, ...	75 00	
	A. B. Spicer,	watching weirs, ...	25 00	
	H. A. Surface,	one minnow net, ...	7 75	
June	A. N. Cheney,	traveling expenses, ...	32 39	
July	A. B. Spicer,	watching and caring for traps, .	50 00	
	Total,	. . . .		$215 14

Schedule "L."

CLAIMS ARISING UNDER FORMER COMMISSION.

		Disbursements.		
1897.				
Oct.	Edgar T. Brackett,	legal services, G. C. Sherman vs. The State, ...	$500 00	
Dec.	D. H. Stanton,	surveying, ...	37 76	
1898.				
April	Thomas Humphrey,	printing and stationery, ...	173 00	
	Total,	. . . .		$710 76

Schedule "M.

Firewarden Claims and Rebates Paid Towns.

Disbursements.

Brandow Printing Co., printing notices, "Look Out for Fire,"			$172 50
American Express Co., expressage on fire notices,			34 30
National Express Co.,	" " "		31 05
Town of	Black Brook,	Clinton Co.,	218 37
"	Dannemora,	"	14 00
"	Andes,	Delaware Co.,	5 00
"	Colchester,	"	11 25
"	Davenport,	"	46 30
"	Hancock,	"	202 75
"	Harpersfield,	"	1 87
"	Roxbury,	"	5 00
"	Jay,	Essex Co.,	23 62
"	Keene,	"	55 25
"	Minerva,	"	70 75
"	Willsborough,	"	2 87
"	Lewis,	"	113 00
"	Chesterfield,	"	32 50
"	Wilmington,	"	107 00
"	Caroga,	Fulton Co.,	60 25
"	Mayfield,	"	4 37
"	Ephratah,	"	22 75
"	Altamont,	Franklin Co.,	19 00
"	Dickinson,	"	45 75
"	Malone,	"	38 75
"	Moira,	"	32 25
"	Harrietstown,	"	32 00
"	Hunter,	Greene Co.,	325 75
"	Cairo,	"	18 00
"	Hamilton,	"	136 25
"	Lake Pleasant,	Hamilton Co.,	16 25
"	Morehouse,	"	3 12
"	Wells,	"	66 00
"	Indian Lake,	"	46 75
"	Long Lake,	"	26 00
"	Webb,	Herkimer Co.,	19 25
"	German Flats,	"	7 50
"	Ohio,	"	5 25
"	Salisbury,	"	34 25
"	Ballston,	Saratoga Co.,	6 00
"	Day,	"	70 25
"	Hadley,	"	24 75
"	Malta,	"	25 00
		Forward,	$2,242 87

	Brought forward,	$2,242 87	
Town of Providence,	Saratoga Co.,	20 25	
" Wilton,	"	47 25	
" Clare,	St. Lawrence Co.,	12 00	
" Fine,	"	21 00	
" Louisville,	"	4 37	
" Pitcairn,	"	19 75	
" Chester,	Warren Co.,	60 50	
" Johnsburgh,	"	100 75	
" Stony Creek,	"	10 19	
" Thurman,	"	99 37	
" Luzerne,	"	50 25	
" Queensbury,	"	195 75	
" Cambridge,	Washington Co.,	13 75	
" Fort Ann,	"	186 25	
" White Hall,	"	158 32	
" Bethel,	Sullivan Co.,	21 50	
" Forestburg,	"	63 50	
" Freemont,	"	55 70	
" Rockland,	"	48 50	
" Thompson,	"	31 25	
" Highlands,	"	123 00	
" Denning,	Ulster Co.,	102 25	
" Gardiner,	"	129 94	
" Shawangunk,	"	267 50	
" Wawarsing,	"	475 00	
" Shandaken,	"	12 00	
" Woodstock,	"	96 75	
" Wolton,	Warren Co.,	31 00	
" Tompkins,	Delaware Co.,	6 25	
" Black Brook,	Clinton Co.,	68 62	
" Russia,	Herkimer Co.,	9 75	
" Greig,	Lewis Co.,	5 00	
" Pitcairn,	St. Lawrence Co.,	11 00	
" Clare,	"	96 00	
" Lumberland,	Sullivan Co.,	80 00	
" Shawangunk,	Ulster Co.,	12 25	
" Olive,	"	89 00	
" Benson,	Hamilton Co.,	257 50	
" Davenport,	Delaware Co.,	20 30	
	Total,		$5,346 18

Schedule "N."

Extermination of Billfish in Black Lake.

1897.				
Nov.	George Monk,	services,	$60 00	
	Frederick Apple,	"	60 00	
				$120 00

Schedule "O."

EXPENSES INCURRED IN CONSTRUCTION OF FISH HATCHERY AT CONSTANTIA, ON ONEIDA LAKE.

1897.		DISBURSEMENTS.		
Oct.	J. Annin, Jr.,	preliminary expenses,	$28 00	
	William Ball,	labor and expenses,	21 15	
	P. W. Leete,	surveying and expenses,	13 21	
	William Ball,	labor and expenses,	73 60	
	George F. Scriba,	" "	45 50	
	J. Annin, Jr., Supt.,	expenses,	13 89	
	Len Gardanier,	labor,	32 85	
	George Lord,	"	37 80	
	Henry Marcellus,	"	34 35	
	Benjamin Phillips,	"	36 60	
	Joseph Getman,	"	34 87	
	William Marcellus,	"	31 72	
	D. L. Sweet,	"	11 02	
	Edward Siefert,	"	32 92	
	Samuel Stratton,	"	25 35	
	Charles Whipple,	"	29 10	
	Seymour Phillips,	"	33 60	
	Peter Venderworker,	"	25 27	
	John B. Black,	hardware,	48 10	
	Arthur Getman,	labor,	22 35	
	John Hedrick,	"	14 85	
	Charles Blowers,	"	22 35	
	Charles Farnett,	"	5 25	
	William Morrison,	"	14 29	
	D. G. Ingersoll,	teamster,	20 10	
	Charles Nichols,	"	41 10	
	W. Henry Richards,	"	28 65	
	Carey Hess,	"	13 20	
	J. E. Marsh,	labor and expenses,	39 89	
	A. A. Beardsley,	labor,	3 10	
	J. W. Callicott,	blacksmith,	3 00	
	J. M. Matteson & Co.,	spikes,	6 30	
	Post & Henderson,	lumber,	786 16	
	C. C. Kellogg & Sons Co.,	shingles,	157 50	
				$1,786 99
Nov.	George F. Scriba,	labor,	$42 29	
	William Ball,	" and expenses,	84 27	
	J. Annin, Jr.,	expenses,	9 90	
	John Carter,	labor,	20 37	
	George Lord,	"	31 97	
		Forward,	$188 80	$1,786 99

1897.			Brought forward,	$188 80	$1,786 99
Nov.	Nelson Van Antwerp,	labor,		18 21	
	Edward Siefert,	"		27 57	
	Benjamin Phillips,	"		31 83	
	Seymour Phillips,	"		31 37	
	Henry Marcellus,	"		29 88	
	William Marcellus,	"		26 02	
	Hiram Dudgeon,	"		33 20	
	Julian Carter, Jr.,	"		35 60	
	G. F. Teale,	blacksmith,		10 33	
	John D. Black,	hardware,		9 33	
	Joseph Getman,	labor,		27 74	
	George Getman,	"		12 21	
	Samuel Stratton,	"		27 04	
	W. H. Richards,	"		59 85	
	D. K. Winn,	tinsmith,		15 75	
	William Morrison,	labor,		33 80	
	Ezra Babcock,	"		20 40	
	Carey Hess,	"		37 35	
	Thomas Sullivan,	"		35 97	
	Charles Whipple,	"		30 83	
	Daniel Sullivan,	"		17 25	
	J. Carter's Sons,	lumber,		23 71	
	Daniel L. Sweet,	labor,		6 37	
	Peter Vanderworker,	"		11 77	
	Len Gardanier,	"		29 95	
	Lewis Johnston,	"		24 40	
	Charles Marcellus,	"		27 00	
	W. B. Baker, attorney,	services,		40 25	
	The Oswego Hardware Co.,	hardware,		24 24	
	Charles Millar & Son,	labor and pipe,		306 17	
	Frederick R. Gerry,	door and window frames,		108 00	
	Post & Henderson,	lumber,		24 83	
					1,387 02
Dec.	George F. Scriba,	labor,		$13 65	
	J. Annin, Jr.,	freight, labor, etc.,		14 40	
	J. E. Marsh,	steel beams, etc.,		78 80	
	Julien Carter, Jr.,	carpenter and labor,		2 60	
	Lewis Johnston,	labor,		2 77	
	Edward Siefert,	"		3 75	
	Seymour Phillips,	"		3 52	
	Hiram Pudgeon,	"		4 30	
	W. H. Richards,	team,		6 70	
	Frank McCann,	painter,		3 50	
	E. F. Whiting,	coal, hardware, etc.,		59 80	
			Forward,	$193 79	$3,174 01

1897.		Brought forward,	$193 79	$3,174 01
Dec.	C. Dorflinger & Son,	hatching jars, ...	232 80	
	J. M. Matteson & Co.,	lead tubes for jars, ...	43 00	
				469 59
1898.				
Jan.	George F. Scriba,	labor, ...	$41 74	
	William Ball,	" and expenses, . .	54 36	
	Hiram Dudgeon,	"	36 70	
	Frank McCann,	"	33 25	
	Lewis Johnston,	"	8 77	
	W. H. Richards,	" with team, . . .	5 25	
	D. K. Winn,	" and material, . . .	7 80	
	E. F. Whiting,	hardware, ...	75 32	
	C. C. Kellogg & Sons Co.,	lumber, ...	243 98	
	Post & Henderson,	lumber, etc., . . .	87 27	
	C. Dorflinger & Son,	Chase hatching jars, . .	55 29	
				649 73
Feb.	George F. Scriba,	labor, ...	$43 75	
	William Ball,	" and expenses, . .	82 25	
	Edgar Johnston,	"	17 00	
	Andrew Daffler,	"	34 00	
	W. H. Richards,	" with team, . . .	9 45	
	Lewis Johnston,	"	17 02	
	Hiram Dudgeon,	"	44 00	
	Frank McCann,	"	43 75	
	Benjamin Phillips,	"	4 05	
	G. F. Teale,	blacksmith, ...	46 85	
	E. F. Whiting,	hardware, ...	30 42	
	Charles Millar & Son,	"	15 00	
	J. M. Matteson & Co.,	transportation cases, . .	277 61	
	Post & Henderson,	lumber, ...	48 61	
	Frederick R. Gerry,	"	35 87	
	Scheeler's Sons,	wire cloth, ...	17 60	
				767 23
Mch.	George F. Scriba,	labor and expenses, . .	$47 77	
	J. Annin, Jr.,	disbursements, ...	40 05	
	Hiram Dudgeon,	labor, ...	37 80	
	William Ball,	"	49 53	
	Charles Pennoyer,	"	14 10	
	Frank Rhoda,	"	18 75	
	Frank McCann,	"	35 00	
	James Flarity,	"	10 50	
	Edgar Johnston,	"	8 00	
	Lewis Johnston,	"	4 50	
	Andrew Daffler,	"	8 00	
	J. M. Matteson & Co.,	hardware, ...	15 77	
	Charles Millar & Son,	pipe, etc., ...	112 09	
		Forward,	$401 86	$5,060 56

1898.		Brought forward,	$401 86	$5,060 56
Mch.	Frederick R. Gerry,	lumber,	18 98	
	Scheeler's Sons,	wire cloth,	36 00	
	Chamberlain's Rubber Store,	tubing,	40 10	
	A. A. Beardsley,	net bows, poles, etc.,	7 00	
	F. S. Beede,	hardware,	13 99	
	E. F. Whiting,	paint, oil, etc.,	24 59	
				542 52
Sept.	George F. Scriba,	labor and expenses,	$57 69	
	Frank McCann,	"	37 60	
	A. A. Beardsley,	labor on flag pole,	4 50	
	C. B. Nicholas,	flag pole,	8 00	
	E. F. Whiting,	oil paint, etc.,	38 60	
				146 39
	Total,			$5,749 47

Schedule "P."

ACQUIRING LAND AND WATER RIGHTS AT STATE HATCHERY AT CALEDONIA.

1898.	DISBURSEMENTS.	
Feb.	McKay heirs, purchase price of land abutting on McKay Pond at Caledonia,	$4,980 00

Schedule "Q."

SERVICES AND DISBURSEMENTS OF COUNSEL IN PROCEEDINGS BROUGHT UNDER CHAPTER 392, LAWS OF 1898.

1898.	DISBURSEMENTS.		
June	Frank L. Bell, attorney,	$7,500 00	
	George R. Malby, attorney,	5,000 00	
	E. Countryman, "	2,500 00	
	Total,		$15,000 00

SUMMARY OF RECEIPTS AND DISBURSEMENTS ON VARIOUS ACCOUNTS, EXCLUSIVE OF REGULAR ACCOUNTS WITH STATE COMPTROLLER, FOR FISCAL YEAR ENDING SEPTEMBER 30, 1898.

	RECEIPTS.	DISBURSEMENTS.	BALANCE OCT. 1, 1898.
Fines and Penalties Account,	$10,099 87	$6,605 19	$3,494 68
Trespass Account,	3,184 78	1,997 72	1,187 06
Net License Account,	840 00	....	840 00
Rental from shellfish lands,	1,305 52	*1,305 52	....
Rentals from State lands, Forest Preserve,	370 00	*370 00	....
Received from sale of whitefish that were killed in stripping,	100 06	*100 06	....
	$15,900 23	$10,378 49	$5,521 74

* Paid to State Comptroller to be turned into the State treasury.

Fines and Penalties Account for Fiscal Year Ending September 30, 1898.

1897.	RECEIPTS.		
Oct.	To balance in State bank, Albany,	$3,872 68	
	People vs. Eugene Edwards,	46 85	
	" E. E. Lang,	24 00	
	" Lewis Edwards,	10 00	
	" John Rigney,	35 00	
	" Donald Shaffer,	10 00	
	" Henry Voran,	6 15	
	" Patrick Logan,	21 10	
	" A. D. Rosecrans,	15 15	
	" A. Rambock et al.,	236 10	
	" Josh. Lucas et al.,	169 00	
	" E. B. Barton,	10 00	
	" Henry Gardner,	10 00	
	" William Rewalt and another,	42 60	
	" Rudolph Magnis,	45 00	
	" Apostah Tomasso,	25 00	
	" James Camp and another,	6 80	
	" Albert Belknapp,	63 00	
	" J. M. Walsh,	50 00	
	" R. C. Hatch,	100 00	
	" Josh. Giannotte,	15 00	
			$4,813 43
Nov.	People vs. James C. Sergent,	$20 00	
	" Charles Webber,	6 00	
	" Henry Hamrack,	32 75	
	" Robert H. Wiley,	40 00	
	" George Adams,	23 50	
	" Charles Johnson,	20 00	
	" George C. Eckert,	5 00	
	" John McClelland,	20 05	
			167 30
Dec.	People vs. James Harmon et al.,	$7 00	
	" David F. Smith,	25 00	
	" Caper Volt,	24 85	
	" George Fuller,	25 00	
	" P. L. Freeman,	7 40	
	" Louis Gerhardt,	25 00	
	" Andrew Mennissing,	3 90	
	" Albert E. Jones,	50 00	
	" George Johnson et al.,	115 00	
	Forward,	$283 15	$4,980 73

1897.		Brought forward,	$283 15	$4,980 73
Dec.	People vs. D. W. Wynkoop,		20 00	
	" Salem Town,		85 00	
	" William and George Pease,		35 75	
	" Bernard Cohen,		120 00	
				543 90
1898.				
Jan.	People vs. Edward Hammond,		$11 30	
	" George Miller et al.,		8 50	
	" William F. Quackenbush,		25 00	
	" Charles Wolf,		5 95	
	" William Kresmer,		30 00	
	" F. G. Stewart,		23 48	
	" Tony Costello,		93 00	
	" Eli Camero,		13 50	
	" Henry Elkins,		2 85	
	" A. T. Peck,		265 00	
	" Charles M. Stubbs,		100 00	
	" A. Basso,		100 00	
	" David B. Scott,		75 00	
	" D. Haley & Co.,		50 00	
	" Halsey Mitchell et al.,		150 00	
				953 58
Feb.	People vs. C. L. Miller et al.,		$13 74	
	" E. F. Steenberg,		30 00	
	" Peter Knoblock et al.,		50 00	
	" Henry Herguth,		15 00	
	" Bennett & Johnson,		44 40	
	" Dart & Fleming,		8 00	
	" T. G. Stewart,		13 20	
	" Weyman & Merton,		33 00	
				207 34
Mch.	People vs. Harmon Simmons,		$10 00	
	" James Palmer et al.,		75 00	
	" John Moore,		117 64	
	" Freeman S. Vaughn,		47 30	
	" Arthur H. Swingle,		10 10	
	" Adelbert Carpenter,		14 00	
	" A. B. Ward,		20 00	
	" William Osterhout,		25 00	
	" Julius G. Smith,		70 00	
	" Ira Cole,		10 00	
				399 04
April	People vs. Fred. Meyers,		$20 00	
	" Albert Winch,		14 25	
	" John P. Freed,		15 10	
		Forward,	$49 35	$7,084 59

1898.		Brought forward,	$49 35	$7,084 59
April	People vs. Earl Degolia et al.,		42 00	
	" Robert Clarke,		15 00	
	" Ira Fiske et al.,		19 50	
	" New York Fish Co.,		150 00	
	" Clayton Lyons,		7 95	
				283 80
May	People vs. E. N. Goodspeed et al.,		$41 95	
	" Frederick Sinberg,		5 40	
	" William Hall,		50 00	
	" Benjamin Sweet,		14 00	
	" Augustus Richer,		60 00	
	" Albert B. Haight,		18 05	
	" Eben Tallman,		9 30	
	" Josh Farley,		5 00	
	" Sanford McCue,		10 00	
	" Bert Bense and another,		37 00	
	" James F. Griffing,		30 10	
	" Warren Towne,		14 85	
	" John N. Thompson,		17 65	
	" Elmer Grinshaw,		24 25	
	" Theodore Krauss,		22 50	
	" John Gladd,		16 00	
	" M. M. Mayhew,		200 00	
	" Henry Conklin,		19 90	
	" Charles F. Beebe,		9 90	
	" Stephen Tarpening,		100 00	
				705 85
June	People vs. Salem Town,		$15 00	
	" William Otis et al.,		50 00	
	" Thomas Charren,		3 20	
	" William Greene		24 00	
	" L. A. Sprague,		14 00	
	" C. F. Herrick et al.,		23 00	
	" Frank Chatman,		7 00	
	" H. Deifendorf,		29 25	
	" Otto Sutzer et al.,		15 00	
	" William H. Holmes,		7 25	
	" Eugene Hallenbeck, Jr.,		10 55	
	" Charles Childs,		5 45	
	" E. E. Miller,		100 00	
	" Jesse Honeywekl et al.,		300 00	
	" John S. Mohler and another,		30 00	
	" John Tanner,		5 00	
	" William H. Jackson,		10 10	
	" Ezra Zellef,		3 22	
		Forward,	$652 02	$8,074 24

1898.		Brought forward,	$652 02	$8,074 24
June	People vs. Conrad Fox,		10 00	
	" Frederick Barnes,		25 00	
	" Benjamin Bunnell,		40 00	
	" W. S. Taft et al.,		15 00	
				742 02
July	People vs. John McDonald, Jr.,		$50 00	
	" James Conklin,		9 88	
	" F. H Hansen,		14 25	
	" Wesley Kline,		14 75	
	" Nelson Davies,		23 45	
	" Cyrus Krounse,		18 50	
	" W. M. Vandenburg,		32 25	
	" Dwight Wager,		20 00	
	" Frank Gordon et al.,		27 60	
	" W. S. Gatting,		10 00	
	" W. A. Myers,		249 25	
	" Earl Babcock,		20 00	
	" George W. Thomas,		10 00	
	" J. W. Watts,		50 00	
	" Peter Beshaw,		11 50	
	" Burton & Barrows,		20 00	
				581 43
Aug.	People vs. W. & F. Near and G. Engle,		$30 00	
	" James H. McGifney,		25 00	
	" Charles Stevens,		50 00	
	" Otto Wasmund,		18 60	
	" H. F. Wells,		38 25	
	" Burton A. Petrie,		98 00	
	" Sherman Denton,		22 90	
	" George Houghtaling,		75 00	
	" Arthur Lyle,		50 00	
	" James Conley,		21 75	
	" George Perigo,		32 30	
				461 80
Sept.	People vs. Freeland Jones,		$24 50	
	" Rodener G. Bailey,		22 75	
	" James Hutchinson,		80 20	
	" Charles H. Dart,		9 88	
	" Sidney Tromblee,		58 05	
	" William H. Brown,		25 00	
	" Roscoe Coon,		15 00	
	" Adelbert Conklin,		5 00	
				240 38
	Total receipts,			$10,099 87

DISBURSEMENTS.

1897.				
Oct.	Sammis & Bierck,	attorneys' fees, . . .	$75 00	
	F. H. Kelly,	justice's fees, ...	4 25	
	Willett Kidd,	witness expenses, . . .	7 50	
	W. L. Reed,	moiety, ...	12 00	
	M. M. Jackson,	"	5 00	
	Taylor & Nichols,	attorneys' fees, . . .	79 05	
	John L. Ackley,	moiety, ...	9 95	
	Simon Marshall,	"	10 00	
	L. S. Emmons,	"	5 00	
	James F. Shedden,	"	3 07	
	William Wolf,	traveling expenses, . . .	6 52	
	A. B. Strough,	" " . . .	5 92	
	W. L. Reed,	moiety, ...	10 55	
	George B. Smith,	traveling expenses, . . .	7 57	
	John W. Lisk,	moiety, ...	118 05	
	Edgar Hicks,	"	84 50	
	James Holmes,	"	5 00	
	Morgan M. Jackson,	"	5 00	
	George B. Smith,	"	13 87	
	J. W. Littlejohn,	"	22 50	
	George W. Van Buren	"	12 50	
	W. L. Reed,	"	3 40	
	Albert Warren,	"	31 50	
	George B. Smith,	justice's fees, ...	9 89	
	Robert S. Jones,	court costs, ...	4 55	
	James S. Fox,	justice's fees, ...	2 95	
	Weed Benedict,	constable's fees, . . .	9 05	
	Elmer Warren,	deputy sheriff's fees, . .	13 25	
	B. W. Hoye,	justice's fees, ...	2 05	
	L. S. Emmons,	court costs, ...	8 05	
	L. B. Starke,	justice's fees, ...	4 25	
	Jas. Wright,	attorney's fees, . . .	15 00	
	E. W. Bozard,	" " . . .	15 00	
	Frederick H. Baker,	" " . . .	15 00	
	William H. Ronerdink,	justice's fees, ...	3 25	
	James E. Herbert,	constable's fees, . . .	4 75	
	Edwin C. Smith,	attorney's fees, . . .	10 00	
	J. M. Bennett,	constable's fees, . . .	2 50	
	Michael Markham,	" " . . .	3 50	
	Thomas J. Leddy,	justice's fees, ...	10 40	
	George W. Van Buren,	moiety, ...	7 50	
				$678 64
Nov.	E. J. Lobdell,	taxable costs, ...	$70 00	
	" "	extraordinary expenses, . .	68 34	
		Forward,	$138 34	$678 64

1897.		Brought forward,	$138 34	$678 64
Nov.	Sammis & Bierck,	judgment for damages,	400 00	
	L. S. Emmons,	constable's fees,	7 87	
	Edwin C. Smith,	attorney's fees,	10 00	
	Joseph Canepi,	moiety,	50 00	
	James Holmes,	"	10 00	
	John W. Lisk,	"	3 00	
	D. N. Pomeroy,	"	16 37	
	W. L. Reed,	"	20 00	
	E. J. Lobdell,	"	11 75	
	James Holmes,	"	10 00	
	A. B. Strough,	traveling expenses,	21 40	
	G. C. Silsbee,	justice's fees,	6 90	
	L. K. Williamson,	constable's fees,	9 50	
	Hiram J. Blood,	justice's fees,	3 50	
	" "	" "	7 15	
	Sheridan L. Buck,	" "	47 84	
	Daniel Eldridge,	constable's fees,	15 50	
	Smith & Castleman,	attorneys' fees,	25 00	
	Robert S. Jones,	moiety,	2 50	
	Charles H. Tree,	justice's fees,	7 10	
	Root, Orton, Baldwin & Co.,	attorneys' fees,	15 00	
	Frederick Cripps,	constable's fees,	10 70	
	Julius C. Case,	justice's fees,	2 20	
	William F. Lynn,	attorney's fees,	5 00	
	Taylor & Nichols,	" "	10 00	
	Harry C. Whitney,	constable's fees,	3 10	
	Thomas McGowan,	" "	5 65	
	Joseph Colby,	" "	4 80	
				880 17
Dec.	Harry E. Whitney,	constable's fees,	$3 60	
	George W. Van Buren,	moiety,	12 50	
	George B. Smith,	"	12 42	
	Carlos Hutchins,	"	10 00	
	M. C. Worts,	"	3 70	
	John E. Leavitt,	"	12 50	
	F. E. Dunham,	constable's fees,	8 00	
	W. T. Magoffin,	justice's fees,	3 95	
	" "	" "	12 75	
	George Carver,	moiety,	1 95	
	John L. Ackley,	"	25 00	
	Simon Marshall,	"	9 45	
	E. C. Smith,	attorney's fees,	26 74	
	N. C. Steele,	constable's fees,	15 05	
	H. H. Thompson,	justice's fees,	75	
	Clark & Tuthill,	attorneys' fees,	10 00	
		Forward,	$168 36	$1,558 81

1897.			Brought forward,	$168 36	$1,558 81
Dec.	Smith Soule,	attorney's fees,		15 00	
	E. C. Coons,	justice's fees,		8 19	
	H. C. Boardman,	sheriff's fees,		8 45	
	J. W. Atkinson,	attorney's fees,		15 00	
	James O'Brien,	constable's fees,		5 10	
	J. W. Pond,	moiety,		42 50	
	Sammis & Bierck,	attorneys' fees,		114 59	
	F. E. Dunham,	constable's fees,		12 00	
	Edgar Hicks,	moiety,		60 00	
					449 19
1898.					
Jan.	John L. Ackley,	moiety,		$5 65	
	James Geraghty,	"		4 25	
	Willett Kidd,	"		12 50	
	George H. Bush,	"		2 97	
	Willett Kidd,	"		10 00	
	George W. Van Buren,	"		15 00	
	Charles Carter,	attorney's fees,		7 50	
	G. M. Virgil,	constable's fees,		10 00	
	Henry F. Wheelock,	sheriff's fees,		10 00	
	A. D. Richardson,	attorney's fees,		15 60	
	W. G. Valentine,	" "		10 00	
	George Cook,	justice's fees,		6 35	
	Homer Hall,	constable's fees,		5 00	
	Henry French,	constable's fees,		23 10	
	J. S. Whipple,	attorney's fees,		27 00	
	Baldwin & Magee,	" "		20 00	
	William F. Bailey,	justice's fees,		5 25	
	Levi S. Lamb,	attorney's fees,		5 00	
	John U. Schroth,	sheriff's fees,		6 90	
	Carlos Hutchins,	court costs,		5 75	
	L. S. Emmons,	moiety,		50 00	
	" "	"		50 00	
	" "	"		37 50	
	John F. Kenney,	sheriff's fees,		4 58	
	Howard H. Widener,	attorney's fees,		25 00	
	A. M. T. St. John,	printing,		52 50	
	John H. Booth,	attorney's fees,		5 00	
	" "	" "		5 00	
	E. G. Gould,	attorney's fees,		31 75	
	Smith Soule,	justice's fees,		20 00	
	James F. Shedden,	moiety,		75 00	
	Edgar Hicks,	"		25 00	
	G. A. Case,	"		6 87	
	Spencer Hawn,	"		15 00	
			Forward,	$611 02	$2,008 00

1898.		Brought forward,	$611 02	$2,008 00
Jan.	G. B. Smith,	moiety, ...	25 00	
	George J. Stayman,	justice's fees, ...	5 60	
	Thomas Doyle,	constable's fees, ...	2 00	
	E. C. Smith,	attorney's fees, ...	10 70	
	William Wood, Jr.,	constable's fees, ...	4 85	
	" "	" "	3 85	
	E. C. Smith,	attorney's fees, ...	11 59	
	George J. Stayman,	constable's fees, ...	4 00	
	Benjamin W. Loring,	justice's fees, ...	12 60	
	Smith Soule,	attorney's fees, ...	10 00	
	Baldwin & Magee,	attorneys' fees, ...	22 50	
	Clark & Tuthill,	" "	35 00	
	B. H. McCollum,	court costs, ...	6 30	
	Charles T. Ennis,	attorney's fees, ...	10 00	
	Frank Winship,	constable's fees, ...	10 85	
	A. J. Helmer,	" "	2 50	
	Eugene Wade,	justice's fees, ...	2 35	
	M. M. Compson,	attorney's fees, ...	11 65	
	Lewis Deuchler,	justice's fees, ...	12 30	
	Hoag & Hammond,	attorneys' fees, ...	50 00	
	M. C. Worts,	moiety, ...	22 20	
	Joseph Sterling,	"	4 00	
	D. N. Pomeroy,	court costs, ...	10 10	
	" "	" "	1 25	
	" "	" "	3 50	
	" "	" "	6 15	
	F. T. Hamilton,	attorney's fees, ...	50 00	
	William Miner,	" "	50 00	
				1,001 86
Mch.	Charles Van Steenburgh,	moiety, ...	$5 00	
	J. W. Pond,	costs on appeal, ...	10 00	
	Alvin Winslow,	moiety, ...	37 50	
	William Everson,	"	50 00	
	M. C. Worts,	"	23 65	
	F. M. Potter,	"	5 05	
	E. J. Lobdell,	"	7 00	
	L. S. Emmons,	"	10 00	
	" "	"	12 50	
	James R. Van Ness,	attorney's fees, ...	5 00	
	W. J. McClusky,	" "	15 00	
	Lockwood & Hill,	" "	135 44	
	J. Lee Tucker,	" "	3 00	
	James O'Brien,	constable's fees, ...	7 12	
	D. J. Yeager,	justice's fees, ...	6 75	
				333 01
			Forward,	$3,352 87

1898.		Brought forward,		$3,352 87
April	J. W. Pond,	advanced for expenses,	$60 00	
	Robert S. Jones,	amount of fine returned (case of Julius G. Smith),	70 00	
	William Everson,	moiety,	10 00	
	F. S. Beede,	"	7 12	
	F. M. Potter,	"	7 55	
	Spencer Hawn,	"	21 00	
	E. I. Brooks,	"	16 50	
	L. S. Emmons,	"	7 50	
	E. A. Hazen,	"	9 75	
	Joseph St. John,	constable's fees,	8 30	
	Willett Kidd,	court costs,	22 50	
	Thomas Carmody,	attorney's fees,	10 00	
	Baldwin & Magee,	" "	11 25	
	Robert F. Thompson,	" "	10 00	
	Spencer Hawn,	disbursements,	3 13	
	Frederick J. Morey,	amount of judgment,	75 67	
	Taylor & Nichols,	attorneys' fees,	55 15	
	Clark & Tuthill,	" "	10 00	
	A. H. Hull,	constable's fees,	3 15	
	Benjamin W. Loring,	justice's fees,	10 95	
	Edgar Hicks,	moiety,	75 00	
				504 52
May	James Holmes,	moiety,	$20 97	
	F. M. Potter,	"	2 70	
	" "	"	25 00	
	E. J. Lobdell,	"	7 00	
	N. H. McCollum,	"	30 00	
	G. R. Wheeler,	"	9 02	
	Albert Warren,	"	4 65	
	E. A. Hazen,	"	2 50	
	Joseph Northup,	"	5 00	
	E. I. Brooks,	"	18 50	
	Albert Warren,	"	15 05	
	F. M. Potter,	"	7 42	
	James F. Shedden,	"	1 75	
	T. H. Donnelly,	"	8 82	
	F. S. Beede,	"	12 12	
	A. A. Wyckhoff,	"	11 25	
	Joseph Northup,	"	8 00	
	John E. Leavitt,	"	100 00	
	John L. Ackley,	"	9 95	
	J. W. Pond,	disbursements,	8 76	
	W. E. Hoysradt,	attorney's fees,	12 00	
	William J. Powers,	" "	50 00	
		Forward,	$370 46	$3,857 39

1898.		Brought forward,	$370 46	$3,857 39
May	William F. Bailey,	justice's fees,	3 65	
	Charles O. Bartlett,	constable's fees,	12 30	
	Frederick H. Baker,	attorney's fees,	5 00	
	Henry Copenhagen,	constable's fees,	2 05	
	James E. Herbert,	" "	3 00	
	E. C. Smith,	attorney's fees,	15 00	
	W. H. Ronerdink,	justice's fees,	6 90	
	John L. Ackley,	moiety,	4 95	
	L. S. Simmons,	"	21 52	
	Frank C. Seaman,	constable's fees,	9 25	
	James W. Tucker,	attorney's fees,	30 00	
	Charles W. G. Ross,	justice's fees,	17 70	
				501 78
June	E. J. Lobdell,	moiety,	$18 84	
	J. W. Pond,	"	7 50	
	Joseph Northup,	"	25 00	
	B. H. McCollum,	"	1 60	
	E. J. Lobdell,	"	12 00	
	F. M. Potter,	"	7 00	
	" "	"	11 50	
	E. I. Brooks,	"	3 50	
	Charles Vogelsang,	"	14 62	
	William M. Munger,	"	7 50	
	Charles M. Munger,	"	3 62	
	James Holmes,	"	5 27	
	E. I. Brooks,	"	2 72	
	J. W. Littlejohn,	"	44 50	
	E. J. Lobdell,	"	150 00	
	John E. Leavitt,	"	6 00	
	F. S. Beede,	"	14 50	
	William Wolf,	"	6 00	
	James Holmes,	"	5 05	
	J. F. Olin,	"	1 61	
	D. P. Wood,	"	5 00	
	William Everson,	"	12 50	
	J. D. Mills,	constable's fees,	9 50	
	J. M. Maybee,	attorney's fees,	10 00	
	F. O. Butterfield,	constable's fees,	13 20	
	H. E. Owen,	attorney's fees,	10 00	
	George Marenus,	constable's fees,	1 85	
	George Dougherty,	" "	2 45	
	Julius C. Carr,	justice's fees,	6 60	
	August Mayer,	constable's fees,	7 35	
	E. C. Smith,	attorney's fees,	10 25	
	Chamberlain & Page,	attorneys' fees,	75 00	
		Forward,	$512 03	$4,359 17

1898.			Brought forward,	$512 03	$4,359 17
June	R. R. McLane,	justice's fees,		2 00	
	R. P. Conklin,	" "		13 70	
	W. H. Wood,	constable's fees,		9 70	
	C. L. Waring,	attorney's fees,		17 22	
	Frederick H. Baker,	" "		85 58	
	C. L. Waring,	" "		8 94	
	Spencer Hawn,	disbursements,		12 50	
	J. R. Van Ness,	attorney's fees,		25 00	
	F. D. McNeil,	constable's fees,		5 95	
	George Marenus,	" "		5 75	
	H. H. Widener,	attorney's fees,		87 60	
	George B. Smith,	moiety,		20 00	
	Charles Vogelsang,	"		7 50	
					813 47
July	New York State National Bank, protested check,			$31 85	
	Alvin Winslow,	moiety,		25 00	
	John L. Ackley,	"		4 94	
	H. H. McKinnon,	"		7 12	
	E. A. Hazen,	"		7 37	
	Charles Knox,	"		11 72	
	L. S. Emmons,	"		9 25	
	Albert Warren,	"		16 12	
	Spencer Hawn,	"		10 00	
	T. H. Donnelly,	"		13 80	
	J. H. Lamphere,	"		10 00	
	L. S. Emmons,	"		5 00	
	Isaiah Vosburg,	"		25 00	
	J. F. Shedden,	"		5 75	
	E. J. Lobdell,	"		10 00	
	E. W. Bozard,	attorney's fees,		10 00	
	H. E. Owen,	" "		5 00	
	Robert F. Thompson,	" "		10 00	
	Milton Carter,	" "		10 00	
	Thomas Todd,	" "		7 30	
	B. F. Beers,	justice's fees,		5 60	
	Sammis & Bierck,	attorneys' fees,		11 04	
	George Carver,	disbursements,		14 50	
	John P. Kellas,	attorney's fees,		40 00	
	M. A. Martin,	justice's fees,		5 80	
	F. H. McOmber,	" "		10 05	
	W. H. McGrath,	" "		17 65	
	E. W. Swan,	constable's fees,		2 00	
	William Mack,	" "		4 95	
	M. M. Compson,	" "		6 00	
	M. H. Ingersoll,	justice's fees,		17 90	
			Forward,	$370 71	$5,172 64

1898.		Brought forward,	$370 71	$5,172 64
July	L. S. Emmons,	disbursements,	19 16	
	A. W. Craig,	justice's fees,	3 10	
	F. L. Clark,	attorney's fees,	25 00	
	George Barton,	constable's fees,	5 45	
	M. J. McGuire,	justice's fees,	5 55	
	John A. Adams,	" "	1 25	
	G. M. Williams,	judgment for costs,	53 51	
	G. M. Patterson,	justice's fees,	6 60	
	Charles Dudley,	constable's fees,	3 75	
	A. M. Payne,	justice's fees,	6 60	
	John C. Taylor,	attorney's fees,	10 00	
	Charles M. Faulkner,	constable's fees,	14 90	
	George H. Weyant,	justice's fees,	17 00	
				542 58
Aug.	L. S. Emmons,	moiety,	$15 00	
	E. J. Lobdell,	"	12 50	
	Isaiah Vosburg,	"	25 00	
	William Everson,	"	9 30	
	William M. Barnett,	"	1 82	
	T. A. Donnelly,	"	19 12	
	E. A. Hazen,	"	49 00	
	Charlex Knox,	"	11 45	
	George Carver,	"	91 80	
	F. S. Beede,	"	32 50	
	Alvin Winslow,	"	25 00	
	Robert S. Jones,	"	10 87	
	Joseph Northup,	"	16 15	
	Reuben Gray,	constable's fees,	2 25	
	Urie Van Tassaell,	" "	6 00	
	Sylvanus Moore,	justice's fees,	14 10	
	H. E. Owen,	attorney's fees,	10 00	
	Ethel M. McGonigal,	" "	35 00	
	D. D. Cameron,	justice's fees,	2 35	
	H. C. Stratton,	attorney's fees,	10 00	
	A. W. Craig,	justice's fees,	3 50	
	Baldwin & Magee,	attorneys' fees,	35 00	
	N. C. Steele,	constable's fees,	14 20	
	Burton N. Wiltsie,	justice's fees,	7 45	
	Edwin C. Smith,	attorney's fees,	15 00	
	Samuel Kennedy,	constable's fees,	2 00	
	Union Building Association,	use of hall for holding court,	3 00	
	Delbert C. Hebbard,	attorney's fees,	10 00	
	D. D. Cameron,	justice's fees,	5 65	
	Tuttle & Hallock,	judgment for damages,	163 66	
				658 67
			Forward,	$6,373 89

1898.			Brought forward,	$6,373 89
Sept.	Carlos Hutchins,	moiety,	$12 25	
	Bernard Salisbury,	"	11 37	
	" "	"	40 10	
	John L. Ackley,	"	4 94	
	W. J. Alfred,	"	29 02	
	John E. Leavitt,	"	12 50	
	" "	"	10 02	
	G. S. Van Alstyn,	justice's fees,	14 90	
	Jesse Jackson,	services,	7 50	
	Dudley & Childs,	attorneys' fees,	34 00	
	George Cook,	justice's fees,	3 55	
	Homer Hall,	constable's fees,	6 75	
	George W. Harmony,	disbursements,	3 15	
	Frederick O. Wait,	constable's fees,	20 50	
	B. H. McCollum,	disbursements,	20 75	
				231 30
	Total disbursements,			$6,605 19

Recapitulation of Fines and Penalties Account.

Number of cases in foregoing schedule,		160
Total amount recovered during fiscal year,	$6,227 19	
Balance in bank September 30, 1897,	3,872 68	
		$10,099 87
Disbursements during fiscal year,		6,605 19
Balance in bank September 30, 1898,		$3,494 68

Trespass on State Lands.

1897.	RECEIPTS.		
	Balance in State Bank October 1, 1897,		$831 03
Oct.	People vs. M. Floyd,	$24 00	
			24 00
Nov.	People vs. S. M. Rorke (Smith & Leonard),	$150 00	
	" Albert McCann,	50 00	
	" Scott Patterson,	20 00	
	" " "	20 00	
			240 00
Dec.	People vs. Scott Patterson,	$171 00	
	" Martin Lyon,	15 00	
	" Alvin A. Abbott,	25 00	
	" Frank Moore and another,	49 00	
	" C. Parquette,	14 00	
	" Isaiah Perkins,	102 50	
	" Willifred Colombe,	99 00	
	" Hannah Nolan,	24 00	
	" Charles Smith,	15 00	
			514 50
1898.			
Feb.	People vs. Antoine Colombe,	$100 00	
			100 00
Mch.	People vs. William J. Horton,	$30 00	
	" Patrick Kelly,	18 00	
	" John Rogers,	14 00	
	" John Davidson,	34 50	
			96 50
April	People vs. Arch Graham,	$19 00	
	" H. L. Wait, posts sold,	5 00	
	" C. A. McArthur,	30 00	
	" Scott Patterson,	39 00	
	" George West and M. Armer,	850 00	
	" Samuel Stiles,	40 00	
	" Royal Sterns,	8 00	
	" Frederick Lyons,	10 00	
	" William Edget,	10 00	
	" E. C. Ash,	10 00	
	" Hiram Scribner,	19 75	
	" J. S. Graves,	35 00	
	" Louis Souci,	8 50	
	" O. W. Shelden,	270 00	
	" Juna Moshier,	24 50	
			1,378 75
	Total receipts,		$3,184 78

DISBURSEMENTS.

1897.				
Oct.	E. J. Lobdell,	moiety, ...	$12 00	
				$12 00
Nov.	Isaac La Grange,	disbursements, ...	$7 50	
	Hiram A. Benham,	surveying, ...	15 00	
	E. J. Lobdell,	money advanced, ...	20 00	
	" "	expenses, ...	14 32	
	John P. Badger,	attorney's fees, . . .	44 64	
	J. W. Littlejohn,	moiety, ...	25 00	
	S. J. Palmer,	witness expenses, . . .	22 66	
	Isaac La Grange,	" " . . .	7 50	
				156 62
1898.				
Jan.	C. W. Smith,	attorney's fees and expenses, .	$350 86	
	Barney L. Goucher,	justice's fees, ...	4 50	
	G. A. McCoy,	surveying, ...	20 50	
	G. N. Woodworth,	"	29 00	
	John E. Leavitt,	moiety, ...	24 50	
	G. A. McCoy,	surveying, ...	16 00	
	James R. Van Ness,	attorney's fees, ...	93 85	
	E. J. Lobdell,	moiety, ...	7 00	
	Carlos Hutchins,	"	25 00	
	E. J. Lobdell,	"	25 00	
	" "	"	12 00	
	Carlos Hutchins,	"	9 00	
	Alvin Winslow,	"	7 50	
	S. B. Jenkins,	attorney's fees, ...	1 70	
	E. J. Lobdell,	moiety, ...	25 00	
	J. W. Pond,	disbursements, ...	6 96	
	S. J. Palmer,	expenses, ...	33 31	
	C. D. Gilson,	"	21 25	
	James R. Van Ness,	attorney's fees, ...	50 00	
	M. S. Bevins,	" "	150 00	
	B. H. McCollum,	moiety, ...	15 00	
	E. J. Lobdell,	"	7 00	
				934 93
Mch.	J. W. Littlejohn,	moiety, ...	$11 87	
	E. J. Lobdell,	"	17 25	
	J. W. Littlejohn,	"	6 87	
				35 99
April	E. J. Lobdell,	moiety, ...	$9 50	
	J. Newton Fiero,	attorney's fees, ...	53 00	
	Carlos Hutchins,	disbursements, ...	24 50	
	J. W. Littlejohn,	moiety, ...	15 00	
	" "	"	25 00	
		Forward,	$127 00	$1,139 54

1898.				
		Brought forward,	$127 00	$1,139 54
April	Nicholas Shaul,	moiety,	25 00	
	J. W. Pond,	"	25 00	
				177 00
May	Lyman Frost,	justice's fees,	$4 60	
	James R. Van Ness,	attorney's fees,	5 00	
	J. W. Houghton,	" "	250 00	
	Elmer Ostrander,	county clerk's fees,	1 00	
	James Green,	surveying,	7 00	
	Alvin Winslow,	moiety,	20 00	
	" "	"	4 00	
	E. J. Lobdell,	"	5 00	
	" "	"	5 00	
	" "	"	5 00	
	" "	"	9 87	
	B. H. McCollum,	"	17 50	
				333 97
June	Robert King,	surveying,	$9 50	
	Willis J. Fletcher,	attorney's fees,	194 19	
				203 69
July	Alvin Winslow,	moiety,	$25 00	
	H. L. Wait,	"	12 25	
	Silas Lawton,	services,	6 00	
				43 25
Aug.	Lucius Kelley,	services,	$21 00	
	Alvin Winslow,	disbursements,	2 02	
	Lorin Kelley,	services,	56 00	
				79 02
Sept.	William Wolf,	disbursements,	$21 25	
				21 25
	Total disbursements,			$1,997 72

Balance in bank September 30, 1897,	$831 03
Receipts during fiscal year ending September 30, 1898,	2,353 75
Total,	$3,184 78
Disbursements as per schedule,	1,997 72
Balance in bank September 30, 1898,	$1,187 06

SUMMARY OF LICENSES ISSUED TO NET FISH FOR FISCAL YEAR ENDING SEPTEMBER 30, 1898.

Number issued for Lake Ontario,	90
" " Lake Erie,	82
" " Otsego Lake,	46
" " Hudson River,	247
" " Delaware River,	10
" " Wappinger Creek,	3
" " Ten Mile River,	2
" " Chaumont Bay, etc.,	30
Total licenses issued,	510
Total receipts from licenses,	$658 00
Balance October 1, 1897,	182 00
Balance September 30, 1898,	$840 00

Rentals of Shellfish Lands.

1897.	RECEIPTS		
Oct.	Commissioner Thompson,	$189 67	
Nov.	" "	27 50	
Dec.	" "	406 07	
1898.			
Jan.	Commissioner Thompson,	84 20	
Feb.	" "	170 49	
April	" "	81 26	
May	" "	66 22	
June	" "	144 93	
Aug.	" "	135 18	
	Total receipts,		$1,305 52
1897.	DISBURSEMENTS.		
Nov.	James A. Roberts, Comptroller,	$189 67	
	" " "	27 50	
Dec.	" " "	406 07	
1898.			
Jan.	James A. Roberts, Comptroller,	84 20	
Feb.	" " "	65 00	
	" " "	105 49	
May	" " "	66 22	
June	" " "	226 19	
Aug.	" " "	135 18	
	Total disbursements,		$1,305 52

Rentals of State Lands.

1898.	Receipts.		
July	W. P. Mason,	$150 00	
	W. D. Mann,	50 00	
	T. H. Stott,	20 00	
Aug.	J. B. Henderson,	50 00	
Sept.	A. L. Judson,	100 00	
	Total receipts,		$370 00

1898.	Disbursements.		
July	James A. Roberts, Comptroller,	$50 00	
	" " "	50 00	
Sept.	" " "	270 00	
	Total disbursements,		$370 00

Miscellaneous Receipts.

1898.	Receipts.		
Jan.	From Charles H. Babcock, Commissioner, cash received from Supt. James Annin, for sale of whitefish from Canandaigua Lake,	$100 06	
	Total receipts,		$100 06

1898.	Disbursements.		
Jan.	James A. Roberts, Comptroller,	$100 06	
	Total disbursements,		$100 06

Schedule of Licenses Issued to Net Fish and Receipts for Same for the Fiscal Year Ending September 30, 1898.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
Henry Deidrich,	Coxsackie,	Hudson River,	20 fyke,	$1 00
Harry T. Ray,	Hudson,	"	30 "	1 00
R. L. Clarkson,	Tivoli,	"	2 "	1 00
Lee Warner,	Kuchville,	Lake Ontario,	2 gill,	2 00
Orvis Luff,	Henderson,	"	1 "	1 00
C. H. Sabin,	North Fair Haven,	"	1 "	1 00
I. H. Allerdice,	Poelsburg,	Hudson River,	5 fyke,	1 00
Ernest Olin,	Hudson,	"	3 "	1 00
Horace Hallenbeck,	"	"	20 "	1 00
I. A. Elting,	"	"	7 "	1 00
William Hallenbeck,	Schodack Landing,	"	10 "	1 00
E. A. Brandow,	Athens,	"	4 "	1 00
James Kinnecutt,	Albany,	"	20 "	1 00
Harry Knol,	Schodack Landing,	"	12 "	1 00
William Welch,	Wemple,	"	6 "	1 00
A. H. Donerly,	Tivoli,	"	3 "	1 00
I. P. Warner,	Stuyvesant Landing,	"	5 "	1 00
Frazer & Gill,	Henderson,	Lake Ontario,	1 gill,	1 00
W. H. Stevens,	"	"	1 ciscoe,	1 00
F. B. Riechert,	Poughkeepsie,	Wappinger Creek,	1 gill,	1 00
G. T. Record,	Dover Plains,	Ten Mile River,	1 "	1 00
Lester Miller,	North Germantown,	Hudson River,	20 fyke,	1 00
Abram Spanburgh,	Hudson,	"	20 "	1 00
			Forward,	$24 00

SCHEDULE OF LICENSES.—Continued.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$24 00
George N. Sheffer,	Linlithgo,	Hudson River,	30 fyke,	1 00
Ephram Snyder,	North Germantown,	"	12 "	1 00
Ransler Proper,	Linlithgo,	"	30 "	1 00
E. A. Brandow,	Athens,	"	4 "	1 00
Henry Sheffer,	Germantown,	"	10 "	1 00
John Locknell,	North Germantown,	"	15 "	1 00
D. W. Secor,	Hudson,	"	20 "	1 00
W. Fredenburgh,	Catskill,	"	15 "	1 00
W. I. Race,	Hudson,	"	20 "	1 00
J. H. Hamm,	"	"	20 "	1 00
William Miller,	Germantown,	"	8 "	1 00
John Pilkington,	Wilson,	Lake Ontario,	1 gill,	1 00
Peter Race,	Hudson,	Hudson River,	20 fyke,	1 00
Charles Stark,	Pawling,	Ten Mile River,	1 net,	1 00
Peter Gregory,	Bath-on-Hudson,	Hudson River,	18 fyke,	1 00
Jacob Sheffer,	North Germantown,	"	4 "	1 00
C. M. Smith,	New Hackensack,	Wappinger Creek,	1 gill,	1 00
Ernest Olin,	Hudson,	Hudson River,	20 fyke,	1 00
Levi Ham,	Catskill,	"	10 "	1 00
L. F. Decker,	Catskill Station,	"	2 "	1 00
C. H. Wheeler,	Wilson,	Lake Ontario,	1 gill,	1 00
Simon Rockfeller,	Germantown,	Hudson River,	3 fyke,	1 00
H. E. Kelly,	Tivoli,	"	4 "	1 00
Theodore Brandow,	Hudson,	"	5 "	1 00
Henry Fellen,	Linlithgo,	"	10 "	1 00
			Forward,	$49 00

SCHEDULE OF LICENSES.—Continued.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$49 00
R. L. Clarkson,	Tivoli,	Hudson River,	2 fyke,	1 00
I. A. Shover,	Watervliet,	"	1 dip,	1 00
William Welch,	Wemple,	"	8 fyke,	1 00
Timothy Wilson,	Wilson,	Lake Ontario,	1 gill,	1 00
William Wilson,	"	"	1 "	1 00
G. D. Martin,	Poughkeepsie,	Wappinger Creek,	1 "	1 00
Philip Shannon,	Watervliet,	Hudson River,	1 scap,	1 00
H. H. Waring,	Medina,	Lake Ontario,	1 gill,	1 00
Daniel Murry,	Watervliet,	Hudson River,	1 dip,	1 00
Henry Cohn,	Hudson,	"	7 fyke,	1 00
W. H. Hallenbeck,	Schodack Landing,	"	10 "	1 00
Peter F. Bronk,	Stuyvesant,	"	15 "	1 00
D. M. Wheeler,	Wilson,	Lake Ontario,	2 gill,	2 00
John Scharff,	Wemple,	Hudson River,	1 seine,	1 00
Thomas McKernan,	Watervliet,	"	30 fyke,	1 00
William Stroker,	Buffalo,	Lake Erie,	1 gill,	1 00
Anton Potosi,	"	"	1 "	1 00
J. H. McGilfrey,	Bath-on-Hudson,	Hudson River,	15 fyke,	1 00
Oscar Shultis,	Cheviot,	"	20 "	1 00
William H. Brandow,	Catskill,	"	15 "	1 00
James McGregor,	Derby,	Lake Erie,	1 trap,	1 00
" "	"	"	1 gill,	1 00
James King,	"	"	1 "	1 00
" "	"	"	1 "	1 00
T. W. Strobel,	Buffalo,	"	3 "	3 00
			Forward,	$77 00

SCHEDULE OF LICENSES.—Continued.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$77 00
George F. Mugredge,	Buffalo,	Lake Erie,	1 gill,	1 00
E. A. Alvers,	Wilson,	Lake Ontario,	1 "	1 00
John Wagner,	Youngstown,	"	1 "	1 00
F. L. Powley,	"	"	2 "	2 00
Eldin Sprague,	Pillar Point,	"	1 "	1 00
A. Van Sternburgh,	Youngstown,	"	1 "	1 00
Mary L. Best,	Hudson,	Hudson River,	1 seine,	1 00
Hammer & Race,	"	"	1 "	1 00
A. Stammell,	Rensselaer,	"	10 fyke,	1 00
William Clark,	Watervliet,	"	1 dip,	1 00
Coons & Saulspaugh,	Hudson,	"	20 fyke,	1 00
Joseph Square,	Buffalo,	Lake Erie,	1 gill,	1 00
John S. Wilson,	Wilson,	Lake Ontario,	1 "	1 00
J. A. Elting,	Hudson,	Hudson River,	7 fyke,	1 00
Horace Hallenbeck,	"	"	20 "	1 00
John Hallenbeck,	"	"	1 seine,	1 00
John H. Hill,	West Camp,	"	20 fyke,	1 00
A. Stammell,	Rensselaer,	"	1 seine,	1 00
Cornelius Best,	Stuyvesant,	"	20 fyke,	1 00
Clarence Temple,	Linlithgo,	"	30 "	1 00
W. Johnsbee,	Castleton,	"	10 "	1 00
Johnsbee & Tobias,	"	"	2 seine,	1 00
Herman Signow,	"	"	2 "	1 00
J. B. Lewis,	"	"	20 fyke,	1 00
Emery Tryon,	Lake View,	Lake Erie,	1 gill,	1 00
			Forward,	$103 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$103 00
H. J. McEwan,	Evans,	Lake Erie,	1 gill,	1 00
"	"	"	2 seine,	1 00
Lee Warner,	Kuchville,	Lake Ontario,	1 gill,	1 00
I. A. Gambell,	Yates,	"	1 "	1 00
C. S. Watkins,	Irving,	Lake Erie,	1 "	1 00
Waters & Funk,	North Germantown,	Hudson River,	20 fyke,	1 00
I. H. Allerdice,	Poelsburg,	"	5 "	1 00
J. M. Askins,	Troy,	"	1 scap,	1 00
M. Halscher,	Castleton,	"	2 seine,	1 00
M. Halscher,	"	"	30 fyke,	1 00
George W. Miller,	Cheviot,	"	15 "	1 00
Henry Striland,	Coeymans,	"	6 "	1 00
A. H. Donnerly,	Tivoli,	"	5 "	1 00
William Ronshea,	Troy,	"	1 drop,	1 00
Joseph Oathout,	"	"	10 fyke,	1 00
Joseph Aby,	Watervliet,	"	1 dip,	1 00
W. H. Stammell,	Albany,	"	7 fyke,	1 00
"	"	"	1 seine,	1 00
Frank Pound,	Athol Springs,	Lake Erie,	1 gill,	1 00
J. W. Page,	Derby,	"	1 "	1 00
E. B. Horton,	Henderson Harbor,	Lake Ontario,	1 "	1 00
Timothy Sheehan,	Poelsburg,	Hudson River,	2 seine,	1 00
J. B. Lynch,	Coxsackie,	"	1 "	1 00
George A. Wicke,	Rensselaer,	"	6 fyke,	1 00
Clarence Jackway,	Fredonia,	Lake Erie,	1 trap,	1 00
			Forward,	$128 00

SCHEDULE OF LICENSES.—Continued.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$128 00
Frank Shovel,	Watervliet,	Hudson River,	1 dip,	1 00
Silas Noble,	Olcott,	Lake Ontario,	5 gill,	5 00
John McIntyre,	Irving,	Lake Erie,	1 "	1 00
John H. Dyer,	Watervliet,	Hudson River,	5 hoop, }	1 00
"	"	"	1 dip, }	
Edward Albertson,	Stuyvesant,	"	1 seine,	1 00
Frank Thompson,	Kuchville,	Lake Ontario,	2 gill,	2 00
E. Joseph,	Buffalo,	Lake Erie,	1 "	1 00
John O'Keefe,	"	"	1 "	1 00
John Silvey,	"	"	1 "	1 00
John Pilkington,	Wilson,	Lake Ontario,	1 "	1 00
Henry Peterson,	Angola,	Lake Erie,	1 sturgeon,	1 00
Peter Nelson,	"	"	1 sucker,	1 00
Charles Peter,	Schodack Landing,	Hudson River,	1 seine,	1 00
James Vanderpool,	Cedar Hills,	"	1 "	1 00
F. Cookingham,	Rensselaer,	"	1 fyke,	1 00
Alfred Shiffer,	Germantown,	"	2 gill,	1 00
F. W. Elling,	Greenport,	"	2 fyke,	1 00
Charles Trautwein,	Buffalo,	Lake Erie,	1 gill,	1 00
C. W. Desmond,	"	"	1 "	1 00
John Beck,	"	"	3 "	3 00
Jacob Bush,	Columbiaville,	Hudson River,	1 seine, }	1 00
"	"	"	1 dip, }	
William Firebrand,	West Seneca,	Lake Erie,	1 gill,	1 00
E. L. Morgan,	"	"	1 "	1 00
			Forward,	$158 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$158 00
Frederick Solomon,	Cedar Hill,	Hudson River,	1 seine,	1 00
Robert Taylor & Son,	Point Breeze,	Lake Ontario,	1 gill,	1 00
Taylor & Roche,	"	"	3 sturgeon,	3 00
G. A. Wicke,	Rensselaer,	Hudson River,	1 seine,	1 00
John Kehner,	Glenmont,	"	15 fyke,	1 00
"	"	"	1 seine,	1 00
Thomas A. Huddy,	Buffalo,	Lake Erie,	1 gill,	1 00
" "	"	"	1 sturgeon,	1 00
A. A. Bugbee,	Olcott,	Lake Ontario,	1 gill,	1 00
B. S. Martin,	Angola,	Lake Erie,	2 "	2 00
"	"	"	2 trap,	2 00
W. H. Jackway,	Westfield,	"	1 "	1 00
H. J. Willis,	"	"	1 gill,	1 00
W. J. Peckham,	North Evans,	"	1 "	1 00
J. B. Page,	Derby,	"	1 "	1 00
Harry Moore,	Lyndonville,	Lake Ontario,	1 "	1 00
M. C. Rodker,	Colchester,	Delaware River,	1 seine,	1 00
Theodore Race,	Hudson,	Hudson River,	5 fyke,	1 00
E. M. Hover,	Linlithgo,	"	3 drift,	1 00
Rance Riddle,	Albany,	"	5 fyke,	1 00
John Duffy,	Linlithgo,	"	1 drift,	1 00
Lester Miller,	North Germantown,	"	2 shad,	1 00
J. Fitzpatrick,	Youngstown,	Lake Ontario,	1 gill,	1 00
C. C. Lockwood,	Olcott,	"	1 "	1 00
Joseph Crowley,	Kuchville,	"	1 "	1 00
			Forward,	$187 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$187 00
C. Martlekofsky,	Albany,	Hudson River,	24 fyke,	1 00
Samuel Melius,	Saugerties,	"	10 "	1 00
Thomas Murphy,	Watervliet,	"	20 "	1 00
George Denne,	"	"	1 seine,	1 00
Peter Gregory,	Bath,	"	1 "	1 00
John Locknell,	North Germantown,	"	3 drift,	1 00
John Spellman,	Catskill Station,	"	2 fyke,	1 00
Cornelius Slingerland,	Coeymans,	"	1 seine,	1 00
Ansil Westcott,	Yates,	Lake Ontario,	1 gill,	1 00
William Clark,	Kuchville,	"	1 "	1 00
George Wagner,	Youngstown,	"	2 "	2 00
William Shiffer,	Troy,	Hudson River,	1 seine,	1 00
J. A. Robinson,	Green Island,	"	1 "	1 00
Frank Pound,	Athol Springs,	Lake Erie,	1 fyke,	1 00
Alfred Olson,	Buffalo,	"	1 gill,	1 00
H. A. Monroe,	Westfield,	"	2 "	2 00
Anthony Gotschalk,	"	"	1 "	1 00
R. Hoot & Son,	Point Breeze,	Lake Ontario,	1 "	1 00
" "	"	"	1 sturgeon,	1 00
George B. Martin,	Olcott,	"	1 gill,	1 00
W. H. Comstock,	Point Breeze,	"	2 "	2 00
George Flicker,	Malden,	Hudson River,	2 drift,	1 00
William Swart,	"	"	2 "	1 00
William H. Swart,	"	"	2 "	1 00
William H. Askins,	Lansingburgh,	"	1 seine,	1 00
			Forward,	$215 00

SCHEDULE OF LICENSES.—Continued.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$215 00
Charles Wood,	Coxsackie,	Hudson River,	1 gill,	1 00
John Ryan,	Olcott,	Lake Ontario,	1 "	1 00
Frank Wirtz,	Buffalo,	Lake Erie,	2 "	2 00
M. D. Tucker,	"	"	2 "	2 00
J. Van Apledorn,	Glenmont,	Hudson River,	1 seine,	1 00
Frederick Moore,	North Germantown,	"	2 drift,	1 00
Frederick Mosley,	New Baltimore,	"	1 "	1 00
N. Pauley,	Albany,	"	25 fyke,	1 00
J. McNamara,	Rensselaer,	"	1 dip,	1 00
Jennings & Pechtal,	Catskill Station,	"	2 gill,	1 00
Oscar Shultes, Jr.,	Cheviot,	"	3 "	1 00
A. Rightmeyer,	Linlithgo,	"	2 drift,	1 00
John Burns,	Buffalo,	Lake Erie,	1 gill,	1 00
Frederick Helwig,	Dunkirk,	"	1 "	1 00
" Jr.,	"	"	1 "	1 00
George Paxton,	"	"	1 "	1 00
A. Baker,	"	"	1 "	1 00
Theodore F. Clark,	Watervliet,	"	1 seine,	1 00
C. H. Bogart,	Downsville,	Delaware River,	1 drag,	1 00
J. W. Fuller,	"	"	1 "	1 00
N. A. White,	Delhi,	"	1 "	1 00
A. R. Briggs,	Coeymans,	Hudson River,	2 seine,	1 00
Owen McLoughlin,	Troy,	"	1 scap,	1 00
T. R. Platner,	Linlithgo,	"	2 gill,	1 00
Charles H. Turpening,	Malden,	"	2 drift,	1 00
			Forward,	$242 00

SCHEDULE OF LICENSES.—Continued.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$242 00
Benjamin J. Overbaugh,	Malden,	Hudson River,	2 drift,	1 00
Russell Overbaugh,	"	"	2 "	1 00
David Overbaugh,	"	"	2 "	1 00
G. W. Turpening,	"	"	2 "	1 00
James D. Rightmyer,	"	"	2 "	1 00
William Hallock,	Harwood,	Delaware River,	2 seine,	2 00
Samuel Overbaugh,	West Camp,	Hudson River,	5 gill,	1 00
C. J. Rightmyer,	Malden,	"	3 "	1 00
J. J. Pindar,	Catskill,	"	5 seine,	1 00
W. L. Ackerman,	Wilson,	Lake Ontario,	1 gill,	1 00
J. & N. Cronise,	Catskill,	Hudson River,	3 "	1 00
J. N. Plass,	Catskill Station,	"	2 "	1 00
D. Hallenbeck,	" "	"	2 "	1 00
Jesse Cole,	" "	"	2 "	1 00
R. I. Case,	Portland,	Lake Erie,	3 trap,	3 00
H. E. Kelly,	Tivoli,	Hudson River,	3 drift,	1 00
Snyder & Sheffer,	North Germantown,	"	3 gill,	1 00
J. Hanrahan,	Rensselaer,	"	12 fyke,	1 00
Cornelius Best,	Stuyvesant,	"	2 seine,	1 00
T. B. Best,	Linlithgo,	"	2 gill,	1 00
W. C. Saulspaugh,	North Germantown,	"	2 drift,	1 00
John Desmond,	Dunkirk,	Lake Erie,	1 gill,	1 00
J. A. Martin,	Olcott,	Lake Ontario,	1 "	1 00
Willard Warner,	Kuchville,	"	1 "	1 00
John Lewis,	Smith's Landing,	Hudson River,	2 drift,	1 00
			Forward,	$270 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$270 00
W. S. Sprague,	Downsville,	Delaware River,	2 drag,	2 00
A. England,	Angola,	Lake Erie,	1 gill,	1 00
J. S. Coons,	North Germantown,	Hudson River,	3 "	1 00
Chester Rockefeller,	Cheviot,	"	3 drift,	1 00
Louis Oliver,	Albany,	"	1 seine,	1 00
G. W. Drumgold,	North Germantown,	"	1 drift,	1 00
Martin Coon,	"	"	1 "	1 00
C. H. Lasher,	"	"	2 gill,	1 00
Samuel Sheffer,	"	"	4 "	1 00
Haskell Dietrich,	Coxsackie,	"	1 seine,	1 00
Schlaeber & Saubert,	Smith's Landing,	"	2 gill,	1 00
William Hagadorne,	Woodville,	Lake Ontario,	1 "	1 00
C. E. Ackerman,	Wilson,	"	1 "	1 00
Ernest Thayer,	Point Breeze,	"	1 "	1 00
H. E. Turpening,	Malden,	Hudson River,	2 "	1 00
Richard Edgley,	Columbiaville,	"	15 fyke,	1 00
John Barton,	Lake View,	Lake Erie,	1 trap,	1 00
C. H. McGarrett,	Westfield,	"	1 "	1 00
"	"	"	1 gill,	1 00
Herman Myers,	Buffalo,	"	1 "	1 00
Clarke Boner,	Youngstown,	Lake Ontario,	2 "	2 00
George Wickham,	Malden,	Hudson River,	2 "	1 00
Isaac Zielman,	"	"	2 "	1 00
Frank Cooper,	Cooperstown,	Otsego Lake,	1 seine,	1 00
M. D. Eckler,	"	"	1 "	1 00
			Forward,	$297 00

SCHEDULE OF LICENSES.—Continued.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$297 00
F. & D. B. Wood,	Cooperstown,	Otsego Lake,	1 seine,	1 00
E. J. Farquharson,	"	"	1 "	1 00
L. C. Flint,	Spent Brook,	"	1 "	1 00
Stuart & Gould,	Springfield Centre,	"	1 "	1 00
G. W. Thayer,	" "	"	1 "	1 00
Smith & Snyder,	" "	"	1 "	1 00
Wood & Acker,	Cherry Valley,	"	1 "	1 00
J. K. Rightmyer,	Malden,	Hudson River,	2 gill,	1 00
Thomas McKernan,	Watervliet,	"	1 seine,	1 00
Ephraim Snyder,	North Germantown,	"	2 drift,	1 00
J. H. Eaton,	Coxsackie Station,	"	1 fyke,	1 00
Kirke E. White,	Springfield Centre,	Otsego Lake,	1 seine,	1 00
J. S. Defrate,	" "	"	1 "	1 00
Alfred Brockway,	" "	"	1 "	1 00
W. J. Thayer,	" "	"	1 "	1 00
Frank McEwen,	Nashville,	"	1 "	1 00
F. & D. House,	Cooperstown,	"	1 "	1 00
John Oathout,	West Troy,	Hudson River,	1 "	1 00
Smith & Fiero,	Tivoli,	"	3 gill,	1 00
P. P. Smith,	"	"	2 "	1 00
Charles Fredenburg,	Catskill,	"	3 "	1 00
Lester Kisselburgh,	Athens,	"	3 scap,	1 00
Patrick Brodhue,	Buffalo,	Lake Erie,	1 sturgeon,	1 00
T. P. Gardiner,	Smith's Landing,	Hudson River,	1 gill,	1 00
Anthony Simmons,	Malden,	"	2 drift,	1 00
			Forward,	$322 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$322 00
Clarence Wolven,	Malden,	Hudson River,	2 drift,	1 00
J. H. Salspaugh,	Cheviot,	"	2 seine,	1 00
Miller & Shotis,	"	"	2 "	1 00
Henry Odell,	Coxsackie,	"	20 fyke,	1 00
A. Castle,	New Baltimore,	"	2 seine,	1 00
H. L. Lasher,	West Camp,	"	1 gill,	1 00
Thomas Dennee,	Cape Vincent,	Lake Ontario,	1 "	1 00
R. J. Barryman,	Somerset,	"	1 "	1 00
F. P. Smith,	Kendall,	"	1 sturgeon,	1 00
H. L. Moore,	West Camp,	Hudson River,	4 gill,	1 00
William Disher,	Cheviot,	"	1 "	1 00
Theodore Brandow,	Hudson,	"	2 "	1 00
H. F. Drake,	Linlithgo,	"	3 "	1 00
Nathan Baxter,	Hancock,	Delaware River,	1 "	1 00
P. E. Tridee,	Lake View,	Lake Erie,	1 "	1 00
Miller & Hoke,	Cooperstown,	Otsego Lake,	1 seine,	1 00
Peasley & Wyckhoff,	East Springfield,	"	1 "	1 00
Burt Hibbard,	Cooperstown,	"	1 "	1 00
Parish & Parish,	"	"	1 "	1 00
Parshall & Mason,	"	"	1 "	1 00
S. S. Kuishkern,	"	"	1 "	1 00
F. E. Hopkins,	"	"	1 "	1 00
Barton & Bemis,	"	"	1 "	1 00
Hibbard & Fisk,	"	"	1 "	1 00
Weederspoon & Patterson,	"	"	1 "	1 00
			Forward,	$347 00

SCHEDULE OF LICENSES.—Continued.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$347 00
C. McChesney,	Cooperstown,	Otsego Lake,	1 seine,	1 00
George E. Newkirk,	"	"	1 "	1 00
N. J. Quaif,	Fly Creek,	"	1 "	1 00
George F. Muggridge,	Buffalo,	Lake Erie,	1 sturgeon,	1 00
Joseph Edwards,	Lake View,	"	1 trap,	1 00
Eugene Shafer,	Olcott,	Lake Ontario,	1 gill,	1 00
Joseph Hamod,	County Line,	"	1 "	1 00
Jacob Sheffer,	North Germantown,	Hudson River,	2 drift,	1 00
Lewis W. Cashdollar,	Tivoli,	"	2 gill,	1 00
A. L. Cross,	"	"	1 "	1 00
James Kinnecutt,	Albany,	"	20 fyke,	1 00
J. S. Melius,	Bath,	"	1 gill,	1 00
Alfred Hull,	Rosebloom,	Otsego Lake,	1 seine,	1 00
V. P. Cooper,	Cooperstown,	"	1 "	1 00
George Halpin,	"	"	1 "	1 00
Hogan & Potter,	"	"	1 "	1 00
E. J. Tryon,	Lake View,	Lake Erie,	5 trap,	5 00
C. J. Higgs,	County Line,	Lake Ontario,	1 gill,	1 00
James Garrick,	Kuchville,	"	1 "	1 00
Eldred & Hines,	Cooperstown,	Otsego Lake,	1 seine,	1 00
Lewis Evans,	Buffalo,	Lake Erie,	1 sturgeon,	1 00
Isaac Lucus,	Malden,	Hudson River,	1 gill,	1 00
Alpheus Simmons,	Tivoli,	"	2 sturgeon,	1 00
Frank Turpening,	Malden,	"	2 drift,	1 00
George Fredenburgh,	Catskill,	"	3 "	1 00
			Forward,	$376 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$376 00
M. F. Dunn,	Buffalo,	Lake Erie,	1 gill,	1 00
Peter Georgiana,	Malden,	Hudson River,	2 drift,	1 00
Edward Sniffen,	"	"	1 "	1 00
Henry Funk,	Linlithgo,	"	1 "	1 00
William Britton,	Coeymans,	"	1 seine,	1 00
Simmonds & Snyder,	West Camp,	"	1 drift,	1 00
R. B. Sheffer,	Catskill,	"	3 gill,	1 00
William Miller, Jr.,	North Germantown,	"	2 "	1 00
George Wallace,	Hudson,	"	1 seine,	1 00
William Hull,	Malden,	"	2 gill,	1 00
Henry Filler,	Catskill Station,	"	2 "	1 00
W. W. Golden,	Downsville,	Delaware River,	2 drag,	2 00
Henry D. Face,	Evans,	Lake Erie,	1 sturgeon,	1 00
C. J. Jackway,	Cushing,	"	2 trap,	2 00
E. H. Crook,	Ellisburg,	Lake Ontario,	1 seine,	1 00
Del. Mallory,	Cooperstown,	Otsego Lake,	1 "	1 00
Charles Austin,	Stottville,	Hudson River,	1 "	1 00
W. Van Steenburgh,	Watervliet,	"	1 "	1 00
Alfred Olsen,	Buffalo,	Lake Erie,	1 trap,	1 00
S. H. Shelden,	Cooperstown,	Otsego Lake,	1 seine,	1 00
Fredenburgh & Rathbone,	Springfield Centre,	"	1 "	1 00
L. A. Rowland,	Shinhopple,	Delaware River,	1 "	1 00
N. J. Rulison,	"	"	1 "	1 00
Charles Flicher,	Malden,	Hudson River,	2 gill,	1 00
Walter Flisher,	"	"	2 "	1 00
			Forward,	$403 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$403 00
Frank Leek,	Athens,	Hudson River,	1 seine,	1 00
C. F. Van Duser,	Hudson,	"	2 gill,	1 00
J. M. Van Loon,	Coxsackie,	"	2 seine,	1 00
B. & F. Kenyon,	County Line,	Lake Ontario,	1 gill,	1 00
Kenyon & Payne,	" "	"	1 "	1 00
C. F. James,	Chaumont,	"	5 sturgeon,	5 00
Ed. Overbaugh,	Smith's Landing,	Hudson River,	2 gill,	1 00
Charles Plass,	Catskill Station,	"	1 drift,	1 00
William Bacher,	Malden,	"	2 gill,	1 00
E. Briggs,	Coxsackie,	"	1 "	1 00
John Outt,	"	"	1 "	1 00
Theodore Featsel,	"	"	2 drift,	1 00
O. C. Hill,	West Camp,	"	1 gill,	1 00
F. C. Melius,	Saugerties,	"	1 "	1 00
A. T. Sharpsteen,	Barkers,	Lake Ontario,	1 "	1 00
A. H. Daniel,	Lindenville,	"	1 "	1 00
William Stevenson,	Evans,	Lake Erie,	1 "	1 00
M. Washuco,	Buffalo,	"	1 "	1 00
A. H. Gazelley,	Cooperstown,	Otsego Lake,	1 seine,	1 00
W. L. Atwater,	Barkers,	Lake Ontario,	1 gill,	1 00
Joseph Webber,	Evans,	Lake Erie,	1 "	1 00
William F. Davidson,	Troy,	Hudson River,	1 seine,	1 00
Harry Ray,	Hudson,	"	3 drift,	1 00
C. H. Sabin,	North Fairhaven,	Lake Ontario,	1 gill,	1 00
F. W. Ingraham,	Dunkirk,	Lake Erie,	6 trap,	6 00
			Forward,	$437 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$437 00
John C. Barber,	Three Mile Bay,	Lake Ontario,	2 trap,	2 00
John H. Correll,	North Huron,	"	3 gill,	3 00
J. H. Williams,	Irving,	Lake Erie,	1 sturgeon,	1 00
John Hooper,	Buffalo,	"	1 "	1 00
J. H. Greene,	Coxsackie,	Hudson River,	1 gill,	1 00
A. D. Sheffer,	Catskill,	"	1 "	1 00
H. B. Whitbeck,	Stuyvesant,	"	1 drift,	1 00
Frank Thompson,	Kuchville,	Lake Ontario,	1 sturgeon,	1 00
Warren & Outwater,	Cape Vincent,	"	1 gill,	1 00
A. D. Lathrop,	Stockport Centre,	Hudson River,	1 drift,	1 00
J. A. Lake,	North Germantown,	"	1 gill,	1 00
John M. Miller,	Linlithgo,	"	2 "	1 00
A. H. Lanphere,	Dunkirk,	Lake Erie,	1 "	1 00
Gates Phillips,	Cape Vincent,	Lake Ontario,	1 "	1 00
H. G. Bartells,	Green Island,	Hudson River,	2 seine,	1 00
F. E. Finckle,	Stuyvesant,	"	1 drift,	1 00
John Oberst,	Buffalo,	Lake Erie,	1 gill,	1 00
George R. Davis,	Cooperstown,	Otsego Lake,	1 seine,	1 00
Harry Hoffman,	Tivoli,	Hudson River,	2 gill,	1 00
Mary L. Best,	Hudson,	"	1 seine,	1 00
Bert Sweet,	Dunkirk,	Lake Erie,	1 gill,	1 00
Abram Wisse,	Pultneyville,	Lake Ontario,	1 sturgeon,	1 00
Wallace Barney,	Didwell,	"	1 gill,	1 00
Timothy Wilson,	Wilson,	"	1 "	1 00
Gerry Bristol,	Buffalo,	Lake Erie,	1 "	1 00
			Forward,	$465 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$465 00
Clarence Jackway,	Cushing,	Lake Erie,	1 trap,	1 00
Thomas Smith,	Buffalo,	"	1 sturgeon,	1 00
W. H. Brandow,	Catskill,	Hudson River,	2 drift,	1 00
B. J. Kelly,	Buffalo,	Lake Erie,	1 gill,	1 00
Holland & Bromway,	Angola,	"	1 "	1 00
Frank Luik,	Tivoli,	Hudson River,	2 sturgeon,	1 00
Samuel Melius,	Saugerties,	"	2 gill,	1 00
D. E. Stickney,	Buffalo,	Lake Erie,	1 sturgeon,	1 00
S. Atwater,	County Line,	Lake Ontario,	1 gill,	1 00
John W. Merchant,	North Greece,	"	2 "	2 00
T. H. Whitbeck,	Stuyvesant,	Hudson River,	1 drift,	1 00
Oscar Shotis,	Cheviot,	"	2 sturgeon,	1 00
Rathbone & Baird,	East Springfield,	Otsego Lake,	1 seine,	1 00
D. W. Gailbraith,	Charlotte,	Lake Ontario,	1 gill,	1 00
E. P. Root,	Pillar Point,	"	1 "	1 00
D. M. Wheeler,	Wilson,	"	3 "	3 00
Barney & Vorce,	Henderson,	"	1 "	1 00
Frederick Felts,	Somerset,	"	1 "	1 00
John Kreagor,	Ontario,	"	1 "	1 00
W. H. Grace,	Furnaceville,	"	1 "	1 00
W. M. Dick,	Three Mile Bay,	"	1 "	1 00
Hotaling & Bois,	Springfield Centre,	Otsego Lake,	1 seine,	1 00
W. C. Webster,	Furnaceville,	Lake Ontario,	3 gill,	3 00
Myron Parsons,	Forest Lawn,	"	1 "	1 00
Silas Riley,	Buffalo,	Lake Erie,	1 "	1 00
			Forward,	$495 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$495 00
Nelson Gilbert,	Ellisburg,	Lake Ontario,	1 gill,	1 00
Walter Lintz,	Chaumont,	"	1 "	1 00
A. F. Benton,	Cooperstown,	Otsego Lake,	1 seine,	1 00
Guy Rice,	Youngstown,	Lake Ontario,	1 gill,	1 00
Willis Woodward,	Furnaceville,	"	1 "	1 00
Charles Rockefeller,	Germantown,	Hudson River,	1 "	1 00
George Wright,	Hilton,	Lake Ontario,	1 "	1 00
Harvey Warner,	Three Mile Bay,	"	1 "	1 00
Simon Failing,	" "	"	1 sturgeon,	1 00
F. M. Gray,	Cooperstown,	Otsego Lake,	1 seine,	1 00
Frank Tinklepaugh,	"	"	1 "	1 00
C. Vasler,	Three Mile Bay,	Lake Ontario,	1 sturgeon,	1 00
John McIntyre,	Irving,	Lake Erie,	1 gill,	1 00
L. Boice,	Springfield Centre,	Otsego Lake,	1 seine,	1 00
J. Miniger,	Westfield,	Lake Erie,	1 gill,	1 00
William Proper,	Linlithgo,	Hudson River,	30 fyke,	1 00
Ailsworth & Tabor,	Cooperstown,	Otsego Lake,	1 seine,	1 00
W. F. Lewis,	Springfield Centre,	"	1 "	1 00
John Kinnecutt,	Albany,	Hudson River,	20 fyke,	1 00
Misner & Walters,	Dunkirk,	Lake Erie,	1 gill,	1 00
B. S. Sinnebaugh,	Coeymans,	Hudson River,	11 fyke,	1 00
Charles Rightmyer,	Malden,	"	10 "	1 00
William Stewart,	Dunkirk,	Lake Erie,	1 gill,	1 00
Dedrick & Tettsell,	Coxsackie,	Hudson River,	10 fyke,	1 00
B. Vander Walk,	Albany,	"	25 "	1 00
			Forward,	$520 00

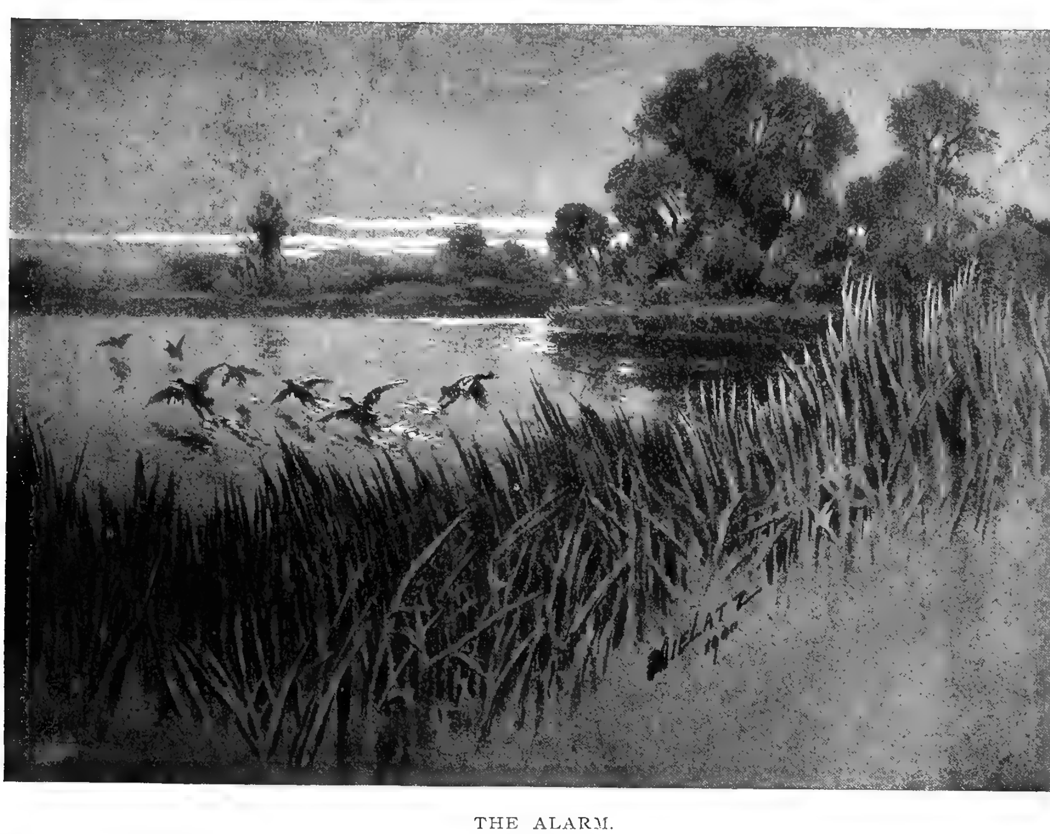
SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$520 00
Leonard Earl,	Catskill,	Hudson River,	5 fyke,	1 00
G. W. English,	Dunkirk,	Lake Erie,	1 gill,	1 00
W. H. Brazier,	Cedar Hill,	Hudson River,	10 fyke,	1 00
John Schultz,	Albany,	"	15 fyke,	1 00
L. W. Cashdollar,	Madalin,	"	25 fyke,	1 00
John M. Van Loon,	Coxsackie,	"	10 fyke,	1 00
D. E. Grant,	Furnaceville,	Lake Ontario,	1 gill,	1 00
R. P. Brewer,	Hudson,	Hudson River,	2 fyke,	1 00
Thomas Murphy,	Watervliet,	"	1 gill,	1 00
Frederick Busikenfeld,	Cedar Hill,	"	20 fyke,	1 00
S. S. Dingman,	Dexter,	Black River Bay,	5 "	5 00
Frederick N. Knapp,	"	" "	5 "	5 00
George B. Horton,	Chaumont,	Lake Ontario,	1 ciscoe,	1 00
Henry Everly,	Dexter,	"	5 fyke,	5 00
C. Vasler,	Three Mile Bay,	"	5 "	5 00
"	" "	"	5 "	5 00
Charles Lynch,	Tivoli,	Hudson River,	20 "	1 00
Robert Taylor,	Point Breeze,	Lake Ontario,	1 sturgeon,	1 00
F. M. Baldwin,	Pillar Point,	"	5 trap,	5 00
F. W. Burlingame,	"	"	5 fyke,	5 00
Henry Warner,	Three Mile Bay,	"	14 "	14 00
William Dick,	" "	"	5 scap,	5 00
Frederick Silver,	Chaumont,	"	5 fyke,	5 00
William Linsey,	Pillar Point,	"	5 "	5 00
John C. Barber,	Three Mile Bay,	"	5 scap,	5 00
			Forward,	$602 00

SCHEDULE OF LICENSES.—CONTINUED.

LICENSEE	RESIDENCE	WATER	KIND OF NET	FEES
			Brought forward,	$602 00
John C. Barber,	Three Mile Bay,	Lake Ontario,	5 scap,	5 00
Elden Sprague,	Pillar Point,	"	2 gill,	2 00
"	"	"	5 trap,	5 00
Myron Galloway,	Sacketts Harbor,	"	5 "	5 00
"	" "	"	2 gill,	2 00
Lester Nugent,	Chaumont,	"	2 ciscoe,	2 00
James Williams,	Dexter,	Black River Bay,	5 fyke,	5 00
William F. Pettitt,	Sacketts Harbor,	" "	5 "	5 00
James Ward,	" "	" "	5 "	5 00
William Baldwin,	Pillar Point,	Lake Ontario,	3 trap,	3 00
George N. Root,	"	"	5 fyke,	5 00
E. E. Root,	"	"	5 trap,	5 00
E. Billinger,	Three Mile Bay,	"	5 fyke,	5 00
C. F. James,	Chaumont,	"	1 gill,	1 00
W. M. Jonson,	"	"	1 "	1 00
			Total,	$658 00


A DAY FOR BLINDS.


THE ALARM.

Report of the Chief Protector.

To the Commissioners of Fisheries, Game and Forests:

GENTLEMEN:—I have the honor to submit the following report of the work of the Protectors and Foresters during the fiscal year ending September 30, 1898:

The following devices, which were being illegally used for catching fish, have been captured and destroyed:

Seines,	56
Fyke nets,	971
Trap nets,	320
Gill nets,	584
Squat nets,	221
Pound nets,	2
Dip nets,	17
Tip ups,	65
Spears,	13
Set lines,	457
Total number of devices destroyed,	2,706
Valued at	$29,515

Three hundred and sixty-nine persons were prosecuted during the year for violating the Fisheries, Game and Forest Laws. Of this number 335 were convicted, thirty discharged, and four held to grand jury. The total amount of fines, penalties and costs imposed by the courts in these cases was $10,827.49, of which $8,480.94 has been collected by the Department and deposited in accordance with law, and an aggregate penalty of 735 days' imprisonment has been imposed.

I think this is an excellent showing, and I confidently assert that all statements, from whatever source they proceed, that the Fisheries, Game and Forest Laws are everywhere disregarded and violated, are reckless statements of persons who have no knowledge of the subject. Doubtless, violations have occurred which have not come to the knowledge of the Department. This is inevitable, owing to the fact that it is impossible to cover the whole State with the limited number of Protectors that are allowed by law. But it is certain that the number of these cases is not so great as some would make it appear. Several reports of violations of the Deer Hounding Law have reached me, every one of which has been carefully investigated and found to be based upon evidence so flimsy as to discredit the report.

In some localities of the State there is a manifest unfriendliness to the laws for the protection of fish and game, so much so that it is impossible to secure convictions in the local courts. In several cases an acquittal or a disagreement of the jury has resulted from the plea of the defendant's counsel that the Protector or the complainant was out for "blood money," meaning his share of the fine if conviction is had.

In one of the courts in Greater New York a person arraigned under section 78 of the Fisheries, Game and Forest Law for shooting song birds was discharged on the ground that section 1493 of the charter of that city supercedes the Fisheries, Game and Forest Laws. For the same reason moneys collected as fines for violations of the Fisheries, Game and Forest Laws has been turned over to the City Comptroller instead of to this Department.

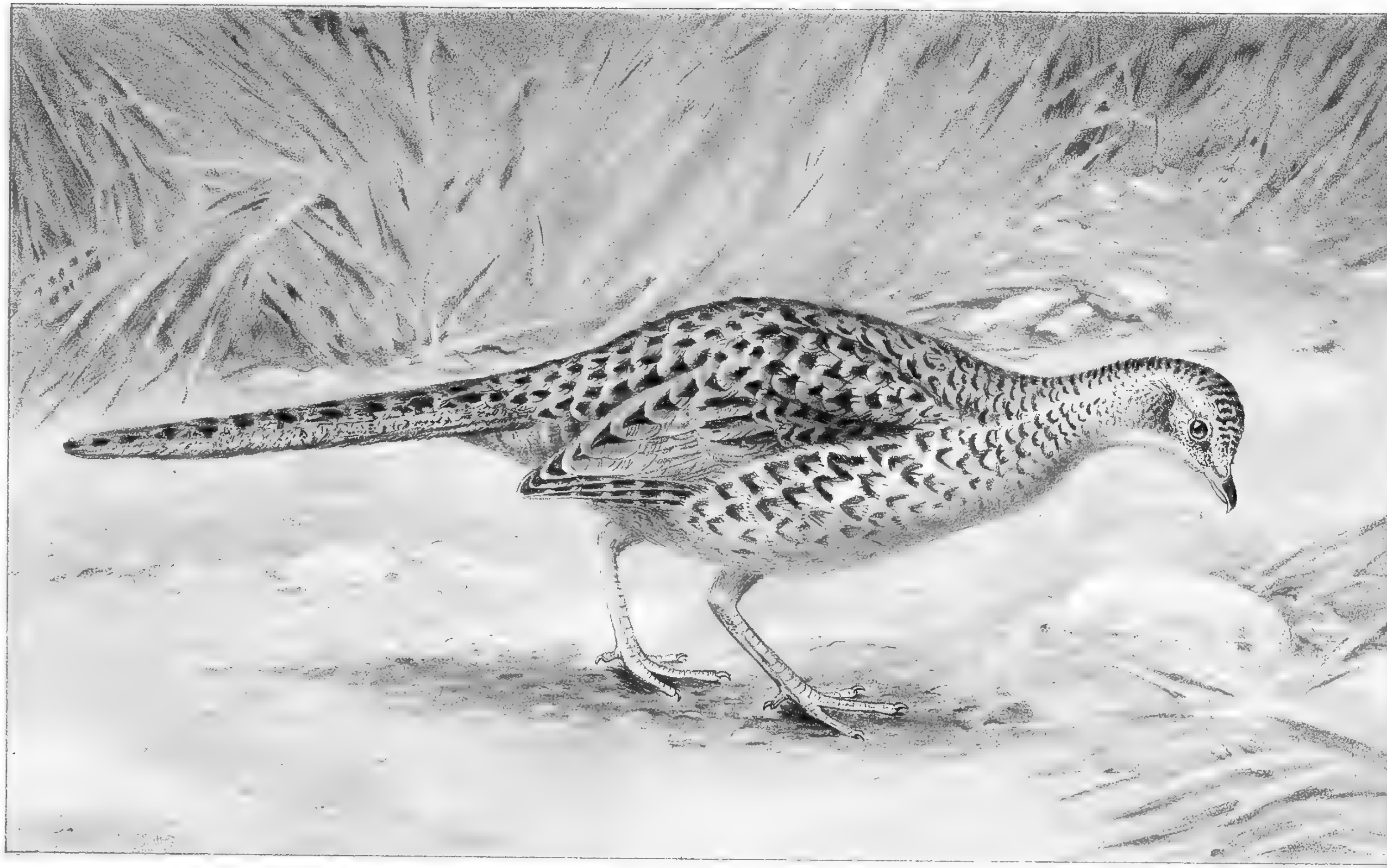
This will necessitate a civil action to obtain an opinion of the higher court as to the true meaning of the law.

Respectfully submitted.

J. W. POND,

Chief Protector.

AN EXPERT.



RING-NECKED PHEASANT. Female
(PHASIANUS TORQUATUS.)

Report of the Superintendent of State Hatcheries.

CALEDONIA, N. Y., *October* 1, 1898.

To the Commissioners of Fisheries, Game and Forests:

GENTLEMEN:—The work for the year closing September 30 has been highly satisfactory, and in importance and value exceeds that of any previous year.

At the beginning of the fiscal year, work was commenced on a new hatchery at Constantia, on Oneida Lake, in Oswego county, and the same was completed, equipped and all ready for work April 1. The Commission named it the Oneida Hatchery. A special appropriation of $6,000 for acquiring a suitable site, building and equipping of a fresh-water fish food hatchery, was passed by the Legislature of 1897. The work was finished within the amount of the appropriation, and it is a first-class hatchery in every respect. Pike-perch, yellow perch, ciscoes and whitefish are among the fish that will be hatched there the first year. The pike and the perch are hatched in the spring, ciscoes and whitefish in the fall and winter. The manner of hatching the above-named fish is called the jar-method; glass jars, each holding about four quarts of eggs, are used. Trout are hatched in an entirely different manner. The hatchery has the capacity for handling 125,000,000 eggs of the spring-spawning fish, and again in the fall and winter of 35,000,000 eggs of the fall or winter-spawning fish, such as whitefish and ciscoes.

It is the intention to build ponds for black bass in connection with this hatchery, where the bass can deposit their eggs naturally, and the young bass be collected and distributed. Comparatively few people know that black bass have never been hatched artificially like trout, mascalonge, pike-perch, shad, whitefish, etc. The nearest approach has been to confine a limited number of bass in one or two artificial ponds so constructed that after the eggs were hatched and the young old enough, the adult bass were taken or driven out of the ponds and the young collected and fed until they could be distributed. I trust some one will have the time and patience to continue experimenting in the line of artificial bass hatching, as I believe it can and will yet be done. Then, and not until then, will it be possible to supply a sufficient quantity of black bass to meet all the requisitions made by our citizens. The shortening of the legal or open season for catching bass cannot but help to increase the number of these fish.

In the past, all of the bass distributed by this Commission, and the same is true of other State Commissions, have been obtained by netting where bass were numerous. This has always resulted in strong opposition from the people living in the vicinity where the netting was done. On this account the distribution of the small-mouth black bass has been discontinued, but the distribution of the large-mouth black bass, incorrectly called Oswego bass, was continued from near Clayton, same as in years past. The young bass were obtained from a marshy creek entering the St. Lawrence. The past year's distribution was 116,450, larger than the previous ten years' output.

The hatchery located near Saranac Inn, in Franklin county, called the Adirondack Hatchery, has been entirely remodeled and enlarged. Six and eight-inch iron pipes have been laid from the hatchery (a distance of about 2,000 feet) to a point at the bottom of Little Clear Lake, where the water is fifty feet deep and the temperature stands at forty-two degrees, and varies only four degrees summer and winter. This furnishes the hatchery, and an entire system of rearing ponds, with an abundance of the very best pure water, making it one of the most valuable hatcheries in the State.

Now, it is possible to raise thousands of trout there to eight, ten and fifteen months old before planting them in the streams and ponds of the northern portion of the State.

In addition to the trout hatching, glass hatching jars sufficient for hatching 10,000,000 frostfish eggs have been supplied and put in complete running order.

The location of the Adirondack Hatchery as a distributing point is unsurpassed by any point in the Adirondacks. The surrounding four counties contain hundreds of the very best trout lakes, ponds and streams that are now almost barren of trout. Where fingerling and yearling trout have been planted in this section in the past two years, from some of our other hatcheries, most flattering and enthusiastic reports as to the fishing are at hand.

In 1896 the Legislature appropriated $5,000 to buy and improve what was called the McKay pond and springs, in the town of Caledonia, Livingston county. This pond furnished power for a saw and grist mill, and after the owners had used the water as they saw fit, it furnished the supply for the Caledonia State Hatchery, located about one-half mile below the mills.

There was considerable delay in getting a perfect title to this property, and all of the water rights connected with it, as your Commission deemed it advisable to have the absolute control of this water and the necessary land, so as to improve and protect the springs, that the flow passing from the springs to the hatchery below would always be absolutely fresh and pure.

Soon after the Commission came into possession of the property, we commenced the cleaning of the springs, and the removing of everything in the vicinity that in any way might prove detrimental in the future. For over seventy years all kinds of foul matter had been collecting in and around these springs. The accumulation varied in depth from one to four feet. All of this had to be removed down to the hard, gravelly bottom, over at least an acre and one-half. This process developed quite a large additional amount of water. All of the springs are now clean, and a wall or diking constructed about them to prevent their again filling up. This insures to the hatchery a sure supply of pure water.

At the Cold Spring Hatchery, on Long Island, new ponds have been built, so that the water supply can be fully utilized, and the greatest number of fish possible turned out. With these additional ponds, and the necessary grading that has been done upon the grounds, it makes this plant one of the most attractive in the State.

Another very gratifying fact in regard to this hatchery is, that it has on hand for distribution more fingerlings and yearlings than the total production of the hatchery for three previous years.

At the Beaverkill Hatchery, in Sullivan county, the water supply always becomes so warm in the summer that it is impossible to rear fingerlings, and all the spring's hatch of fry must be taken away by the first or middle of May, on account of the water warming up so very fast at the beginning of hot weather.

Locating a small spring on the hills about 1,200 feet from the hatchery, and finding that it was feasible to pipe the water to the hatchery, a contract was made with the owner of the spring, allowing the Commission to collect the water and conduct it to the hatchery for one year without charge, and if at the end of the year the Commission wished to continue using the water, they could lease the spring and the right to convey the water to the hatchery for a term of forty-nine years for $100, which would be in full for all rights during said term.

The work of conducting this water to the hatchery was all done early in December, and considering the small amount of water otherwise obtainable, the supply has certainly been worth double the cost, and I recommend that the Commission lease the spring.

About 5,000 fingerling trout were reared at this hatchery since the above spring water supply was obtained.

Other springs, situated from two to five thousand feet from the hatchery, that will furnish considerable more pure water, can be leased if desired.

The necessary repairs and the improved water supply for each of the hatcheries has had the most careful attention. All of the hatcheries are run to their greatest capacity. New and improved methods are being introduced, and it may be said without exaggeration that the hatcheries of New York State are superior to any of the kind in this or any other country.

The policy adopted by the Commission of planting larger and older fish in addition to fry, is meeting the approbation of the fishing fraternity. From the numerous reports received in regard to the fishing in streams and lakes, where fingerlings or yearlings have been planted, it is satisfactorily shown that the work should be continued, as the results fully warrant the additional expense.

Reports have been received regarding streams and lakes stocked within the last two years with fingerling and yearling brown and rainbow trout (waters that never before contained these varieties), that during the past fishing season specimens varying in weight from one-half to one and one-half pounds have been taken. From all over the State comes encouraging reports of better fishing. The Commission has done more in the way of restocking the streams in the past two years than was ever done before.

An actual count is always made of the fingerlings and yearlings sent out by your Commission. Ten thousand fingerlings or 8,000 yearlings make a large carload. Three hundred and fifty thousand fingerlings (thirty-five carloads) have been sent out by your Commission inside of three months, and 40,000 yearlings (fifty carloads) will be ready for distribution next spring.

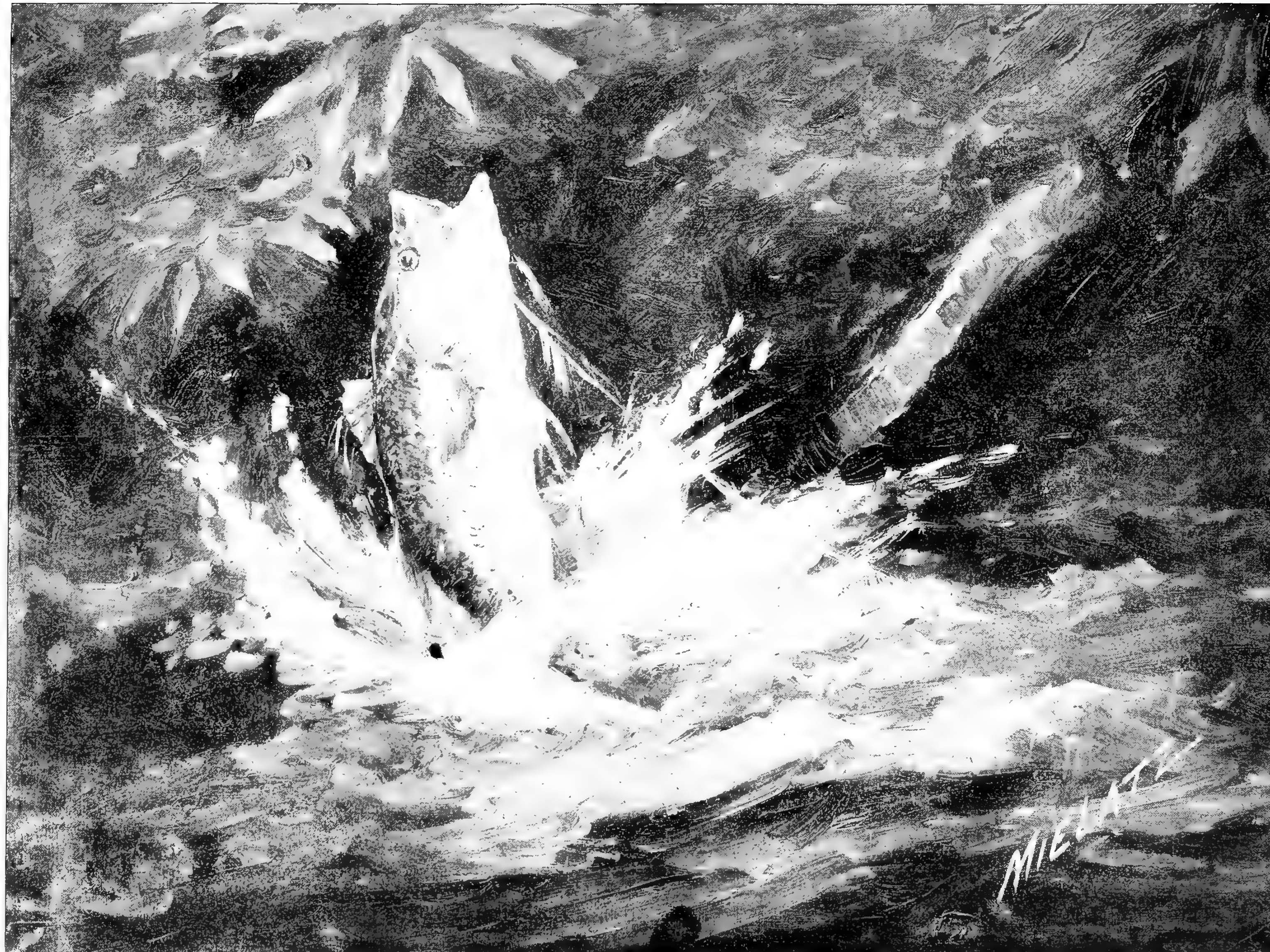
It is pleasing to know that the Fish Commissions of other States have commenced the planting of fingerlings and yearlings.

With the continued efforts to have our hatcheries increase their output of fingerlings and yearlings comes the question of expense. Two of the principal items entering into the cost of producing this sized fish is the food and the time taken to prepare it. Recent experiments with new food lead me to believe that the cost of production can be materially reduced.

Experiments in the mode of hatching and rearing young of some varieties of fish previously considered impossible to raise have been successful. I refer to the hatching and rearing in confinement of the red-throat trout. About 100,000 fingerlings of this variety are now at the Caledonia and Pleasant Valley Hatcheries. The eggs were taken from the adult fish confined in the hatchery ponds.

We have also been successful in hatching mascalonge eggs by the glass-jar method, and the rearing of the young fry to the length of four and four and one-half inches in three months.

It has also been found by actual work and experiment that our inland lakes can furnish whitefish eggs in sufficient numbers for the restocking of Lake Ontario and inland waters with this valuable food fish. Over 20,000,000 of whitefish were hatched and planted during the past year, and the supply of eggs were obtained from inland waters of the State.



LARGE-MOUTH BLACK BASS.

Previous to the fall of 1896, all of the whitefish eggs hatched by New York State Fish Commissions were obtained from Lakes Ontario and Michigan, in November and December of each year, but on account of storms and scarcity of fish in recent years, the number obtained was always very uncertain, and the expenses were sure to be heavy. It is seldom that storms of sufficient strength occur to interfere with our work of collecting eggs on our inland lakes, so that we can now always calculate on obtaining whitefish eggs at a reasonable expense, and as the fishing grounds are within two or three hours from the hatcheries, there is but slight loss in transportation, whereas, by the old method it was often a month after the eggs were taken before they arrived at our hatcheries. At present it would be almost impossible to collect under the most favorable circumstances 5,000,000 whitefish eggs at the east end of Lake Ontario. Formerly this was the best spawning ground for whitefish in the lake.

For the past five years, plants of whitefish fry have been made by the Commission in Lake Ontario, from Charlotte west to Lewiston, and the past summer the fishing off the Niagara county shore has been better than it has been before in thirty years. I state this upon the most reliable information. The fishermen in that section all unite in saying, that if the plants can be continued in a liberal manner, the old-time fishing can be restored.

A few years ago the United States Fish Commission, and some of the States bordering on the Great Lakes, erected large and extensive whitefish hatcheries, some single plants having a capacity for handling 200,000,000 eggs. To-day part of them are running about half their capacity, and others are closed. All of this is due to the great falling off in the whitefish catch. Ten or fifteen years ago some of the best authorities in the country predicted that unless the whitefish were protected at once, they would soon be exterminated.

This matter was deemed of such importance that meetings were called by people interested in the subject, and the matter was thoroughly discussed, and the States bordering on the Great Lakes were asked to provide a close season, and to restrict the size of the mesh of the nets the fishermen were using, but on account of the opposition by the fishermen, little was accomplished.

Two years ago Michigan passed a law, making a close season on whitefish and lake trout during the greater part of their spawning season. These facts demonstrate the necessity for better protection of the comparatively few whitefish that still remain in our State waters.

We have found whitefish in abundance in Hemlock Lake this season, weighing from three to ten pounds each. A small plant of whitefish was made in one of our northern inland lakes in 1894–5. This fall we found that these whitefish had attained an average weight of one and one-half pounds each, and that they were abundant.

In my report of a year ago, mention was made of the satisfactory results attending the breeding of the Mongolian or ring-necked pheasants, carried on in connection with the Pleasant Valley Hatchery, near Bath, Steuben county.

The past year the work has been continued as far as the limited space on the grounds would permit. Having no special appropriation for this work, it has not been pushed as far as recent results would warrant. From a dozen birds in the spring of 1897, the flock has increased to 180 fine, healthy birds at the present time. This fully warrants the Commission asking for an appropriation to carry on the work. It does not come directly under the Hatchery Department, but the work has been directed by Commissioner Babcock, chairman of the committee having charge of that branch of the work.

For the past year the pheasantry has been one of the great attractions for the numerous visitors to the Pleasant Valley Hatchery grounds.

The mascalonge hatching is carried on at Bemus Point, on Chautauqua Lake. It was here that these fish were first hatched artificially by the old Fish Commission of the State of New York.

Hatching mascalonge eggs has always been done in boxes with a double wire screen top and bottom, and arranged in the lake. The State owns a storehouse at the point conveniently located, in which all the bulky appliances for carrying on the work are stored. This building is also the headquarters of the men during the hatching season, which lasts about six weeks.

Until the past season, it had been considered impossible to successfully hatch mascalonge eggs in any way except in the boxes mentioned. A lack of water at the proper elevation permitted of our operating only a few of the glass jars, but they demonstrated what could be done. The experiment was highly successful, and it is perfectly safe to say that with a hatching house properly equipped the annual output of fry can be doubled. This is important, as the growing scarcity of mascalonge in the St. Lawrence River has been apparent for some time.

Your Commission is the only Fish Commission (the Wisconsin Commission excepted) that makes provisions for the artificial propagation of mascalonge.

Experiments in rearing the fry in confinement were also made during the past season. The fry were hatched on the nineteenth day of May and placed in a small artificial pond. They were removed from the pond on the nineteenth day of August, having attained the length of four and four and one-half inches. We could not keep them in the pond longer, as, owing to dry weather, the water supply failed on the date last above mentioned.

The fishing in Chautauqua Lake for mascalonge and black bass cannot be excelled in any other lake of our State. This is entirely due to the disposition on the part of the inhabitants in the vicinity of the lake to abide strictly by the Game and Fish Laws, and to the liberal planting of young mascalonge in the lake by your Commission.

In the last report of your Commission it was suggested to the members of the Legislature, that they pass a bill giving the Fish Commission power to stop all fishing on small streams where they think the situation demands it, for a period of from three to five years. I think it essential that the Commission have the power to stop fishing entirely in the small brooks tributary to the Adirondack lakes or large streams. These small brooks rarely contain a trout over five inches in length. As soon as the trout reach that size, they always drop down out of the brook and into the larger waters below. These small brooks are the nurseries, and my observation is, that all through the Adirondacks you will find plenty of people that are continually fishing these brooks for small trout. Not one of their catch is of the legal size, but no one will make a complaint against them. In many cases the proprietor of a hotel, or a boarding-house, keeps one or two boys, or a man, continually at work fishing the brooks so that his table may be supplied with so-called brook trout.

In planting young trout from the hatcheries, especially in the spring or fall, it is desirous that they should be planted in these nursery brooks, and our attendants are always instructed to have them planted in such brooks when possible, but when these fish are caught out before they have had a chance to reproduce, or to attain legal size, it will be slow work for our hatcheries to restock such waters as the Fulton Chain of lakes, Cranberry Lake, with its many tributaries, and the many lakes in other sections in the Adirondacks. When it is possible to stop fishing at all times on these small brooks, then can we expect the quickest and best returns for our labor of stocking.

I cannot help referring to the fish car, the property of the State, and the very important part it has taken in transporting the product of the hatcheries. During the year it has made forty-six trips with fish, each time loaded with from 100 to 125 cans. It would be impossible to deliver our yearly increased output without this car.

Your Commission thought it advisable to erect a building for the protection of this car from the elements. Consent was obtained from the New York Central and Hudson River Railroad Company to erect such a building on their property in Caledonia. They kindly laid the necessary track into the car house, so that now when the car is not in use, it has proper protection and care.

During the warm weather of last summer, the car had a thorough overhauling and painting. This is the only time during the year that the car is idle long enough to do such work.

In this connection, I wish to call attention to the liberal and continuous courtesies extended to the Commission by the railroads of the State in hauling free the State fish car, with the necessary crew in charge, and transporting fish and fish eggs with attendant, and returning the empty cans free in the baggage cars of their lines.

The following is a record of the distribution from each hatchery, and the total summary of all for the year ending September 30, 1898.

Yours respectfully,

J. ANNIN, Jr.,

Superintendent of Hatcheries.

Distribution of Fish from each Hatchery.

Adirondack Hatchery.	
Brook trout,	508,060
Brown trout,	147,140
Rainbow trout,	23,000
Lake trout,	130,000
Frostfish,	3,250,000
Beaverkill Hatchery.	
Brook trout,	774,875
Brown trout,	86,700
Caledonia Hatchery.	
Brook trout,	365,112
Brown trout,	367,268
Rainbow trout,	45,125
Lake trout,	368,786
Red-throat trout,	1,000
Whitefish,	18,300,000
Fresh-water shrimp,	65,000
Clayton Hatchery.	
Ciscoes,	15,000,000
Whitefish,	5,800,000
Large-mouth black bass,	115,100
Chautauqua Lake Hatchery.	
Mascalonge,	2,650,000
Oneida Hatchery.	
Pickerel,	50
Pike-perch,	17,550,472
Small and large-mouth black bass,	1,350
Yellow perch,	2,562,800

Cold Spring Hatchery.

Brook trout,	466,000
Brown trout,	93,835
Rainbow trout,	44,485
Tom cods,	48,000,000
Smelt,	48,000,000
Lobsters,	6,550,000
Shad,	1,214,800

Catskill Hatchery.

Herring,	1,500,000
Shad,	3,882,600
Shad (donated to State waters by the U. S. Fish Commission),	5,800,000

Fulton Chain Hatchery.

Brook trout,	790,750
Brown trout,	55,000
Lake trout,	199,000
Frostfish,	1,500,000

Pleasant Valley Hatchery.

Brook trout,	295,250
Brown trout,	120,800
Rainbow trout,	75,400
Lake trout,	29,000

Sacandaga Hatchery.

Brook trout,	858,000
Brown trout,	90,000
Lake trout,	187,000
Frostfish,	1,035,000

Distribution of Fish for Year Ending September 30, 1898.

VARIETY.	AGE.	AMOUNT PLANTED.	
Brook trout,	Fry,	3,964,500	
Brook trout,	Fingerlings,	72,785	
Brook trout,	Yearlings and older,	20,762	
	Total,		4,058,047
Brown trout,	Fry,	857,000	
Brown trout,	Fingerlings,	34,640	
Brown trout,	Yearlings and older,	69,103	
	Total,		960,743
		Forward,	5,018,790

Variety.	Age.	Amount Planted.	
		Brought forward,	5,018,790
Rainbow trout,	Fry,	119,000	
Rainbow trout,	Fingerlings,	33,500	
Rainbow trout,	Yearlings and older,	35,760	
	Total,		188,260
Lake trout,	Fry,	762,000	
Lake trout,	Fingerlings,	133,725	
Lake trout,	Yearlings,	18,786	
	Total,		914,511
Pike perch,	Fry,	17,550,250	
Pike-perch,	Yearlings and adults,	222	
	Total,		17,550,472
Bass,		115,850	
Yellow perch,		2,562,800	
	Total,		2,678,650
Red-throat trout,	Fingerlings,	1,000	
Pickerel,		50	
Herring,		1,500,000	
Lobsters,		6,550,000	
Tom cods,		48,000,000	
Smelt,		48,000,000	
Ciscoes,		15,000,000	
Frostfish,		5,785,000	
Mascalonge,		2,650,000	
Whitefish,		24,100,000	
Shad,		10,897,400	
Shrimp,		65,000	
			162,548,450
	Grand total,		188,899,133

Report of the Shellfish Commissioner.

To the Commissioners of Fisheries, Game and Forests:

GENTLEMEN:—I have the honor of transmitting the following preliminary report of the Shellfish Department of the Fisheries, Game and Forest Commission of which I have charge:

During the past year there have been granted 228 applications for oyster lots, covering from one to ten acres each. Perhaps a fair average would be about five acres each, or a total of 1,140 acres. This work was done principally in Jamaica Bay in both Queens and Kings counties.

Together with this work there have been made a map and survey covering Long Island Sound from Port Jefferson to Horton's Point, a distance of about fifty miles, as provided by chapter 458 of the Laws of 1898 for the purpose of granting franchises in Long Island Sound for oyster cultivation within the jurisdiction of Suffolk county; and I sincerely hope the present Legislature will extend the same powers over the lands under water in Queens and Nassau counties, in order to enable our oystermen to compete with those of other States in raising and cultivating this great article of food in deep water.

The State Engineer's office has given us very great assistance in this work, and enabled us to complete the survey with very little extra expense to the State. Already several applications for franchises have been made and are awaiting the regular course of advertising and sale at auction, as required by law.

All of which is respectfully submitted,

EDWARD THOMPSON,
Shellfish Commissioner.

The St. Lawrence River Park.

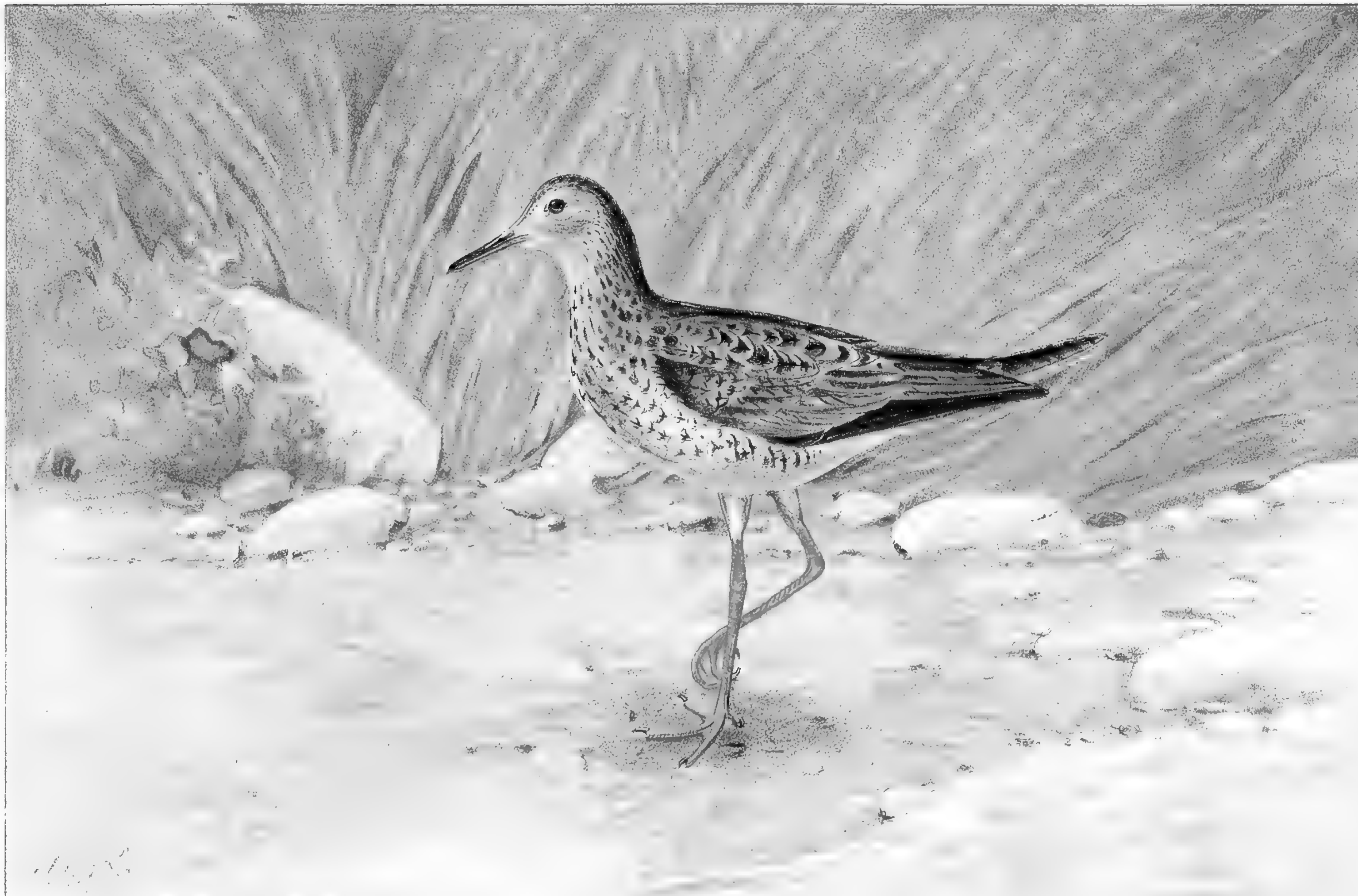
PURSUANT to the provisions of chapter 273, Laws of 1897, this Commission has purchased several points on the River St. Lawrence to be used by the public for the purposes of recreation, camping, fishing, etc.

The tracts purchased and prices paid therefor are as follows:

Burnham's Point, near Cape Vincent,	$500
Cedar Point, between Cape Vincent and Clayton,	1,400
Canoe Point, on Eel Bay,	4,200
Watterson's Point, on Canadian side of Well's Island,	700
Mary Island, opposite Alexandria Bay,	5,000
Kring's Point, near entrance to Goose Bay,	2,300
One-half of Cedar Island, near Chippewa Bay,	3,000
One-half of Lotus Island, nine miles below Ogdensburgh,	4,500
De Wolf Point, on Lake of the Isles,	500

These islands and shore points are well located, easy of access and in every way suitable for public park purposes. This Commission has contracted with a responsible person for the construction of docks for steamers and row boats, wherever necessary.

These grounds have been cleared of fallen timber, underbrush, loose stones, etc.



UPLAND PLOVER.
(BARTRAMIA LONGICAUDA.)

Suggestions and Recommendations.

WE RECOMMEND that there be a close season of one month for whitefish during their spawning season. With the work being done by the Commissioners in stocking lakes and the close season of one month, while spawning, we feel confident that this most valuable fish can be restored to the great lakes and made plentiful in several of the smaller ones throughout the State.

The Commissioners having made a successful start in rearing game birds, have gone as far as their very limited means would permit, and would recommend that an appropriation be granted for the construction of suitable enclosures and the further continuance of the work. With the birds on hand and a small appropriation, 500 Mongolian pheasants could be reared and distributed this year.

We recommend that the law of 1898, which provided a bounty for the seizure and destruction of illegal devices for the taking of fish, be amended by the reduction of the bounties, and a safeguard against a repetition of the frauds that were practiced during the past year.

We recommend that an appropriation of $2,000 be made for the care and maintenance of the lands recently purchased on the St. Lawrence River.

COMMON MACKEREL.
(SCOMBER SCOMBRUS.)

Distribution of Fish.

Schedule of Waters Stocked for the Fiscal Year Ending September 30, 1898.

DISTRIBUTION OF BROOK TROUT FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
G. W. Fredericks,	Greycourt Creek,	Chester,	Orange,	5,000
A. R. Eastman,	Woodhull Lake,	Wilmurt,	Herkimer,	25,000
Gillman & McNeil,	Several streams.	Preston, etc.,	Chenango,	12,000
G. B. Crandall,	" "	Randolph,	Cattaraugus,	10,000
John Branch et al.,	Otsquago Creek,	Stark, etc.,	Herkimer, etc.,	8,000
Nicholas Ossant,	Crystal Creek, etc.,	Watson,	Lewis,	8,000
Warren Mann,	Dayton Brook, etc.,	Parishville,	St. Lawrence.	10,000
Michael J. Yonker,	Beaverkill stream,	Wawarsing, etc.,	Ulster, etc.,	8,000
T. D. Sullivan,	Various waters,	Long Lake,	Hamilton,	25,000
E. E. Kelly,	Spring Brook,	Norway,	Herkimer,	5,000
F. T. Huxley et al.,	Perth Center Creek, etc.,	Perth, etc.,	Fulton, etc.,	10,000
John Irvin,	Star Lake,	Fine,	St. Lawrence,	10,000
J. E. Mattern,	Dugan Creek,	Caledonia,	Livingston,	5,000
Howard L. Potter,	Sand Hill Creek,	Unadilla,	Otsego,	8,000
De Ruyter Sportsmen Club,	Tioughnioga River,	De Ruyter,	Madison,	15,000
Almanzo Hutchins,	Caroga Creek,	Caroga,	Fulton,	10,000
Jerome Holmes,	Pleasant Brook,	Brookfield, etc.,	Madison, etc.,	5,000
A. L. Maxtin,	Otsdawa Creek,	Otego,	Otsego,	10,000
Peter Flint,	Three brooks,	Ticonderoga,	Essex,	10,000
"	Harvey & Grant Brooks,	"	"	5,000
W. H. Cunningham,	Thomas Brook,	Chenango,	Broome,	2,000
John Harrica et al.,	Bradley Lake,	Dannemora,	Clinton,	8,000
G. W. Lamont,	Big Indian Creek,	Shandaken,	Ulster,	10,000
Henry E. Bedell,	Grout Brook,	Scott,	Cortland,	5,000
"	Eaton Brook,	Summer Hill,	Cayuga,	5,000
Charles D. Martin,	Otsdawa Creek,	Otego,	Otsego,	10,000
W. M. Deitz,	Various brooks,	Butternuts,	"	20,000

DISTRIBUTION OF BROOK TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
G. W. Shoemaker,	Headwaters Schoharie River,	Hunter,	Greene,	10,000
Frederick Barton,	Owego Creek,	Owego,	Tioga,	8,000
H. P. Witthoft,	West Branch Delaware River,	Bloomfield,	Delaware,	8,000
A. A. Maynard,	Various streams,	Stamford,	"	15,000
John P. Harper,	West Branch St. Regis River,	Parishville, etc.,	St. Lawrence,	15,000
A. M. Warner,	Various brooks,	Harpersfield,	Delaware,	10,000
Charles E. Taylor,	Sugar and White Rivers,	West Turin,	Lewis,	10,000
W. R. Lee,	Croton River, etc.,	Pawling,	Dutchess,	15,000
Willis E. Clark,	Lawrence Brook, etc.,	Moira, etc.,	Franklin,	15,000
George M. Weed,	Various brooks,	Amenia,	Dutchess,	10,000
"	West Branch Ten Mile River,	"	"	6,000
Otsego Fish Association,	Various streams,	Otsego, etc.,	Otsego,	15,000
F. Sawyer,	Upper Chateaugay Lake,	Lyon Mountain,	Clinton,	10,000
Alexander W. Mackey,	Bedford Creek, etc.,	Rensselaerville,	Albany,	5,000
C. H. Weidner,	Bushkill Stream,	Olive,	Ulster,	10,000
Eli T. Partridge,	Various streams,	Smithville,	Chenango,	20,000
H. F. Whittenhall,	Wheeler and Camden Brooks,	Greene,	"	10,000
W. J. Ayres & Son,	Deer River,	Duane,	Franklin,	10,000
B. L. Crandall,	Canasawacta Creek,	Pharsalia, etc.,	Chenango,	8,000
C. A. Cartright,	Owego Creek,	Richford, etc.,	Tioga,	8,000
Dr. J. G. Leonard,	"	Harford,	Cortland,	10,000
W. & E. Sawyer,	Champlain River,	Ellenburgh,	Clinton,	8,000
James P. O'Neil,	O'Neil Stream,	Altoona,	"	8,000
J. A. Fleming,	East Owego Creek,	Owego,	Tioga,	8,000
W. C. Pierce,	Owego and West Owego Creeks,	Richford,	"	10,000
H. A. Howard,	Five Brooks,	Hague,	Warren,	15,000
Martin Lobdell,	Walls Brook,	Schuyler Falls,	Clinton,	8,000

DISTRIBUTION OF BROOK TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Black River Fish and Game Association,	Various brooks,	Marcy, etc.,	Oneida,	50,000
William Osborn,	Lake Pleasant,	Lake Pleasant,	Hamilton,	35,000
G. L. Goodfellow et al.,	Manlius Mill Brook,	Manlius,	Onondaga,	5,000
Charles H. Horner,	Indian Brook,	Weathersfield,	Wyoming,	4,000
William E. Ames,	East Branch Unadilla River,	West Winfield,	Herkimer,	10,000
D. H. Hull,	Five streams,	Petersburgh,	Rensselaer,	12,000
H. B. Hill,	Johnson Stream,	Ancram,	Columbia,	8,000
Barton & Hoysradt,	Punch Brook,	"	"	5,000
W. N. Spurge,	Nissequogue River,	Smithtown,	Suffolk,	8,000
E. G. Johnson,	Various streams,	Franklin,	Delaware,	15,000
William H. Robinson,	Little Chazy Lake,	Altoona, etc.,	Clinton,	8,000
W. W. Joslin,	Seven brooks,	Yorkshire,	Cattaraugus,	8,000
J. H. Benedict,	Headwaters Oriskany Creek,	Sangerfield, etc.,	Oneida, etc.,	10,000
Frederick Klorner,	Four Creeks,	Highmarket,	Lewis,	15,000
N. Ossont,	Independence River,	Watson,	"	5,000
Casper W. Baker,	Baker Brook,	Au Sable,	Clinton,	5,000
Worthington Whitehouse,	Rum Brook, etc.,	Greenburgh,	Westchester,	8,000
M. J. Knickerbocker,	Ellis Creek, etc.,	Saratoga Springs,	Saratoga,	8,000
Perry S. Hoysradt,	Spring Brook,	Ancram,	Columbia,	5,000
Joseph Crammer,	Beaverkill River,	——	Sullivan,	8,000
W. F. Hendrickson,	Berry Brook,	——	Delaware,	8,000
M. L. Loomis et al.,	Sauquoit Creek,	Paris,	Oneida,	10,000
W. E. McCasland,	Various waters,	Saranac, etc.,	Clinton,	10,000
John M. Briggs,	Saw Mill River,	Tarrytown,	Westchester,	8,000
O. H. Perry,	Shaker Hollow Creek,	White Creek,	Washington,	8,000
H. C. Stevens, Secretary,	Hemlock Creek, etc.,	Groton,	Tompkins,	8,000
Loren D. Cushman,	Brook,	Plymouth,	Chenango,	5,000

DISTRIBUTION OF BROOK TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
B. F. Vail,	Wawayanda Creek, etc.,	Warwick,	Orange,	10,000
Thomas E. Tignin,	Swamp Brook,	Sherburne,	Chenango,	5,000
Thomas D. Scott,	Great Brook,	North Norwich,	"	10,000
Minot Mitchell,	Titus Brook,	" "	"	5,000
A. W. Davis,	N'th Branch Tonawanda River,	Java, etc.,	Wyoming,	3,000
"	McCumber Creek,	" "	"	3,000
Charles Edkins,	Headwaters Chenango River,	Hamilton, etc.,	Madison,	10,000
H. R. Phillips,	Potter Creek,	Jerusalem,	Yates,	10,000
A. Crandall,	Jones and Burke Creeks,	East Winfield,	Herkimer,	8,000
Charles J. Reno,	Manorkill Creek,	Schodack,	Rensselaer,	5,000
W. H. Wright,	Rogers Hollow Brook, etc.,	Unadilla, etc.,	Otsego, etc.,	10,000
Rome Custodial Asylum,	Ponds,	Rome,	Oneida,	5,000
W. H. Bartlett,	Several brooks,	Amenia,	Dutchess,	10,000
E. Ham,	Five streams,	Stamford,	"	10,000
A. I. Vaughn,	Vaughn,	Beekmantown,	Clinton,	5,000
John W. Holt,	Cat Tail Stream,	Livingston Manor,	Sullivan,	8,000
Andrew Smith,	Coxton Creek,	Rosendale,	Ulster,	8,000
Sherburne Fish and Game Association,	Various streams,	Sherburne,	Chenango,	10,000
J. M. Case,	Flat Creek, etc.,	Gilboa,	Schoharie,	15,000
P. M. Rathbun,	Hollow Brook,	Niles, etc.,	Cayuga,	10,000
Robert H. Stickle,	Bryant Spring Brook,	Ancram,	Columbia,	5,000
Hamilton Fish and Game Pro. Ass'n,	Willow Brook, etc.,	Hamilton,	Madison,	20,000
D. I. Roberts,	Dryden Brook, etc.,	Deposit,	Delaware,	8,000
"	Cold Spring Brook, etc.,	"	"	8,000
"	Knight's Creek, etc.,	Stockport,	"	5,000
"	Mineral Stream, etc.,	Mountainville,	Orange,	10,000
"	Cadosia Creek,	Hancock,	Delaware,	5,000

DISTRIBUTION OF BROOK TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
D. I. Roberts,	Wild Cat Brook,	Tuxedo,	Orange,	8,000
Nelson Fish and Game Association,	Headwaters Chittenang River,	Nelson,	Madison,	10,000
W. O. Ensign,	Willomoe,	Rockland,	Sullivan,	10,000
Sherwood Phillips,	Clove Creek,	Fishkill, etc.,	Putnam,	8,000
J. M. Van Valkenburgh,	Schoharie Hill, etc.,	Lexington,	Greene,	10,000
A. A. McCoy,	Various waters,	Arietta, etc.,	Hamilton,	25,000
Arthur Boehm,	Stony Creek,	Hope, etc.,	Hamilton, etc.,	15,000
P. R. Fisk,	Payne Brook, etc.,	Hamilton, etc.,	Madison,	8,000
W. L. Mead,	Nash and Behan Brooks,	Dannemora,	Clinton,	10,000
John A. Mott,	Various brooks,	Manlius,	Onondaga,	5,000
H. Frank Pulver,	Punch Brook,	Pine Plains, etc.,	Dutchess, etc.,	6,000
Michael Mullen,	Ten Mile River,	Cochecton, etc.,	Sullivan,	8,000
Alvah F. Finch,	Little Meadow Brook,	Rockland,	"	8,000
James F. Wood,	Wood Brook,	Fremont, etc.,	"	8,000
Ahira Green,	Durber Brook,	Rockland,	"	8,000
George Weiss,	Beaverkill River,	"	"	8,000
Beckley Howes,	Branches Wiscoy Creek,	Eagle,	Wyoming,	10,000
E. D. Crosley,	Various brooks,	Scott, Homer, etc.,	Cayuga, Cortland,	12,000
G. L. Davis,	Cainlot Creek,	Johnstown,	Fulton,	5,000
John Sayre,	Cold Spring Brook,	Warwick,	Orange,	5,000
Gregory Finch,	Kohler Brook,	Rockland,	Sullivan,	8,000
James Trudden,	Spring Brook,	Colchester,	Delaware,	8,000
M. T. Bailey et al.,	Seven streams,	Five towns,	Greene,	8,000
J. M. Case,	Nigger Creek,	Broome,	Schoharie,	8,000
Edward Schubert,	Pascock Stream,	Union, etc.,	Rockland,	5,000
A. M. Traver,	Rock City and Saw Hill,	Red Hook,	Dutchess,	5,000
Wm. Rutherford,	Trout Brook,	Potsdam, etc.,	St. Lawrence,	10,000

DISTRIBUTION OF BROOK TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Little Valley Fish and Game Pro. Ass'n,	Baker Creek,	Little Valley,	Cattaraugus,	12,000
W. A. Shapley,	Bradley Brook,	Lebanon,	Madison,	8,000
Cassius Winch,	Various waters,	Wilmington,	Essex,	5,000
Rod and Gun Club,	East and North Brooks, etc.,	Philmont,	Columbia,	8,000
A. S. Prime,	Trib. E. Branch Au Sable River,	Jay,	Essex,	5,000
Homer Genung et al.,	Six Mile Creek,	Dryden, etc.,	Tompkins,	5,000
Alexander Voorhees,	Pond and Gee Brooks,	Rockland,	Sullivan,	8,000
Charles M. Munger,	Pine Swamp Creek, etc.,	Warsaw, etc.,	Wyoming,	6,000
Jordan Club,	Jordan River,	Hopkinton, etc.,	St. Lawrence, etc.,	10,000
George Cecil,	Sucker and Mill Brooks,	Schroon, etc.,	Essex, etc.,	10,000
W. B. Martin,	Bushkill, etc.,	——	Ulster, etc.,	10,000
Duck Derby,	Otis Pond,	Santa Clara,	Franklin,	5,000
M. S. Ives,	Five creeks,	Turin,	Lewis,	15,000
J. H. Martin,	White Lake Brook,	Bethel,	Sullivan,	8,000
D. H. Abrams,	Cherry Brook,	Lake Pleasant,	Hamilton,	15,000
Alonson Burlingame,	Virgil Creek,	Virgil, etc.,	Tompkins, etc.,	5,000
William Dennis,	Mountain Brook, etc.,	Dover,	Dutchess,	5,000
M. H. Wright,	Hardenburgh Stream,	Rockland,	Sullivan,	8,000
David Sturgess,	Brown's Brook,	Lake Pleasant,	Hamilton,	15,000
Isaiah Perkins,	Mason Lake,	"	"	25,000
Salamanca Gun and Rod Club,	Windfall Creek,	Great Valley,	Cattaraugus,	3,000
" "	Harkness Brook,	"	"	3,000
" "	Saw Mill Run,	Salamanca,	"	3,000
" "	Newton Run Creek,	"	"	3,000
" "	Rock City Creek,	Great Valley,	"	3,000
" "	McIntosh Creek,	Red House,	"	3,000
Peter Ossont,	Black and Crystal Creeks,	New Breman,	Lewis,	5,000

DISTRIBUTION OF BROOK TROUT FRY.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
George Moshier,	Red Brook,	Wawarsing,	Ulster,	5,000
C. J. Wiggins,	Four streams,	Westfield,	Cattaraugus,	8,000
J. D. Morley,	Sacandaga Lake,	Lake Pleasant,	Hamilton,	35,000
William Cluchey,	Cohocton River, etc.,	Avoca, etc.,	Steuben,	5,000
S. Bulkley,	Beaverkill River, etc.,	Rockland, etc.,	Sullivan,	10,000
Jay Davidson,	"	"	"	15,000
Eugene E. Sutton,	Peters Creek,	South Valley,	Cattaraugus,	3,000
W. O. Schaywadder,	Silver Hollow Stream,	Woodstock,	Ulster,	8,000
Frank Barton,	Shokomeko Trout Brook,	Pine Plains,	Dutchess,	5,000
Charles T. Telford,	East Branch Ouleout,	Meredith,	Delaware,	8,000
F. M. Bouck,	Martin Brook,	Colesville,	Broome,	8,000
Henry Hall,	Lake Colby,	Harrietstown,	Franklin,	10,000
Steuben County Association,	Headwaters Cohocton River,	Eleven towns,	Steuben,	50,000
John H. Fisher,	Gilman Lake,	Lake Pleasant,	Hamilton,	20,000
Charles Moon,	Corrigan Brook,	Saranac,	Clinton,	5,000
Byron Bissell,	Unnamed mountain streams,	Carrollton,	Cattaraugus,	8,000
Charles H. Duell,	Five brooks,	Horicon,	Warren,	10,000
H. J. Fuller,	Woolf Creek,	Castile,	Wyoming,	5,000
William Casey,	Howard and Spring Brooks,	Columbus,	Chenango,	5,000
Francis I. Bradford,	E. Branch Little Salmon River,	Bangor,	Franklin,	10,000
Robert Lafountaine,	Canfield Brook,	Dannemora,	Clinton,	5,000
W. C. Edmoston,	Various brooks,	Phelps,	Ontario,	5,000
W. R. Dodge,	Tributaries Beaverkill River,	Rockland,	Sullivan,	8,000
Amos Huntley,	Canasawacta Creek,	Plymouth, etc.,	Chenango,	5,000
S. D. Francisco,	Campbell Brook,	Colchester,	Delaware,	5,000
A. S. Bronck,	Various ponds,	Harrietstown,	Franklin,	15,000
George Cecil,	Sucker and Mill Brooks,	Schroon, etc.,	Essex, etc.,	10,000

DISTRIBUTION OF BROOK TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
William Yardon,	Otsquago Creek,	Stark, etc.,	Herkimer, etc.,	5,000
J. W. Parker, Secretary,	King's Church Brook,	Cambridge,	Washington,	10,000
" "	Headwaters Tomkannock Cr'k,	Pittstown, etc.,	Rensselaer,	10,000
" "	Willow Creek,	Hoosick, etc.,	"	5,000
Andrew S. Bard,	Shurruck,	Tompkins,	Delaware,	5,000
A. H. Crounse,	Onesquethaw Creek,	New Scotland, etc.,	Albany,	5,000
Theodore Wheeler,	Mountain Brook, etc.,	South Dover,	Dutchess,	5,000
E. T. Reed,	Several streams,	Mansfield, etc.,	Cattaraugus,	10,000
J. F. Jones,	Cold, Miller and Fall Brooks,	Lyonsdale,	Lewis,	15,000
George T. Record,	Butts Hollow and other brooks,	Washington, etc.,	Dutchess,	10,000
J. D. Newton,	Westkill,	Lexington,	Greene,	10,000
H. W. Leonard,	Mad River,	Camden,	Oneida,	10,000
D. J. Doughty,	Streams in Naples,	Naples,	Ontario,	10,000
M. E. Brimmer, Secretary,	White Creek,	White Creek, etc.,	Washington, etc.	15,000
Rensselaer and Wash. Co. Pro. G. Ass'n,	Shingle Hollow Brook,	Hoosick,	Rensselaer,	10,000
Edward L. Mitchell,	Dunbar Creek,	Coeymans,	Albany,	8,000
Frank M. Dodge,	Benton Hollow Stream,	Liberty,	Sullivan,	8,000
B. C. Wilkinson,	Ham Trout Brook,	Pine Plains,	Dutchess,	5,000
Charles E. Childs,	Foote Brook, etc.,	Mayfield,	Fulton,	10,000
Cyrus Mott,	Overton Brook, etc.,	Rockland,	Sullivan,	10,000
Lincoln Kittle,	Bascomb Brook,	"	"	5,000
E. C. Harvey,	Merris Stream,	Georgetown,	Madison,	8,000
William Dart,	Second Lake,	Webb,	Herkimer,	20,000
W. W. Stevens,	Windfall Pond,	"	"	10,000
N. S. Messiter,	Fish Brook,	Liberty,	Sullivan,	8,000
Charles V. Messiter,	Mongaup River,	"	"	8,000
J. S. Barnet,	Baskbish Falls Stream,	Copake,	Columbia,	8,000

DISTRIBUTION OF BROOK TROUT FRY.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
George W. Cooper,	Willoemoe,	Rockland,	Sullivan,	10,000
James Ryan,	West Branch Limestone Creek,	Pompey,	Onondaga,	3,000
Warner E. Sprague,	Willoemoe and Beaverkill Rivers,	Rockland, etc.,	Sullivan, etc.,	15,000
C. W. Lansing et al.,	Various streams,	Plattsburgh, etc.,	Clinton,	10,000
Charles Herring,	"	Walton,	Delaware,	30,000
D. Fitzgerald,	Mill Brook,	Rockland,	Sullivan,	5,000
Abram Smith,	Tribs. of Roleff Jansen Kill,	Gallatin,	Columbia,	5,000
Elijah Parks,	West Mongaup River,	Liberty,	Sullivan,	8,000
I. Post,	Middle Mongaup,	"	"	8,000
J. W. Shepardson,	Otselic Creek, etc.,	Georgetown, etc.,	Madison, etc.,	15,000
Michael Schaefer,	Knox Brook,	Liberty,	Sullivan,	5,000
F. J. Oakley,	Europe Brook,	Copake,	Columbia,	5,000
William H. Averill,	Spring Brook,	Richland,	Oswego,	10,000
W. E. Purdy,	Trout Brook, etc.,	"	"	10,000
W. D. Streeter et al.,	Salmon River,	Richland, etc.,	"	20,000
J. A. Crawford,	Various streams,	Hamden,	Delaware,	25,000
C. A. Norbury,	Various brooks,	Mamakating, etc.,	Sullivan, etc.,	10,000
Joel Kimball,	"	Liberty,	Sullivan,	10,000
H. D. Pixley,	Oriskany Creek, etc.,	Kirkland,	Oneida,	10,000
F. R. Bain,	Sherman Brook,	Dover, etc.,	Dutchess,	6,000
Smith Chittenden,	Otego Creek,	Hartwick,	Otsego,	8,000
Onondaga Anglers Association,	Onondaga Creek,	Onondaga, etc.,	Onondaga,	15,000
John H. Tatham,	Nick's Lake,	Webb,	Herkimer,	15,000
W. A. Parker,	Wylie Brook,	Coventry,	Chenango,	5,000
George P. Langford,	Sconondoa Creek,	Augusta,	Oneida,	10,000
J. W. Starks,	Various streams,	Altona,	Clinton,	10,000
B. B. Sayer,	Bellvale Creek,	Warwick,	Orange,	8,000

DISTRIBUTION OF BROOK TROUT FRY.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Miles Reed,	Angle Mill Stream,	Bethel, etc.,	Sullivan,	5,000
Albert Hallenbeck,	Winan's Spring Brook,	Copake,	Columbia,	8,000
Jay Schufelt,	Boston Corners Stream,	Copake, etc.,	"	5,000
Moses F. Nelson,	Deep Hollow Brook,	Highland,	Orange,	5,000
William H. Brooks,	Queensborough Brook,	"	"	3,000
A. Jay Thompson,	Cherry Valley Creek and Tribs.,	Cherry Valley,	Otsego,	10,000
S. W. Barnard,	Slide Brook,	St. Armand,	Essex,	10,000
H. F. Titus,	Sumner Brook,	"	"	10,000
E. W. White,	Moose Lake,	"	"	10,000
R. P. Town,	Grass Pond,	"	"	10,000
Benjamin F. Gladding,	Otselic River,	Georgetown, etc.,	Madison, etc.,	10,000
T. F. Duncan,	Otselic Creek,	Otselic,	Chenango, etc.,	10,000
W. Martin,	Twaddle's Brook,	Hancock,	Delaware,	8,000
W. D. Stevenson,	Branches of Moses Kill,	Argyle,	Washington,	8,000
John F. Van Der Cook,	Various waters,	Delhi,	Delaware,	15,000
William Winter,	"	"	"	20,000
F. W. Abrams,	Pisico and Tea Lakes, etc.,	Arietta,	Hamilton,	35,000
David Aird,	Oxbow Lake,	Lake Pleasant,	"	15,000
D. I. Roberts,	Ridge Brook, etc.,	Highland Mills,	Orange,	5,000
Fisheries, Game and Forest Com.,	Headwaters of Jessup River,	Lake Pleasant,	Hamilton,	50,000
" "	Miami River,	"	"	25,000
J. C. Mussell,	Gibbs Lake and tributaries,	Webb,	Herkimer,	10,000
Josiah A. Wood,	Pine Creek,	"	"	10,000
J. J. Perkins,	Nick Lake,	"	"	5,000
Dwight B. Sperry,	Eagle Creek,	"	"	10,000
Frank B. Peck,	Eagle Bay Creek,	"	"	5,000
E. F. Abbott,	West Marsh Brook,	"	"	10,000

DISTRIBUTION OF BROOK TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
J. E. Ball,	Second Lake,	Webb,	Herkimer,	5,000
C. M. Barrett,	Third Lake Creek, etc.,	"	"	5,000
Cortland Sportsman's Club,	Five brooks,		Cortland,	15,000
George A. Stevens,	Lake Placid and Mirror Lake,	North Elba,	Essex,	25,000
Frank E. Kendall,	McKenzie Pond,	"	"	10,000
John Everett,	Indian Brook, etc.,	Chatham,	Columbia,	12,000
James Sturgess,	Lake Pleasant,	Lake Pleasant,	Hamilton,	20,000
Fisheries, Game and Forest Com.,	Outlet of Gilman's Lake,	"	"	5,000
" "	Tribut. W. Br'ch Sacandaga Riv.	Arietta,	"	20,000
" "	Nicholas Creek,	Lake Pleasant,	"	10,000
" "	Wilcox Lake,	Stony Creek,	Essex,	15,000
" "	Two brooks,	Lake Pleasant,	Hamilton,	10,000
" "	Echo Lake,	"	"	5,000
" "	Charley Lake,	"	"	10,000
" "	Elm Lake,	"	"	10,000
" "	Tributaries to Sacandaga Lake,	"	"	25,000
" "	Cherry Creek,	"	"	10,000
" "	Elbow Creek,	Wells,	"	10,000
" "	Brown Creek,	Lake Pleasant,	"	10,000
" "	Hawley Creek,	Wells,	"	10,000
C. A. Cline,	Weebotuck and tributaries,	North East,	Dutchess,	10,000
William Von Der Linden,	Spring Brook,	Rhinebeck,	"	5,000
Charles M. Washburn,	Fishkill Creek,	Beekman,	"	5,000
Charles Emans, Jr.,	Johnsville stream,	East Fishkill,	"	5,000
John W. Butts,	Cold Spring,	McIntyre,	"	5,000
C. Hicks,	Willow Brook,	Clinton,	"	8,000
J. W. Hutton,	Upper Chateaugay Lake,	Lyon Mountain,	Clinton,	10,000

DISTRIBUTION OF BROOK TROUT FRY.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
F. L. Turner,	Lake Titus,	Malone,	Franklin,	10,000
W. M. Strough,	Six creeks,	Salisbury,	Herkimer,	15,000
Whitman Wilcox,	Cold Spring Brook,	Lebanon,	Madison,	5,000
Walter Peak,	Trout Brook,	Hancock,	Delaware,	8,000
C. M. Woolsey,	Willoemoe and tributaries,	Rockland,	Sullivan,	8,000
Mrs. Morgan Davis,	Tributaries of Beaverkill River,	"	"	8,000
E. H. J. Hawver,	Race Brook,	"	"	8,000
J. D. Davidson,	Shin Creek and Beaverkill,	"	"	8,000
C. H. Champlin,	McConnell stream,	Howard,	Steuben,	5,000
Louis Fleischman,	Headwaters of Delaware River,	Middletown,	Delaware,	10,000
E. Williams,	Black River and tributaries,	Leyden,	Lewis,	8,000
Thomas Glenn,	Deer Lake, Beaver River, etc.,	Croghan,	"	15,000
Warren Humes,	Middle Br'ch Oswegatchie Riv.	Diana,	"	15,000
George H. Davis,	Cedar Lake Creek,	Litchfield,	Herkimer,	8,000
O. F. Hulser,	Long Lake, Cummings C'k, etc.,	Forestport,	Oneida,	10,000
William A. Light,	West Canada Creek,	Russia, etc.,	Herkimer,	10,000
John D. Kernan,	Pine Creek and Gulf Brook,	Forestport,	Oneida,	10,000
F. C. Stevens,	Crow, Brainards and McCumbers Creeks,	Attica,	Wyoming,	3,000
A. G. Saxton,	Myrick and Sweezy Brooks,	Sherman,	Chautauqua,	5,000
"	Calhoun Brook,	Westfield, etc.,	"	5,000
A. Wetall,	Tributary of Beaverkill,	Hardenburgh,	Ulster,	5,000
Prof. H. J. Shaw,	Great and West Brooks,	New Berlin,	Chenango,	10,000
Walter N. Thayer,	Chazy Lake,	Dannemora,	Clinton,	10,000
J. M. Wardner,	Rainbow Lake and tributaries,	Brighton, etc.,	Franklin,	10,000
Fisheries, Game and Forest Com.,	Pumpkin Hollow Creek,	Wells,	Hamilton,	10,000
" "	Doig Creek,	Hope,	"	10,000

DISTRIBUTION OF BROOK TROUT FRY.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Spy Lake,	Arietta,	Hamilton,	15,000
" "	Little Rock Pond,	Wells,	"	15,000
" "	Little Round Pond,	Lake Pleasant,	"	15,000
J. D. Morley,	South Inlet of Lake Pleasant,	"	"	15,000
"	Fawn Lake,	"	"	15,000
"	Little Otter,	"	"	15,000
Fisheries, Game and Forest Com.,	Tributaries of Stony Creek, etc.,	Northampton,	Fulton,	20,000
" "	Outlet Little Clear Lake,	Santa Clara,	Franklin,	10,000
" "	Seventh Lake,	Morehouse,	Hamilton,	25,000
" "	Eighth Lake,	"	"	25,000
" "	Hellgate Ponds,	Webb,	"	10,000
George C. Titmuss,	Kinne Brook,	Thompson,	Sullivan,	5,000
Howard Tillotson,	West Branch of Mongaup,	Bethel,	"	5,000
William O. Hill,	West Branch of Delaware River,	Kortright,	Delaware,	8,000
"	Wright's Brook,	"	"	8,000
D. B. Cole,	Bushkill Stream,	Middletown,	"	8,000
S. F. Scott,	Various waters,	"	"	8,000
F. J. Inderlick,	Dudley Creek,	Lisle,	Broome,	10,000
B. W. Wood,	Mill Brook,	Schuyler,	Herkimer,	10,000
Carlos Hutchins,	Wakeley and Deep Ponds, etc.,	Lake Pleasant,	Hamilton,	25,000
Fisheries, Game and Forest Com.,	Willomoe River,	Rockland, etc.,	Sullivan,	35,000
" "	Bug Lake,	Morehouse,	Hamilton,	8,000
" "	John's Lake,	Webb,	Herkimer,	8,000
" "	Moss Lake,	"	"	8,000
" "	Bub's Lake,	"	"	8,000
" "	Twitchell Lake,	"	"	10,000
" "	Big Indian Spring Brook,	"	"	5,000

DISTRIBUTION OF BROOK TROUT FRY.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Beaverkill River and tributaries,	Rockland, etc.,	Sullivan,	35,000
" "	Joy Spring,	Webb,	Herkimer,	5,000
" "	Middle Branch Moose River,	"	"	10,000
George W. Jones,	Baxter Brook,	Hancock,	Delaware,	8,000
Fisheries, Game and Forest Com.,	Sands Creek,	"	"	8,000
" "	Bennet and Apley Brooks,	Rockland,	Sullivan,	8,000
" "	Spring Brook,	"	"	15,000
" "	Palmer Brook,	"	"	8,000
" "	Davidson Brook,	"	"	8,000
" "	Berry Brook,	"	"	5,000
" "	Dug Mountain Lakes,	Lake Pleasant,	Hamilton,	25,000
" "	Whitaker Lake,	"	"	25,000
" "	East Branch of Sacandaga River,	Wells,	"	25,000
" "	Mill Creek and Reservoir,	Lake Pleasant,	"	25,000
" "	Congamunck Creek, etc.,	Lake Pleasant, etc.,	"	50,000
" "	Outlet of Pisico Lake,	Arietta,	"	50,000
" "	Lewey Lake,	Lake Pleasant,	"	8,000
" "	Middle Branch Moose River,	Webb,	Herkimer,	10,000
" "	Big Spring Hole Creek,	"	"	10,000
" "	Darbee Brook,	Rockland,	Sullivan,	5,000
" "	Fay Brook,	Harrietstown,	Franklin,	5,000
" "	Two Bridge or Summer Brook,	"	"	5,000
" "	Church Pond,	Santa Clara,	"	5,000
" "	Hoel Pond,	"	"	10,000
" "	Bone Pond,	"	"	5,000
" "	Little Clear Pond,	"	"	5,000
" "	Little Green Pond,	"	"	5,000

DISTRIBUTION OF BROOK TROUT FRY.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	St. Regis Pond,	Santa Clara,	Franklin,	10,000
" "	Big Clear Pond,	Harrietstown,	"	10,000
" "	Slang Ponk,	Santa Clara,	"	10,000
D. M. Roberts,	Grass Pond Brook,	Franklin,	"	2,500

DISTRIBUTION OF BROOK TROUT FINGERLINGS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Walter E. Blackall,	Plum Brook,	Stillwater,	Saratoga,	500
Lewis E. Millert,	Deyo's Creek,	Marbletown, etc.,	Ulster,	800
F. J. Bradford,	E. Branch Little Salmon River,	Bangor,	Franklin,	1,000
Frank D. Cole,	Catskill Creek,	Cairo,	Greene,	700
Little Valley Fish and Game Pro. Ass'n,	Baker Brook,	Little Valley,	Cattaraugus,	1,000
Freeman T. Huxley et al.,	Tribut's of Union Mills Creek,	Northampton,	Fulton,	2,000
A. H. Fowler,	Union Springs Mill Pond,	Springport,	Cayuga,	1,000
Fisheries, Game and Forest Com.,	Little Clear Lake,	Santa Clara,	Franklin,	1,900
" "	Big Clear Lake,	Harrietstown,	"	2,800
" "	Grass Pond,	"	"	860
" "	Harrison Cr'k, etc., First Lake,	Webb,	Herkimer,	4,000
" "	Third Lake Creek, Third Lake,	"	"	2,500
" "	Pine Creek, etc., Fourth Lake,	"	"	2,000
F. B. Petrie,	Cowosolone Creek,	Lenox,	Madison,	1,500
Seward Nurry,	Steele's Creek,	Litchfield, etc.,	Herkimer,	800
E. R. Jenkins,	Delaware River and tributaries,	Stamford,	Delaware,	1,000

DISTRIBUTION OF BROOK TROUT FINGERLINGS.—Continued.

NAME OF APPLICANT	WATER STOCKED.	TOWN	COUNTY	AMOUNT
Bryan, Fritts and Hills,	Taghkanie and Livingston st'ms,	Taghkanie,	Columbia,	1,000
Fisheries, Game and Forest Com.,	Hellgate Lake,	Webb,	Herkimer,	1,000
" "	Nicks Lake,	"	"	1,000
D. I. Roberts,	Ten Mile River,	Narrowsburg,	Sullivan,	500
Fisheries, Game and Forest Com.,	Old Forge Pond,	Webb,	Herkimer,	1,500
" "	Middle Branch, Moose River,	"	"	500
" "	North Branch, Moose River,	"	"	2,000
D. I. Roberts,	Clove Brook,	Port Jervis,	Orange,	500
"	Calicoon Creek,	Calicoon,	Sullivan,	500
J. Q. Adams,	Six streams,	Watertown, etc.,	Jefferson,	1,000
Fisheries, Game and Forest Com.,	Third Lake Creek, Third Lake,	Webb,	Herkimer,	2,000
" "	Pine Creek, Fourth Lake,	"	"	1,500
" "	West Inlet Creek, First Lake,	"	"	1,000
" "	Lily Pond,	"	"	250
H. F. Whittenhall,	Wheeler and Crandall Brooks,	Greene,	Chenango,	800
Daniel Kisselbrach,	Tributaries of Rolif Jansen Kill,	Ancram,	Columbia,	1,000
O. Finch,	Berse Lock outlet,	"	"	1,000
Morton Haynes,	Five streams,	Pawling,	Dutchess,	1,000
W. H. Bartlett,	Three streams,	Amenia,	"	500
Charles Stark,	Burton Brook,	Dover,	"	500
W. Neeling,	Tributaries of Ancram Creek,	Ancram, etc.,	Columbia,	1,000
Matthias Burgher,	Bushkill River,	Olive,	Ulster,	500
G. L. Davis,	Cainlot Creek,	Johnstown,	Fulton,	500
J. J. Lewis,	West Canada Creek, etc.,	Trenton,	Oneida,	1,500
Parish Fish and Game Association,	Four creeks,	Parish,	Oswego,	1,000
Ira S. Smith,	Wawayanda Creek, etc.,	Warwick,	Orange,	500
Rensselaer and Wash. Co. Pro. G. Ass'n,	West Hoosick Brook,	Hoosick,	Rensselaer,	1,000

DISTRIBUTION OF BROOK TROUT FINGERLINGS.—CONCLUDED.

NAME OF APPLICANT	WATER STOCKED.	TOWN	COUNTY	AMOUNT
F. B. Keating,	Leader Brook,	Copake,	Columbia,	500
G. D. Langdon,	Bashbish Falls Stream,	"	"	500
Charles K. Baker,	Mettowee River, etc.,	Granville,	Washington,	1,000
Riley Parsons,	North Branch Moose River,	Webb,	Herkimer,	1,000
C. M. Barrett,	Third Lake Creek, etc.,	"	"	500
Thomas M. Costello,	Penoyer Brook, etc.,	Albion, etc.,	Oswego,	2,000
Fisheries, Game and Forest Com.,	Butler and Palmer Brooks,	Rockland,	Sullivan,	1,525
" "	Barrett Brook,	Colchester,	Delaware,	600
" "	Acid Run,	"	"	550
" "	Becker Brook,	"	"	400
" "	Gage Brook,	"	"	800
Edward Thompson, "	Nissequogue River and tribut's,	Smithtown,	Suffolk,	5,000
J. W. Pond,	Ragged Lake,	Belmont,	Franklin,	1,000
Fisheries, Game and Forest Com.,	Hellgate Lakes,	Webb,	Herkimer,	1,500
" "	Middle Branch Moose River,	"	"	1,000
" "	Harrison's Creek, tributary to First Lake,	"	"	2,000
" "	Third Lake Creek, tributary to Third Lake,	"	"	2,000
" "	Nicks Lake,	"	"	1,500

DISTRIBUTION OF BROOK TROUT YEARLINGS.

NAME OF APPLICANT	WATER STOCKED.	TOWN	COUNTY	AMOUNT
J. Q. Adams,	Felts Mills Creek,	Champion, etc.,	Jefferson,	300
Charles Stark,	Public waters,	Pawling,	Dutchess,	1,000
F. D. Kilburn,	Indian Lake,	Belmont,	Franklin,	1,000
Thomas H. Larkins,	Scotts Brook,	Gerry, etc.,	Chautauqua,	500
DeRuyter Sportsmen's Club,	Tioughinoga River,	De Ruyter,	Madison,	200
John Flynn, Jr.,	Negantskill Creek,	Brunswick, etc.,	Rensselaer,	500
Henry E. Bedell,	Tioughnioga River,	Homer,	Cortland,	200
J. O. Spelman,	Peck, Sulphur, Duncie Brooks,	Victor, etc.,	Monroe, etc.,	400
W. Barlow Dunlap,	West Perth,	Perth,	Fulton,	400
H. F. Whittenhall,	Wheeler and Camden Brooks,	Greene,	Chenango,	100
E. O. Eldredge,	East Branch Oswego Creek,	Berkshire,	Tioga,	200
Dr. J. G. Leonard,	Owego Creek and tributaries,	Harford,	Cortland,	200
Robert D. Black,	Farrington Brook,	Constantia,	Oswego,	100
N. L. Loomis et al.,	Sauquoit Creek,	Paris,	Oneida,	400
J. B. Mills,	Trout, Snow and Rawlins Brooks, etc.,	Chester,	Warren,	500
Frank B. Potter,	Various streams,	"	"	500
Rome State Custodial Asylum,	Fresh water ponds,	Rome,	Oneida,	1,000
W. A. Smyth,	Owego Creek,	Owego,	Tioga,	200
Sherburne Fish and Game Association,	Various streams,	Sherburne,	Chenango,	150
I. H. Benedict,	Waterville Reservoir,	Sangerfield,	Oneida,	100
Nelson Fish and Game Association,	Headwaters Chittenang River,	Nelson,	Madison,	200
Howard P. Denison,	Headwaters Onondaga Creek,	Onondaga,	Onondaga,	300
Louis Will,	Various streams,		Onondaga, etc.,	400
Frederick Holmes,	West Branch Unadilla River,	Bridgewater,	Oneida,	200
Beckley Howes,	E. and W. Br'ches Wiscoy Cr'k,	Eagle,	Wyoming,	250
Phillip Fuess,	Buseped Brook,	Marshall,	Oneida,	300
Homer Genung et al.,	Six Mile Creek,	Dryden, etc.,	Tompkins,	100

DISTRIBUTION OF BROOK TROUT YEARLINGS.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Richard Murphy,	Briggs Creek,	Mohawk,	Montgomery,	300
Jordan Club,	Jordan River,	Altamont, etc.,	Franklin, etc.,	1,000
Onondaga Anglers' Association,	Nine Mile Creek,	Geddes, etc.,	Onondaga,	250
" "	Onondaga Creek,	Onondaga,	"	800
Alonson Burlingame,	Virgil Creek,	Virgil, etc.,	Tompkins, etc.,	100
Thomas W. Fraine,	Flint Brook and tributaries,	Pike,	Wyoming,	125
William Casey,	Howard and Spring Brooks,	Columbus,	Chenango,	100
W. C. Edmoston,	Various brooks,	Phelps,	Ontario,	50
James Ryan,	West Branch Limestone Creek,	Pompey,	Onondaga,	200
Dr. W. J. Wesfelmaine,	Poole's Brook,	Manlius,	"	700
George W. Holloway,	Sawmill Creek,	Clay,	"	300
A. O. Olmstead,	Warner and Nichols Brooks,	Yorkshire,	Cattaraugus,	100
Ernest R. King,	Stonequarry Creek, etc.,	"	"	100
W. A. Parker,	Wylie Brook,	Coventry,	Chenango,	100
George D. Sherman,	Bloody Pond,	Crown Point,	Essex,	200
W. C. Witherbee,	Six ponds and streams,	Moriah,	"	500
Albert Weed,	Clear Pond,	Ticonderoga,	"	200
C. S. McLaughlin,	Lost Pond,	"	"	200
Arcade Rod and Gun Club,	Huzzy Brook, etc.,	Arcade,	Wyoming,	100
B. B. Lewis,	Howlet and Cherry Brooks, etc.,	Freedom,	Cattaraugus,	125
D. Purdy Sias,	Irondequoit and Allen Creeks,	Brighton,	Monroe,	600
E. E. Ford,	Charlotte, Otego and Ouleout Creeks,		Delaware, etc.,	500
Charles A. Ball,	Cool and Brimmer Brooks, etc.,	Wellsville,	Allegany,	100
Charles L. Guy,	Meadow Brook, etc.,	Elizabethtown,	Essex,	700
W. L. Brown,	Tributaries to Ouleout Creek,		Delaware,	500
Charles Davis,	Plattekill Creek,	Saugerties,	Ulster,	500
Fisheries, Game and Forest Com.,	Spring Creek,	Caledonia,	Livingston,	2,000

DISTRIBUTION OF TWO YEARS OLD BROOK TROUT.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
C. S. Bullymore,	Aquarium,	Buffalo,	Erie,	12
Fisheries, Game and Forest Com.,	Breeding Ponds,	Webb,	Herkimer,	200
" "	Spaulding Brook,	Bath,	Steuben,	400

DISTRIBUTION OF BROWN TROUT FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Charles E. Whitney,	Seven brooks,	Humphrey,	Cattaraugus,	8,000
C. B. Bradt,	Four brooks,	Easton, etc.,	Washington, etc.,	10,000
M. W. Morely,	Owl Kill,	White Creek,	Washington,	20,000
"	Whipple Brook,	Cambridge,	"	10,000
E. J. Conroy,	Tributaries of Buffalo Creek,	Java Centre,	Wyoming,	8,000
John F. Kerwin,	Sources Cattaraugus Cr'k, etc.,	Java,	"	8,000
E. L. Fisher, Secretary,	Black Creek,	Bergen,	Genesee,	8,000
Jerome Holmes,	Pleasant Brook,	Brookfield, etc.,	Madison, etc.,	8,000
Peter Flint,	Buck Mountain Pond,	Ticonderoga,	Essex,	5,000
H. F. Cunningham,	Thomas Brook,	Chenango,	Broome,	3,000
John Harrica et al.,	Bradley Lake,	Dannemora,	Clinton,	5,000
Michael D. Hyman,	Big Buffalo Creek,	Sheldon,	Wyoming,	8,000
Henry E. Bedell,	Cold Brook,	Homer,	Cortland,	5,000
Ira Elmendorf,	Esopus Creek,	Olive,	Ulster,	15,000
J. K. Grant,	Various waters,	Harpersfield, etc.,	Delaware, etc.,	15,000
H. P. Witthoft,	West Branch Delaware River,	Bloomville,	Delaware,	5,000

DISTRIBUTION OF BROWN TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
John T. Lynch,	Minanus water,	Bedford,	Westchester,	5,000
Otsego Fish Association,	Various streams,	Otsego, etc.,	Otsego,	10,000
F. Sawyer,	Upper Chateaugay Lake,	Lyon Mountain,	Clinton,	5,000
Alexander W. Mackey,	Rensselaer Creek, etc.,	Waterloo, etc.,	Albany,	10,000
W. J. Ayers & Son,	Twin Lakes,	Malone,	Franklin,	15,000
A. A. Beardsley,	Scriba Creek,	Constantia,	Oswego,	10,000
William Osborn,	Lake Pleasant,	Lake Pleasant	Hamilton,	25,000
Daniel Kisselbrack,	Rolif Jansen Kill,	Ancram,	Columbia,	10,000
John McDonald,	Bennet Hollow Brook,	Otisco Valley,	Onondaga,	5,000
H. E. Heyworth,	Calkins and Elmore Brooks,	Peru,	Clinton,	8,000
W. W. Joslin,	Seven brooks,	Yorkshire,	Cattaraugus,	10,000
John S. Ells,	Beard and Arnold Brooks,	Peru,	Clinton,	8,000
W. R. Weaver,	Clark and Adcock Brooks,	"	"	8,000
Erastus Stafford,	Stafford and Baker Brooks,	Au Sable,	"	8,000
Minot Mitchell,	Titus Brook,	North Norwich,	Chenango,	5,000
Charles Edkins,	Headwaters Chenango River,	Hamilton, etc.,	Madison,	5,000
William G. Dean,	Five Mile Creek,	Jerusalem, etc.,	Yates, etc.,	5,000
James Maxson,	Conowango Creek,	Villenova,	Chautauqua,	10,000
D. I. Roberts,	Cadosia Creek,	Hancock,	Delaware,	5,000
A. A. McCoy,	Various waters,	Arietta, etc.,	Hamilton,	15,000
Frederick Holmes,	West Branch Unadilla River	Bridgewater,	Oneida,	15,000
P. R. Fisk,	Payne, Mill and Rogers Brooks,	Hamilton, etc.,	Madison,	5,000
John A. Mott,	Various brooks,	Manlius,	Onondaga,	5,000
George Weiss,	Beaverkill River,	Rockland,	Sullivan,	8,000
A. M. Traver,	Rock City and Saw Kill,	Red Hook,	Dutchess,	5,000
Cassius Winch,	Various waters,	Wilmington,	Essex,	5,000
Rod and Gun Club,	East and North Brooks, etc.,	Philmont, etc.,	Columbia,	8,000

DISTRIBUTION OF BROWN TROUT FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
A. S. Prime,	East branch Au Sable River,	Jay,	Essex,	5,000
Salamanca Gun and Rod Club,	Big Red House Creek,	Red House,	Cattaraugus,	5,000
" "	Great Valley Creek,	Great Valley,	"	5,000
C. J. Wiggins,	Four streams,	Westfield,	Chautauqua,	12,000
Frank Dunning,	Spring Brook,	Warwick,	Orange,	5,000
Steuben County Association,	Niel's, West and Twelve Mile Cr'k	Wheeler, etc.,	Steuben,	50,000
J. W. Bristol,	Gainesville Stream,	Gainesville,	Wyoming,	10,000
Charles Crooks,	Mud Creek,	New Scotland,	Albany,	10,000
B. W. LeRoy,	Neversink River,	Neversink,	Sullivan,	10,000
E. T. Reed,	Several streams,	Mansfield, etc.,	Cattaraugus,	5,000
D. J. Doughty,	"	Naples,	Ontario,	5,000
J. J. Rembe,	Highland Brook,	Phillipstown, etc.	Putnam, etc.,	10,000
Foster Williams,	Center Brook,	Columbus,	Chenango,	5,000
Charles E. Childs,	Foote Brook, etc.,	Mayfield,	Fulton,	5,000
Schuyler Rod and Gun Club,	Mill Brook,	Schaghticoke,	Rensselaer,	10,000
Henry Martin,	West branches Vly Creek,	New Scotland,	Albany,	10,000
Willis Johnson,	Onisquethaw Creek,	Bethlehem, etc.,	"	10,000
C. W. Lansing et al.,	Various streams,	Plattsburgh, etc.,	Clinton,	10,000
Dr. J. S. Peaslee,	Parks and Wiley Creeks,	Schodack,	Rensselaer,	5,000
Honeoye Falls Anglers' Association,	Deep Pond and Durham Brook,	Menden, etc.,	Monroe, etc.,	10,000
M. C. Bailey,	North Pond,	Rockland,	Sullivan,	8,000
Moses F. Nelson,	Deep Hollow Brook,	Highlands,	Orange,	5,000
"	Buttermilk Falls Brook,	"	"	10,000
William H. Brooks,	Queensborough Brook,	"	"	4,000
W. D. Stevenson,	Summit Lake,	Arguyle,	Washington,	10,000
David Aird,	Oxbow Lake,	Lake Pleasant,	Hamilton,	15,000
J. Simpson,	Garbut Pond,	Wheatland	Monroe,	5,000

DISTRIBUTION OF BROWN TROUT FRY.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Josiah A. Wood,	Pine Creek,	Webb,	Herkimer,	5,000
J. E. Ball,	Second Lake,	"	"	5,000
Major E. L. Sprout et al.,	Beaver Brook,	Mount Hope,	Orange,	10,000
H. C. Benson et al.,	Baxter Brook,	"	"	10,000
Herman Otto,	Bennewater Brook,	"	"	5,000
J. Wilkin,	Tuthill Brook,	"	"	5,000
W. H. Walker,	Christie's Creek,	Caledonia,	Livingston,	5,000
Fisheries, Game and Forest Com.,	Allen's Lake,	Wheatland,	Monroe,	15,000
" "	Spring Creek,	"	"	10,000
James Sturges,	Lake Pleasant,	Lake Pleasant,	Hamilton,	10,000
Fisheries, Game and Forest Com.,	Echo Lake,	"	"	5,000
" "	Tributary to Sacandaga Lake,	"	"	10,000
" "	Elm Lake,	"	"	5,000
F. L. Turner,	Lake Titus,	Malone,	Franklin,	10,000
E. Williams,	Black River and tributaries,	Leyden,	Lewis,	10,000
F. C. Stevens,	Crow and Brainard's Br'ks, etc.,	Attica,	Wyoming,	3,000
A. G. Saxton,	Myrick and Sweezy Brooks,	Sherman,	Chautauqua,	5,000
Piermont Improvement Association,	Sparkill Creek,	Sparkill,	Rockland,	3,000
I. J. Delo,	Sawhill Mountain Stream, etc.,	Woodstock,	Ulster,	10,000
Henry Killick,	Outlet of Spring Pond,	Junius,	Seneca,	8,000
George L. Jaquisk et al.,	Lake Wawaka,	Middletown,	Delaware,	10,000
James F. Scott,	Tremperskill and tributaries,	Andes,	"	10,000
G. C. Davis,	Sylvia Lake,	Fowler,	St. Lawrence	10,000
Fisheries, Game and Forest Com.,	Beaverkill River,	Rockland,	Sullivan,	5,000
" "	Rat Pond,	Santa Clara,	Franklin,	5,000
" "	Grass Pond,	"	"	5,000
" "	Church Pond,	"	"	5,000

DISTRIBUTION OF BROWN TROUT FRY.—CONCLUDED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Little Long Pond,	Santa Clara,	Franklin,	10,000
" "	Bear Pond,	"	"	5,000
" "	Little Green Pond,	"	"	10,000
" "	Hoel Pond,	"	"	5,000

DISTRIBUTION OF BROWN TROUT FINGERLINGS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
C. Hicks,	Wappinger's Creek,	Pine Plains, etc.,	Dutchess,	500
Rev. E. S. Ralston,	Sparkill,	Orangetown,	Rockland,	250
D. I. Roberts,	Gurber Spring Brook, etc.,	Ramapo,	"	500
Michael J. Yonker,	Beerkill,	Wawarsing,	Ulster,	1,000
Peter Flint,	Wooster Pond,	Ticonderoga,	Essex,	500
De Ruyter Sportsmen's Club,	Tioughnioga River,	De Ruyter,	Madison,	1,000
Fisheries, Game and Forest Com.,	Grass Pond,	Harrietstown,	Franklin,	140
Cyrus Durey,	Caroga Creek,	Caroga,	Fulton,	2,000
E. Canfield,	Shawangunk Kill,	Mamakating,	Sullivan,	2,000
Fisheries, Game and Forest Com.,	Upper Chateaugay Lake,	Dannemora,	Clinton,	2,000
" "	Moose River,	Webb,	Herkimer,	2,000
D. I. Roberts,	Greycourt Creek,	Greycourt,	Orange,	250
"	Mountain Brook,	New City,	Rockland,	250
W. James Horton,	Lake Mohegan,	Mohegan, etc.,	Westchester,	250
D. I. Roberts,	Pine Kill,	Otisville,	Orange,	500

DISTRIBUTION OF BROWN TROUT FINGERLINGS.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fred Barton,	Owego Creek,	Owego,	Tioga,	1,000
Fisheries, Game and Forest Com.,	Lake George,		Warren,	1,500
" "	Hoel Pond,	Santa Clara,	Franklin,	1,000
" "	Pollawog Pond,	"	"	1,000
" "	Cold Spring Brook,	Hammondsport,	Steuben,	4,000
Geneganslet Fish and Game Pro. Ass'n,	Various streams,	Smithville,	Chenango,	800
J. J. Lewis,	W. Canada and Cincinnati Creeks	Trenton,	Oneida,	3,000
Fisheries, Game and Forest Com.,	Middle branch Moose River,	Webb,	Herkimer,	500
" "	Tribut's First and Third Lakes,	"	"	3,500
T. S. Pratt,	Mud Lick,	Caton,	Steuben,	500
Fisheries, Game and Forest Com.,	Beaverkill River, etc.,	Rockland, etc.,	Sullivan, etc.,	4,000
" "	Elsworth Brook,	Rockland,	"	700

DISTRIBUTION OF BROWN TROUT YEARLINGS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Freeman T. Huxley,	Tributaries of Han's Creek,	Providence,	Saratoga,	1,000
J. O. Ballard,	Cold Brook,	Belmont,	Franklin,	400
H. C. Allen,	Otselic Creek,	Georgetown,	Madison,	1,000
Henry E. Bedell,	Tioughnioga River,	Homer,	Cortland,	200
W. W. Suits,	Dead Creek,	Van Buren,	Onondaga,	1,000
Edward I. Rice,	Rice Creek,	Dewitt,	"	500

DISTRIBUTION OF BROWN TROUT YEARLINGS.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Otsego Fish Association,	Various streams,	Otsego, etc.,	Otsego,	1,000
William H. Shear,	Onesquithaw Creek,	Coeymans, etc.,	Albany,	300
"	Hanecroix Creek,	" "	"	300
J. S. Buckley et al.,	Salmon Creek,	Sodus Center,	Wayne,	1,000
Black River Fish and Game Pro. Ass'n,	New Forestport Reservoir,	Forestport,	Oneida,	2,000
Robert D. Black,	Farmington Brook,	Constantia,	Oswego,	420
Catskill Fish and Game Club,	Potuck Creek,	Catskill,	Greene,	900
J. B. Mills,	Trout, Snow and other Brooks,	Chester,	Warren,	500
C. H. Wilcox,	Chenango River and tributaries,	Hamilton, etc.,	Madison,	1,000
Frank B. Potter,	Various streams,	Chester,	Warren,	600
William H. Manning,	"	Saratoga Springs, etc.,	Saratoga,	500
I. H. Benedict,	Waterville Reservoir,	Sangerfield,	Oneida,	500
G. R. Stedman,	Fish Creek, etc.,	Amesville,	"	800
M. T. Bailey et al.,	Seven streams,	Five towns,	Greene,	400
Salamanca Gun and Rod Club	Big Red House Creek,	Red House,	Cattaraugus,	100
" "	Great Valley Creek,	Great Valley,	"	100
A. J. Warren,	Tonawanda Creek,	Sheldon,	Wyoming,	400
W. C. Eager,	Warwick Reservoir,	Warwick,	Orange,	500
Steuben County Association,	Niel's, West & Twelve Mile C'ks	Wheeler, etc.,	Steuben,	1,500
J. W. Bristol,	Gainesville Stream,	Gainesville,	Wyoming,	400
Fred J. Tine,	Moyer Creek,	Frankfort,	Herkimer,	1,000
Stephen D. Horton,	Indian Lake,	Putnam Valley,	Putnam,	250
L. C. Fenton,	Sugar Creek,	Ossian,	Livingston,	300
William Dart,	Second Lake,	Webb,	Herkimer,	750
Schuyler Rod and Gun Club,	Mill Brook,	Schaghticoke,	Rensselaer,	100
Honeoye Falls Anglers' Association,	Deep Pond and Durham Brook,	Menden, etc.,	Monroe, etc.,	200
Henry Loftie,	Butternut Creek, etc.,	Onondaga, etc.,	Onondaga,	500

DISTRIBUTION OF BROWN TROUT YEARLINGS.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
George Sullivan,	Lenox and Flynn Streams,	Arcade,	Wyoming,	300
Willard Holsapple,	Rhoda Lake,	Copake,	Columbia,	500
J. Webb Beebe,	Cassadaga Lake,	Stockton, etc.,	Chautauqua,	300
Arcade Rod and Gun Club,	Huzzy Brook, etc.,	Arcade,	Wyoming,	175
A. J. Thompson,	Cherry Valley Creek, etc.,	Cherry Valley,	Otsego,	1,000
Benjamin F. Gladding,	Otselic River,	Georgetown, etc.,	Madison, etc.,	500
Fisheries, Game and Forest Com.,	North branch Moose River,	Webb,	Herkimer,	750
D. I. Roberts,	Highland Mills Creek,	Highland Mills,	Orange,	200
"	Mahwah Creek,	Suffern,	Rockland,	200
A. E. Nickinson,	Tuthill Brook,	Mount Hope, etc.,	Orange,	100
Thomas M. Perry,	Winters Brook,	" "	"	50
Charles Bennett,	Little Shawangunk Kill,	" "	"	100
A. T. Bertholf,	" "	" "	"	100
Charles A. Ball,	Cool and Brimmer Brooks, etc.,	Wellsville, etc.,	Allegany,	1,175
Niagara County Anglers' Club,	Shimps Brook,	Royalton, etc.,	Niagara,	400
Charles Davis,	Plattkill Creek,	Saugerties,	Ulster,	500
Fisheries, Game and Forest Com.,	Spring Creek,	Wheatland,	Monroe,	2,000
Dr. L. C. Galpin et al.,	Oatka Creek,	"	"	500
John Samson,	Allen's Creek,	LeRoy,	Genesee,	1,000
Buffalo City Cemetery,	Forest Lawn Lake,	Buffalo,	Erie,	500
Fisheries, Game and Forest Com.,	Cohocton River,	Bath,	Steuben,	8,000
" "	Allen's Creek,	Wheatland,	Monroe,	3,200
C. Taggart,	Cold Springs,	Urbana,	Steuben,	1,000
Fisheries, Game and Forest Com.,	Basket Brook,	Fremont,	Sullivan,	500
" "	Adams Creek,	"	"	500
" "	Peaks Brook,	"	"	500
" "	Half-way Brook,	Highland,	"	500

DISTRIBUTION OF BROWN TROUT YEARLINGS.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Little Mill Brook,	Highland,	Sullivan,	500
" "	Beaver Brook,	"	"	500
" "	Stony Brook,	"	"	500
" "	Little Green, Little Clear and Hoel Ponds,	Santa Clara,	Franklin,	3,000
" "	Black River and tributaries,	Forestport, etc.,	Oneida,	1,000
" "	Little Clear Pond,	Santa Clara,	Franklin,	2,500
E. C. Stewart,	Cayuga Lake,	. . . . .	Tompkins,	800
W. S. Gavitt,	Outlet of Irwin's Pond,	. . . . .	Wayne, etc.,	300
Fisheries, Game and Forest Com.,	Five Mile Brook and Haskell Cr'k	Allegany, etc.,	Cattaraugus,	900
" "	Sumner Stream,	Arietta,	Hamilton,	2,550
" "	Spring Creek,	Caledonia,	Livingston,	3,000
" "	Cold Spring Brook,	Urbana,	Steuben,	400
" "	Moose Riv. and Old Forge Pond,	Webb,	Herkimer,	350
" "	Beaverkill River and tributaries,	Rockland, etc.,	Sullivan, etc.,	4,050
" "	Spring Creek,	Caledonia,	Livingston,	2,848

DISTRIBUTION OF BROWN TROUT ADULTS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
D. I. Roberts,	Little Shawangunk Kill,	Middletown,	Orange,	100
"	Neversink River,	Deer Park,	"	100
"	Pearl River,	Orangetown,	Rockland,	100
Fisheries, Game and Forest Com.,	St. John Lake or Jones Pond,	Huntington, etc.,	Suffolk, etc.,	435
" "	Lake Ronkonkoma,	Islip,	Suffolk,	200

DISTRIBUTION OF RAINBOW TROUT FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
W. W. Joslin,	Four streams,	Yorkshire,	Cattaraugus,	20,000
M. T. Bailey et al.,	Seven streams,	Five towns,	Greene,	10,000
Cassius Winch,	Various waters,	Wilmington,	Essex,	5,000
Rod and Gun Club,	East and North Brooks, etc.,	Philmont, etc.,	Columbia,	8,000
A. S. Prime,	Six Mile Creek,	Dryden, etc.,	Tompkins,	5,000
Frank Dunning,	Spring Brook,	Warwick,	Orange,	5,000
William H. Brooks,	Queensborough Brook,	Highland,	"	3,000
C. A. Norbury,	Six brooks,	Mamakating,	Sullivan,	10,000
F. L. Turner,	Lake Titus,	Malone,	Franklin,	5,000
Fisheries, Game and Forest Com.,	Cold Spring Brook,	Urbana,	Steuben,	25,000
A. N. Parmiter,	Taylor and Kilby Creeks,	Volney,	Oswego,	15,000
Fisheries, Game and Forest Com.,	Little Green Pond,	Santa Clara,	Franklin,	8,000

DISTRIBUTION OF RAINBOW TROUT FINGERLINGS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
P. H. Willey,	Canasevogue Creek,	Dansville, etc.,	Livingston,	2,500
C. Hicks,	Wappinger's Creek,	Pine Plains, etc.,	Dutchess,	500
Rev. Edward S. Ralston,	Sparkill,	Orangetown,	Rockland,	250
Peter Flint,	Wooster Pond,	Ticonderoga,	Essex,	500
M. S. Northup et al ,	East Canada Lakes,	Caroga,	Fulton,	800
Dr. H. M. Lincoln,	Brook,		Saratoga,	500
P. H. Willey,	Big Mill Creek,		Steuben, etc.,	3,000

DISTRIBUTION OF RAINBOW TROUT FINGERLINGS.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
P. H. Willey,	Knapp's Creek,		Livingston,	1,000
J. W. Pond,	Ragged Lake,	Belmont,	Franklin,	1,500
Saratoga Fishermen,	Bog Meadow and Deer Brooks,	Saratoga Springs,	Saratoga,	700
Fisheries, Game and Forest Com.,	Old Forge Pond,	Webb,	Herkimer,	750
D. I. Roberts,	Greycourt Creek,	Greycourt,	Orange,	250
"	Mountain Brook,	New City,	Rockland,	250
W. James Horton,	Lake Mohegan,	Mohegan, etc.,	Westchester,	250
Fred. J. Tingley,	Mayham Brook, etc.,	Stamford,	Delaware,	1,500
Fisheries, Game and Forest Com.,	Keuka Lake,	Hammondsport,	Steuben,	10,000
W. F. Royce,	Hunter's Lake,	Rockland,	Sullivan,	500
Charles Hicks,	Upton Lake,	Clinton,	Dutchess,	500
Highland Falls Rod and Gun Club,	Highland Lake,	Highlands,	Orange,	500
E. D. Keeney,	Clear Creek, etc.,	Arcade,	Wyoming,	2,500
J. W. Dee,	Hornby Lake,	Hornby,	Steuben,	250
Fisheries, Game and Forest Com.,	Headwaters Cohocton River,	Wayland, etc.,	"	2,500
" "	Beaverkill River, etc.,	Rockland, etc.,	Sullivan,	2,500

DISTRIBUTION OF RAINBOW TROUT YEARLINGS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Rev. J. H. Hoadley,	Brantingham Lake,	Greig,	Lewis,	1,000
Abram J. Miller,	East branch Croton River, etc.,	South East,	Putnam,	1,000
N. Ossont,	Crystal Creek,	Watson,	Lewis,	500
Frank Griswold,	Demon Pond,	Howard,	Steuben,	1,000

DISTRIBUTION OF RAINBOW TROUT YEARLINGS.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
J. B. Mills,	Trout and Snow Brooks, etc.,	Chester,	Warren,	500
William H. Manning,	Various streams,	Saratoga Springs, etc.,	Saratoga,	300
P. M. Rathbun,	Owasco Inlet,	Moravia, etc.,	Cayuga,	1,000
William H. Van Allen,	White Lake,	Bethel,	Sullivan,	1,500
W. C. Eager,	Warwick Reservoir,	Warwick,	Orange,	500
Stephen D. Horton,	Indian Lake,	Putnam Valley,	Putnam,	250
William Dart,	Second Lake,	Webb,	Herkimer,	500
Henry Martin,	West branches Vly Creek,	New Scotland,	Albany,	500
Samuel R. Beardsley,	Paradox Lake,	Severance,	Essex,	1,000
Henry Loftie,	Jamesville Reservoir, etc.,	Lafayette, etc.,	Onondaga,	500
Charles Stark,	Little Whaley,	Pawling,	Dutchess,	500
W. F. Royce,	Hunter's Lake,	Rockland,	Sullivan,	400
C. M. Bartlett,	Kiamesha Lake,	Thompson,	"	300
C. A. Norbury,	Six brooks,	Mamakating,	"	300
W. A. Wells,	Sprout Creek,	La Grange,	Dutchess,	300
John Samson,	Allen's Creek,	LeRoy,	Genesee,	300
Fisheries, Game and Forest Com.,	Hemlock Lake,	. . . . . .	Livingston,	6,000
" "	Keuka Lake,	. . . . . .	Steuben,	10,000
" "	Little Green and Hoel Ponds,	Santa Clara,	Franklin,	1,000
W. J. Ayres & Son,	Twin Lakes,	Malone,	"	500
Fisheries, Game and Forest Com.,	Black River and tributaries,	Forestport, etc.,	Oneida,	1,000
" "	Little Clear Pond,	Santa Clara,	Franklin,	350
" "	Fulton chain of lakes,	Webb,	Herkimer,	2,000
G. V. Norton,	Story Lake,	Watson,	Lewis,	500
Highland Falls Rod and Gun Club,	Highland Lake,	Highlands,	Orange,	400
Charles Hicks,	Upton Lake,	Clinton,	Dutchess,	400
Fisheries, Game and Forest Com.,	Moose River & Old Forge Pond,	Webb,	Herkimer,	500
" "	Cold Spring Brook,	Urbana,	Steuben,	200

DISTRIBUTION OF RAINBOW TROUT ADULTS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Pollawog Pond,	Santa Clara,	Franklin,	125
" "	St. Johns Lake or Jones Pond,	Huntington, etc.,	Suffolk, etc.,	635

DISTRIBUTION OF LAKE TROUT FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
John Irwin,	Star Lake,	Fine,	St. Lawrence,	15,000
Robert Lenox Banks,	Lake George,	. . . . .	Warren,	200,000
William Osborn,	Lake Pleasant,	Lake Pleasant,	Hamilton,	47,000
T. D. Sullivan,	Five ponds and lakes,	Long Lake,	"	25,000
Cassius Winch,	Various waters,	Wilmington,	Essex,	5,000
Isaiah Perkins,	Mason Lake,	Lake Pleasant,	Hamilton,	25,000
J. D. Morley,	Sacandaga Lake,	"	"	55,000
Owen Dunning,	Gilman Lake,	"	"	25,000
J. H. Lamphere,	Owasco Lake,	Owasco, etc.,	Cayuga,	50,000
William Dart,	Second Lake,	Webb,	Herkimer,	10,000
W. W. Stevens,	Moss Lake,	"	"	10,000
F. C. Schenck,	First Lake,	"	"	10,000
F. W. Abrams,	Piseco Lake,	Arietta,	Hamilton,	35,000
Fisheries, Game and Forest Com.,	Big Moose Lake,	Webb,	Herkimer,	25,000
Dwight B. Sperry,	Fourth Lake,	"	"	10,000
E. F. Abbott,	First Lake,	"	"	10,000
J. E. Ball,	First Lake and Creek,	"	"	20,000

DISTRIBUTION OF LAKE TROUT FRY.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUTNY	AMOUNT
C. M. Barrett,	Third Lake,	Webb,	Herkimer,	10,000
George A. Stevens,	Lake Placid, Mirror Lake, etc.,	North Elba,	Essex,	25,000
Walter N. Thayer,	Chazy Lake,	Dannemora,	Clinton,	10,000
J. M. Wardner,	Rainbow Lake,	Brighton,	Franklin,	10,000
Fisheries, Game and Forest Com.,	Eighth Lake, Fulton Chain,	Morehouse,	Hamilton,	25,000
" "	Seventh " "	"	"	30,000
" "	Third " "	Webb,	Herkimer,	10,000
" "	Fourth " "	"	"	10,000
" "	Turtle Pond,	Santa Clara,	Franklin,	5,000
" "	Hoel Pond,	"	"	10,000
" "	Little Clear Pond,	"	"	10,000
" "	St. Regis Pond,	"	"	15,000
" "	Big Clear Pond,	Harrietstown,	"	10,000
" "	Long Pond,	Santa Clara,	"	5,000

DISTRIBUTION OF LAKE TROUT FINGERLINGS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
John E. Hodgman,	Saratoga Lake,	Saratoga Springs, etc.,	Saratoga,	700
Fisheries, Game and Forest Com.,	Canandaigua Lake,	. . . . . .	Ontario,	10,000
S. A. Swenson,	Upper Saranac Lake,	Harrietstown,	Franklin,	5,275
Fisheries, Game and Forest Com.,	First Lake, Fulton Chain,	Webb,	Herkimer,	1,000

DISTRIBUTION OF LAKE TROUT FINGERLINGS.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Fourth Lake, Fulton Chain,	Webb,	Herkimer,	3,500
" "	Keuka Lake,	. . . . .	Steuben, etc.,	17,000
" "	Upper Chateaugay Lake,	Dannemora,	Clinton,	4,550
Ingram and Paxton,	Lake Erie,	Dunkirk,	Chautauqua,	1,000
Fisheries, Game and Forest Com.,	Fulton Chain of Lakes,	Webb,	Herkimer,	3,500
Robert Lenox Banks,	Lake George,	Caldwell,	Warren,	5,600
B. F. Petherane,	Skaneateles Lake,	Skaneateles, etc.,	Onondaga,	5.600
E. D. Crosley,	" "	. . . . .	Cortland, etc.,	5,000
Fisheries, Game and Forest Com.,	First Lake, Fulton Chain,	Webb,	Herkimer,	14,000
" "	Canandaigua Lake,	. . . . .	Ontario,	26,400
" "	Third Lake, Fulton Chain,	Webb,	Herkimer,	2,000
" "	Lake Keuka,	. . . . .	Steuben, etc.,	12,000
" "	Third Lake, Fulton Chain,	Webb,	Herkimer,	2,500
" "	Fourth Lake, "	"	"	6,000
" "	Hemlock Lake,	. . . . .	Livingston,	8,100

DISTRIBUTION OF LAKE TROUT YEARLINGS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
A. R. Eastman,	Woodhull Lake,	Wilmurt,	Herkimer,	2,500
J. B. Mills,	Schroon Lake,	Chester,	Warren,	1,000
E. D. Crosley,	Skaneateles Lake,	. . . . .	Cortland, etc.,	300
George Cecil,	Schroon Lake,	. . . . .	Essex, etc.,	1,000

DISTRIBUTION OF LAKE TROUT YEARLINGS.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Henry Hall,	Lake Colby,	Harrietstown,	Franklin,	2,500
Charles H. Duell,	Brant Lake,	Horicon,	Warren,	1,000
Saratoga C'ty Fish and Game Pro. Ass'n,	Lake Lonely,	Saratoga Springs,	Saratoga,	200
J. H. Lamphere,	Owasco Lake,	Owasco, etc.,	Cayuga,	1,000
William Dart,	Second Lake,	Webb,	Herkimer,	750
Fisheries, Game and Forest Com.,	White Lake,	Forestport,	Oneida,	2,500
" "	Lake McKenzie,	St. Armand,	Essex,	1,250
" "	Big Moose Lake,	Webb,	Herkimer,	500
" "	First Lake,	"	"	500
" "	Canandaigua Lake,	Gorham, etc.,	Ontario,	1,000
" "	Hemlock Lake,	. . . . . .	Livingston,	1,686
" "	Little Clear Pond,	Santa Clara,	Franklin,	1,100

DISTRIBUTION OF PIKE-PERCH FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Stephen D. Horton,	Indian Lake,	Putnam Valley,	Putnam,	50,000
S. F. Horton,	Lake Mohegan,	Yorktown,	Westchester,	50,000
Batavia Fish and Game Pro. Club,	Tonawanda River,	Batavia,	Genesee,	200,000
Marvin R. Smith,	Round Lake,	Phillipstown,	Putnam,	50,000
David Roe, Jr.,	Seneca Lake,	Watkins,	Schuyler,	300,000
De Ruyter Sportsmen's Club,	De Ruyter Reservoir,	De Ruyter,	Madison,	200,000
H. C. Allen,	Hatch's Lake,	Eaton,	"	100,000

DISTRIBUTION OF PIKE-PERCH FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
M. W. Deitz,	Butternut Creek,	Butternuts, etc.,	Otsego,	50,000
W. A. Smyth,	Susquehanna River,	Owego,	Tioga,	200,000
Minot Mitchell,	Chenango River,	. . . . . .	Chenango, etc.,	100,000
Daniel Kisselbrack,	Long Pond,	Ancram,	Columbia,	50,000
James H. Glavin,	Hudson River,	Waterford,	Saratoga,	200,000
J. H. Benedict,	Bailey Lake,	Sangerfield,	Oneida,	50,000
C. H. Wilcox,	Lake Earlville,	Lebanon,	Madison,	100,000
Peter Enders Blair,	Mohawk River,	Florida,	Montgomery,	300,000
Charles E. Hall,	Hudson River,	Lansingburgh,	Rensselaer,	100,000
Peter Woodin,	Mohawk River,	Crescent,	Saratoga,	200,000
D. I. Roberts,	Oquaga Lake,	Deposit,	Delaware,	100,000
William T. Ford,	Mohawk River,	Waterford, etc.,	Saratoga,	200,000
Frank J. Parmentier et al.,	"	Amsterdam,	Montgomery,	300,000
T. W. Highland,	"	Little Falls,	Herkimer,	100,000
John I. Bradley,	Wallkill River, etc.,	Wawayanda,	Orange,	50,000
Anglers' Association of Onondaga,	Onondaga Lake,	. . . . . .	Onondaga,	1,000,000
" "	Oneida River,	. . . . . .	Oswego, etc.,	500,000
" "	Tully Lakes,	Tully,	Onondaga,	300,000
" "	Seneca River,	Lysander,	"	500,000
Robert D. Black,	Oneida Lake,	Constantia,	Oswego,	1,000,000
F. M. Bouck,	Susquehanna River,	Colesville,	Broome,	50,000
William Morse,	Unadilla River,	. . . . . .	Otsego, etc.,	50,000
Frederick Aschoff, Jr.,	Mohawk River,	Amsterdam,	Montgomery,	100,000
O. Finch,	Rhoda Pond,	Ancram,	Columbia,	50,000
H. W. Leonard,	Gifford Lake, etc.,	Camden,	Oneida,	100,000
W. Neeling,	Lower Rhoda Pond,	Ancram,	Columbia,	50,000
Schuyler Rod and Gun Club,	Hudson River,	Stillwater,	Saratoga,	100,000

DISTRIBUTION OF PIKE-PERCH FRY.—Continued.

Name of Applicant	Water Stocked	Town	County	Amount
D. I. Roberts,	Round Lake,	Monroe,	Orange,	200,000
"	Delaware River,	Narrowsburgh,	Sullivan,	100,000
"	Walton Lake,	Monroe,	Orange,	200,000
"	Delaware River,	Long Eddy,	Sullivan,	100,000
H. B. Whitney,	Canandaigua Outlet,	Canandaigua, etc.,	Ontario,	100,000
E. G. Butler,	Susquehanna River,	Bainbridge,	Chenango,	50,000
Honeoye Falls Anglers' Association,	Honeoye Creek, etc.,	Lima, etc.,	Livingston, etc.,	200,000
H. G. Cornell,	Niagara River,	Lewiston,	Niagara,	300,000
Silas I. Wright,	Arnold's Lake,	Milford,	Otsego,	50,000
J. E. Wells,	Prospect Lake,	Goshen,	Orange,	100,000
T. H. Donnelly,	Silver Lake,	Castile, etc.,	Wyoming,	500,000
Wesley Decker et al.,	Wallkill River,	. . . . . .	Orange,	250,000
John E. Marsh,	Oneida Lake,	Constantia,	Oswego,	1,000,000
J. H. Lamphere,	Seneca River,	Brutus, etc.,	Cayuga,	200,000
Henry J. Killick,	Canandaigua Outlet,	Lyons,	Wayne,	100,000
John A. Patterson,	Summit Lake, etc.,	Woodbury,	Orange,	100,000
Erie County Fish and Game Association,	Niagara River,	Buffalo,	Erie,	300,000
C. Y. Fullington et al.,	Grasse and Little Rivers,	Canton,	St. Lawrence,	100,000
John H. Buss,	Cross Lake,	Elbridge,	Onondaga,	200,000
C. Hicks,	Upton Lake,	Clinton,	Dutchess,	50,000
M. D. McNeil,	Chenango River,	Oxford,	Chenango,	100,000
Sheridan Shook,	Spring Lake,	Red Hook,	Dutchess,	50,000
Lancaster Sporting Club,	Lake Como,	Lancaster,	Erie,	50,000
Albert Hallenbeck,	Miller Pond,	Copake,	Columbia,	50,000
Hunter Gun Club,	Oswego River,	Volney,	Oswego,	1,000,000
Isaac M. Brownell,	Unadilla River,	. . . . . .	Chenango, etc.,	50,000
Niagara County Anglers' Club,	Niagara River,	Wheatfield, etc.,	Niagara,	400,000

DISTRIBUTION OF PIKE-PERCH FRY.—CONCLUDED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
James Gallagher,	Oneida Lake,	Constantia, etc.,	Oswego,	1,000,000
Fisheries, Game and Forest Com.,	Irondequoit Bay,	. . . . . .	Monroe,	1,000,000
J. O. Sullivan,	Raquette River,	. . . . . .	St. Lawrence,	200,000
E. L. Fisher,	Black Creek,	Bergen,	Genesee,	300,000
Geneganslet Fish and Game Pro. Ass'n,	Several lakes and ponds,	Smithville,	Chenango,	300,000
Fisheries, Game and Forest Com.,	Canandaigua Lake Outlet,	. . . . . .	. . . .	Adults 10
" "	" "	. . . . . .	. . . .	Yearlings 212
C. V. Collins,	Five lakes,	. . . . . .	Rensselaer,	2,000,000
Highland Falls Rod and Gun Club,	Po Po Loprue Lake,	Highlands,	Orange,	250

DISTRIBUTION OF LARGE MOUTH BLACK BASS FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
F. C. Stevens,	Tonawanda Creek, etc.,	Attica, etc.,	Wyoming,	500
D. I. Roberts,	Greenwood Lake,	. . . . . .	Orange,	6,000
Fenton Magill,	Norman Kill,	Guilderland,	Albany,	1,800
E. L. Fisher, Secretary,	Black Creek,	Bergen,	Genesee,	1,000
W. H. Brennan,	Chenango Lake,	New Berlin,	Chenango,	1,200
Louis I. Hand,	Seneca River,	. . . . . .	Onondaga,	1,400
E. N. Chapman,	Schoharie Creek,	. . . . . .	Schoharie,	1,800
James H. Glavin,	Hudson River,	Waterford,	Saratoga,	1,800
J. H. Benedict,	Gorton and Bailey Lakes,	Sangerfield,	Oneida,	1,500
D. I. Roberts,	Cromiline Creek,	Craigville,	Orange,	1,000

DISTRIBUTION OF LARGE MOUTH BLACK BASS FRY.—Continued.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
D. I. Roberts,	Wallkill River,	Montgomery,	Orange,	1,000
George K. Smith,	Walton Lake,	Monroe,	"	1,000
William T. Ford,	Mohawk River,	Waterford, etc.,	Saratoga,	1,000
H. L. Reed,	"	Amsterdam,	Montgomery,	1,000
V. Oscar Garlock,	"	Fort Plain,	"	1,000
Onondaga Anglers' Association,	Tully Lake,	Tully,	Onondaga,	1,500
D. F. Hoffman,	White Lake,	Bethel,	Sullivan,	1,200
G. C. Williams,	Mohawk River,	Tribes Hill,	Montgomery,	1,000
Albert Crowell,	Wallkill River,	Shawangunk,	Ulster,	500
T. W. Highland,	Mohawk River,	Little Falls,	Herkimer,	1,000
Silas O. Wright,	Arnold's Lake,	Milford,	Otsego,	1,000
E. C. Harvey,	Hatche's Lake,	Eaton,	Madison,	1,800
Schuyler Rod and Gun Club,	Hudson River,	Stillwater,	Saratoga,	1,800
D. I. Roberts,	Mombaska,	Monroe,	Orange,	1,000
Ellsworth Leroy,	Kiamesha Lake,	Thompson,	Sullivan,	1,200
N. D. Bartle,	Guilford Lake,	Guilford,	Chenango,	1,200
R. H. Baker,	Madison Lake,	Madison,	Madison,	1,800
H. B. Whitney,	Canandaigua Outlet,	Canandaigua,	Ontario,	1,500
J. W. Shepardson,	Lake Earlville,	. . . . . .	Madison,	1,200
E. G. Butler,	Susquehanna River,	Bainbridge,	Chenango,	1,000
John H. Briggs,	Tarrytown Reservoir,	Greenburgh,	Westchester,	1,800
E. L. Bailey,	Findley's Lake,	. . . . . .	Chautauqua,	2,400
C. M. Bartlett,	Kiamesha,	Thompson,	Sullivan,	1,200
T. B. Van Wert,	White Lake,	Bethel,	"	1,200
Arcade Rod and Gun Club,	Fish Lake,	Freedom,	Cattaraugus,	1,800
T. H. Donnelly,	Silver Lake,	Castile, etc.,	Wyoming,	4,800
F. O. Rockafellow et al.,	Highland Lake,	Wallkill,	Orange,	1,200

DISTRIBUTION OF LARGE MOUTH BLACK BASS FRY.—CONTINUED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Horace Thompson et al.,	Wallkill River,	. . . . .	Orange,	3,000
E. W. Van Duser,	Oldroyd's Pond,	. . . . .	"	600
A. L. Decker,	Mohegan Lake,	Wallkill,	"	600
John Wilkin et al.,	Bennewater Pond,	Greenville,	"	1,200
D. I. Roberts,	Cromwell Lake,	Highland Mills,	. . . .	1,000
Byron Fox,	Catfish Creek,	Clayton,	Jefferson,	2,000
E. C. Curtis,	Pleasant Lake,	Macomb,	St. Lawrence,	1,000
Olean Sportsman's Club,	Allegany River, etc.,	Olean,	Cattaraugus,	1,800
Benjamin Merrihew,	Beaver Dam,	Olive,	Ulster,	1,000
J. H. Loughran,	Wallkill River,	Montgomery,	Orange,	500
William H. Post,	Orange Lake,	Newburgh,	"	1,000
Thomas Crane,	Small pond,	Somers,	Westchester,	1,200
Andrew Bauer,	Tonawanda Creek,	Sheldon,	Wyoming,	3,000
Amos Wright,	Lime Lake,	Machias,	Cattaraugus,	1,800
Charles B. Howell,	Otter Kill,	Hamptonburgh,	Orange,	1,000
Edward Thompson,	Lake Ronkonkoma,	Brookhaven,	Suffolk,	3,600
Batavia Fish and Game Pro. Ass'n,	Tonawanda River,	Batavia,	Genesee,	1,000
Archie Campbell,	Lebanon Reservoir,	Lebanon,	Madison,	1,200
John Paul,	Syder's Lake,	Poetenskill,	Rensselaer,	500
W. D Stevenson,	Mud Lake,	Argyle,	Washington,	1,800
Highland Falls Rod and Gun Club,	Long Pond,	Highlands,	Orange,	1,000
William R. Weed,	Raquette River,	Potsdam,	St. Lawrence,	500
Fisheries, Game and Forest Com.,	Irondequoit Bay,	Irondequoit, etc.,	Monroe,	13,000
" "	Genesee River,	Rochester,	"	12,000
" "	Orange Lake,	. . . . .	Orange,	3,600
" "	Canandaigua Lake Outlet,	Shortsville,	. . . .	Small mouth 25
" "	" "	"	. . . .	" etc. 250

DISTRIBUTION OF LARGE MOUTH BLACK BASS FRY.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Arthur J. Baldwin,	Awosting Lake,	Wawarsing,	. . . .	Small mouth 100
Highland Falls Rod and Gun Club,	Po Po Loprue Lake,	Highlands,	. . . .	" etc. 250
Fisheries, Game and Forest Com.,	Canandaigua Lake Outlet,	Shortsville,	. . . .	White bass 225

DISTRIBUTION OF YELLOW PERCH FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Canandaigua Lake Outlet,	Shortsville,	Ontario,	1,800
George K. Smith,	Walton Lake and Long Pond,	Monroe,	Orange,	150,000
Dud S. Mersereau,	Susquehanna River,	Union, etc.,	Broome,	150,000
Arthur J. Baldwin,	Awosting Lake,	Wawarsing,	Ulster,	3,500
Fisheries, Game and Forest Com.,	Genesee River,	Rochester,	Monroe,	1,000,000
" "	Oneida Lake,	Constantia,	Oswego,	250,000
" "	Oswego River and Lake Ontario,	Oswego,	"	1,000,000
Highland Falls Rod and Gun Club,	Po Po Loprue Lake,	Highlands,	Orange,	7,500

DISTRIBUTION OF MASCALONGE FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
L. B. Ruttenber,	West Mud Lake,	Arkwright, etc.,	Chautauqua,	50,000
Honest Fisherman's Club,	Cayuga Lake,	Seneca Falls,	Seneca,	200,000
Amos Haskins,	Findley's Lake,	Mina,	Chautauqua,	100,000
E. B. Osgood,	Bear Lake,	Stockton,	"	100,000
H. G. Cornell,	Niagara River,	Lewiston, etc.,	Niagara,	50,000
J. Webb Beebe,	Cassadaga Lake,	Stockton, etc.,	Chautauqua,	50,000
Olean Sportsman's Club,	Allegany River,	Olean,	Cattaraugus,	25,000
Erie County Fish and Game Association,	Niagara River,	Buffalo,	Erie,	50,000
George A. Hills,	East Mud Lake,	Villenova,	Chautauqua,	50,000
R. P. Grant,	St. Lawrence River,	Clayton, etc.,	Jefferson,	1,000,000
Niagara County Anglers' Club,	Niagara River,	Wheatfield, etc.,	Niagara,	50,000
Gouverneur Anglers' Club,	Muscallonge Lake,	Theresa,	Jefferson,	25,000
Fisheries, Game and Forest Com.,	Chautauqua Lake,	. . . . . .	Chautauqua,	900,000

DISTRIBUTION OF WHITEFISH.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
A. J. Shepard,	Chaumont Bay,	Lyme,	Jefferson,	1,800,000
Ingram & Paxton,	Lake Erie,	Dunkirk,	Chautauqua,	2,500,000
Fisheries, Game and Forest Com.,	Canandaigua Lake,	. . . . . .	Ontario,	5,000,000
" "	Hemlock Lake,	. . . . . .	Livingston, etc.,	1,000,000
" "	Lake Ontario,	Charlotte,	Monroe,	4,500,000
" "	Skaneateles Lake,	. . . . . .	Onondaga,	2,500,000

DISTRIBUTION OF WHITEFISH.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Keuka Lake,	. . . . .	Steuben, etc.,	800,000
H. H. Shaw,	Three Mile Bay,	Lyme,	Jefferson,	2,000,000
Fisheries, Game and Forest Com.,	Lake Ontario,	Wilson,	Niagara,	2,000,000
" "	"	Oswego,	Oswego,	2,000,000

DISTRIBUTION OF FROSTFISH FRY.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Henry Hail,	Lake Colby,	Harrietstown,	Franklin,	200,000
Fisheries, Game and Forest Com.,	First Lake, Fulton Chain,	Webb,	Herkimer,	200,000
" "	Third " " "	"	"	300,000
" "	Fourth " " "	"	"	700,000
" "	Big Moose Lake,	"	"	300,000
" "	Lake Placid,	St. Armand,	Essex,	500,000
" "	Upper Saranac Lake,	Santa Clara,	Franklin,	500,000
" "	Lower " "	Harrietstown,	"	500,000
" "	Hoel Pond,	Santa Clara,	"	400,000
" "	Big Clear Lake,	Harrietstown,	"	500,000
" "	Little Clear Lake,	Santa Clara,	"	200,000
" "	Little Green Lake,	"	"	200,000
" "	Loon Lake,	Franklin,	"	250,000
" "	Lake Pleasant,	Lake Pleasant,	Hamilton,	400,000
" "	Sacandaga Lake,	"	"	250,000

DISTRIBUTION OF FROSTFISH FRY.—Concluded.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Pisico Lake,	Arietta,	Hamilton,	250,000
" "	Mud Lake,	Lake Pleasant,	"	135,000

DISTRIBUTION OF CISCOES.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
W. F. Stewart,	Three Mile Bay,	Lyme,	Jefferson,	6,000,000
C. A. Lindsley,	Chaumont Bay,	"	"	6,000,000
Fisheries, Game and Forest Com.,	Lake Ontario,	Charlotte,	Monroe,	3,000,000

DISTRIBUTION OF SMELTS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Benjamin S. Weeks,	Lemon Creek,	Westfield,	Richmond,	1,000,000
Fisheries, Game and Forest Com.,	Northport Harbor,	Huntington,	Suffolk,	5,000,000
" "	Huntington Harbor,	"	"	5,000,000
" "	Oyster Bay,	Oyster Bay,	Queens,	3,000,000
" "	Hudson River,	Tarrytown,	Westchester,	1,000,000
" "	Cold Spring Harbor,	Oyster Bay, etc.,	Queens, etc.,	30,000,000
A. N. Cheney,	Lake Champlain,	. . . .	. . . .	3,000,000

DISTRIBUTION OF TOM CODS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Benjamin S. Weeks,	Lemon Creek,	Westfield,	Richmond,	2,000,000
Fisheries, Game and Forest Com.,	Cold Spring Harbor,		Suffolk,	31,000,000
" "	Lloyd's Harbor,		"	1,500,000
" "	Huntington Harbor,		"	4,000,000
" "	Smithtown River,		"	1,000,000
" "	Oyster Bay Harbor,		Queens,	1,500,000
" "	Northport Harbor,		Suffolk,	6,000,000
" "	Port Jefferson Harbor,		"	1,000,000

DISTRIBUTION OF SHRIMP.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Alder Lake,	Hardenburg,	Ulster,	50,000
J. O. Ballard,	Cold Brook,	Belmont,	Franklin,	3,000
Charles Stark,	Burton Brook,	Dover,	Dutchess,	3,000
Onondaga Anglers' Association,	Nine Mile Creek,	Camillus, etc.,	Onondaga,	3,000
" "	Onondaga Creek,	Lafayette, etc.,	"	3,000
Abram J. Miller	East branch Croton River,	South East,	Putnam,	3,000

DISTRIBUTION OF SHAD.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Fisheries, Game and Forest Com.,	Hudson River,	Catskill,	Greene,	3,000,000
" "	"	Newburgh,	Orange,	2,500,000
" "	"	Catskill,	Greene,	3,882,600
" "	Cold Spring Brook,		Suffolk,	220,000
" "	Smithtown River,		"	994,800
" "	Delaware River,	Port Jervis,	Orange,	300,000

DISTRIBUTION OF LOBSTERS.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	AMOUNT
Benjamin S. Weeks,	Raritan Bay,	Prince's Bay,	Richmond,	300,000
Fisheries, Game and Forest Com.,	Long Island Sound,	Huntington,	Suffolk,	5,210,000
" "	" "	Oyster Bay,	Queens,	1,040,000

DISTRIBUTION OF FISH NOT ELSEWHERE SCHEDULED.

NAME OF APPLICANT	WATER STOCKED	TOWN	COUNTY	FISH	AMOUNT
Arthur J. Baldwin,	Awosting Lake,	Wawarsing,	Ulster,	Pickerel,	50
Fisheries, Game and Forest Com.,	Hudson River,	Catskill,	Greene,	Herring,	1,500,000
" "	Little Clear Pond,	Santa Clara,	Franklin,	Red Throat Trout	1,000

SUMMARY.

Variety.	Age.	Amount Planted.	
Brook trout,	Fry,	3,964,500	
Brook trout,	Fingerlings,	72,785	
Brook trout,	Yearlings,	20,150	
Brook trout,	Adults,	612	
	Total,		4,058,047
Brown trout,	Fry,	857.000	
Brown trout,	Fingerlings,	34,640	
Brown trout,	Yearlings,	68,168	
Brown trout,	Adults,	935	
	Total,		960,743
Rainbow trout,	Fry,	119,000	
Rainbow trout,	Fingerlings,	33,500	
Rainbow trout,	Yearlings,	35,000	
Rainbow trout,	Adults,	760	
	Total,		188,260
Lake trout,	Fry,	762,000	
Lake trout,	Fingerlings,	133,725	
Lake trout,	Yearlings,	18,786	
	Total,		914,511
Red throat trout,	Fingerlings,	1,000	
Black bass,		115,625	
White bass,		225	
Yellow perch,		2,562,800	
Pickerel,		50	
Mascalonge,		2,650,000	
Shad,		10,897,400	
Herring,		1,500,000	
Whitefish,		24,100,000	
Frostfish,		5,785,000	
Ciscoes,		15,000,000	
Tom cods,		48,000,000	
Smelt,		48,000,000	
Lobsters,		6,550,000	
Shrimp,		65,000	
Pike-perch,		17,550,472	
			182,777,572
	Grand total,		188,899,133

Report Upon the Recent Epidemic Among Brook Trout *(Salvelinus fontinalis)* on Long Island.

By GARY N. CALKINS.

HOLDING HARD.

IN May, 1899, an epidemic started among the brook trout in the hatcheries of a trout farm at Northport, Long Island, and did not abate until every fish had died. The painstaking care taken by the State Shellfish Commissioner, Mr. Edward Thompson, during the last ten years in developing an excellent hatchery and in raising a fine breed of trout, thus in one season received a serious check. At the request of the State Fish Culturist, Mr. A. Nelson Cheney, I undertook an examination of the fish for the purpose of ascertaining the direct cause of the epidemic, and if this were due to a parasite, of finding out something of its life history and affinities. Thanks to the courtesy of Mr. Cheney and Mr. Thompson, I was able to get abundant material.

With the exception of the fungus *Saprolegnia*, which does not menace the life of the fish, the brook trout has apparently been very free from disastrous epidemics. In the literature at my command I find no mention of *Salvelinus fontinalis* or *Salmo fario*, as subject to any particular disease, and, to my knowledge, the only statement of a parasite in these forms, was made by Csokor in 1888, in a short description of Gregarinosis.* About ten years ago an epidemic killed off hundreds of the trout in the New York State hatcheries at Cold Spring Harbor, Long Island, but the cause of the trouble was not located and no report was made. From various sources, however,

* (Gregarinosis d. Forellen, *Oesterreich. Zeit. f. wiss Veterinark.* Wien 1888, 11, p. 56-58.)

I have obtained enough evidence to lead me to the conclusion that the epidemic at Cold Spring was quite similar to the present one and if my surmise is correct, it is a significant fact that the same trouble should have occurred in two hatcheries in the same region.

Parasitic diseases are not uncommon among fish and the so-called psorosperms, in particular, have been recognized as disease-causing organisms since 1841, when Johannes Müller first called attention to them. These have since been called the Myxosporidia by Bütschli and other students of the Protozoa, and are now known to be minute unicellular animals which by the accumulation of spores, form great cysts in the muscles and connective tissues of fish. These are the most destructive parasites known to the fish-breeder, and in some cases great epidemics are due to them. During an epidemic among the barbels of the Meuse, in 1883 to 1885, hundreds of fish died every day from this cause. The Myxosporidia are such frequent parasites and so often the cause of fatal diseases in fish that it is not remarkable that I confidently expected to locate the cause of the epidemic in some organism belonging to this group. In this, however, I was disappointed, for the first glance at the diseased fish showed a complete absence of cysts or tumors which characterize many of the more common parasites. Although tumors were absent, the body was frequently ulcerated and great holes in the body walls were often present, while smaller holes were quite characteristic. As this condition frequently accompanies Myxosporidiosis, I was still confident that the organism could be readily determined upon sectioning some of the ulcerated spots. When this was done there were still no traces of Myxosporidia, but instead of them, I found myriads of minute forms belonging to the same group as the Myxosporida, *i. e.*, to the Sporozoa, but which cannot be classified among the usual fish parasites. This parasite, which has never been described, I shall name *Lymphosporidium truttæ*, and in the following report I will give as much of its life history as could be made out.

Characteristic Symptoms of the Disease.

The epidemic was equally fatal to fish of all ages. Mr. Thompson estimates that 2,000 yearlings, 1,000 two and three year old fish, and some 10,000 "fingerlings" (from four to six inches long), were lost. They died as rapidly during the cold days of November as in the hot days of July and August; indeed, the ponds are fed by springs and Mr. Thompson asserts that the temperature of the water never rises above sixty degrees F.

The fish, especially the yearlings, were characterized by sluggish motion and inability to withstand rough treatment of any kind, most of them dying within a few minutes after removal from the waters of the runways to a pail. In the water the

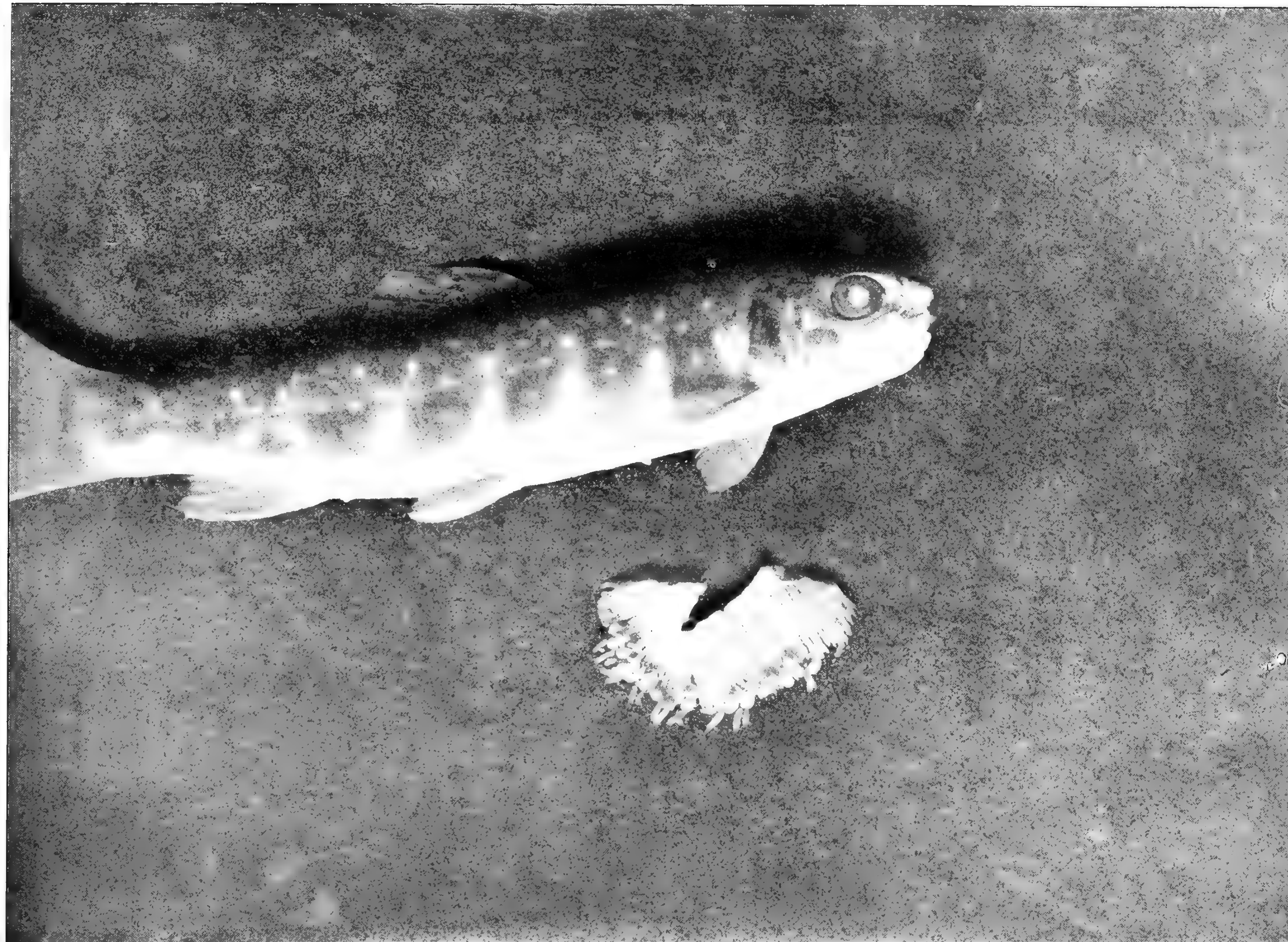


PLATE I.—YOUNG BROOK TROUT, DISEASED.—GILL OF LARGE FISH WITH COPEPOD PARASITES.

actions of the fish were indicative of their diseased condition, for they would frequently rise to the surface and swim upon the side or turn belly-up on the surface, while at one period hundreds of the dead fish were daily removed from the runways. In some of these there were no external indications of the disease; in others, and in the majority of the cases, great red spots or ulcers were visible, sometimes on the belly, again on the back, but most often on the sides. The bases of the fins were particularly subject to these sores and the eyes were often disfigured by them. More serious disfigurements were frequently seen in the entire loss of one half of the lower jaw, bone and tissues being eaten entirely away (Plate I); or, again, the ulcers in the sides would give rise to holes through the body wall and into the body cavity, and live fish were occasionally seen with parts of their viscera hanging out of the holes thus made (Plate II). The red ulcers which are due to the congestion of the blood at the sore spots give place to wide gaping wounds sometimes an inch in diameter where the flesh has dropped out (Plate II). In some cases the vertebræ in the caudal region were thus exposed. In many cases the holes or sores did not go entirely through the body wall but formed shallow and irregular wounds. These sores were most apparent on the small yearlings; the older fish, however, were not exempt but in these cases the sores were proportionately smaller and distributed in all regions of the body.

Methods Employed in the Investigation.

The wide distribution of the sores about the animal, from the posterior end of the body to the eyes and jaws, was sufficient evidence that the cause of the disease was pretty well distributed throughout the organism, and if further evidence was necessary, it was furnished by the cases mentioned above where the fish were found dead with no external sores of any kind. It was at once apparent from these facts that the cause of the trouble was of some deep-lying nature and that, if parasites were at the bottom of it, they must be widely distributed among the various organs in the body and probably carried to all parts by the blood and lymph circulation. The various organs of diseased fish were therefore cut into small pieces and preserved in diverse killing agents, including sublimate acetic, (saturated corrosive sublimate with five per cent. glacial acetic), saturated corrosive sublimate in normal salt solution, and Flemming's fluid (osmic acid, chromic acid, and glacial acetic acid in certain definite proportions) The organs thus preserved included the testis, kidney, ovary, gall bladder, pyloric cœca, digestive tract (including stomach and intestine), liver, gills, and sore spots in the outer wall. These were taken to the laboratory, where they were sectioned in paraffine and stained in various ways, the most satisfactory stain being iron hæmatoxylin with a counterstain of orange or eosin; the Flemming triple stain of safranin, gentian violet and orange also gave very good results as did thionin and eosin.

There was little or no chance to try direct inoculation for, so far as could be seen, all of the fish in the hatchery were affected by the disease at the time my attention was called to it. One experiment, however, was tried. Some fresh trout were obtained from the northern part of the State and three of them were fed with bits of the flesh of diseased fish containing the ulcerated spots. All of these fish died within three months, probably from the same disease that killed off the other trout, but I had no chance to examine them.

The Specific Cause of the Disease.

The cause of the trouble is, I believe, a sporozoan parasite and the life history of the organism is presented in the present report. I hope to be able at a future time to complete the study begun here and to perform conclusive experiments upon inoculation. Owing to the failure to keep the fish alive in aquaria these experiments have not been attempted during the present winter.

The brook trout, like all others of the same family, is subject to the growth of the fungus *Saprolegnia*, but in the Northport hatchery this has never become a menace and has been easily taken care of. Other parasites which were found, especially in the larger fish, represent different groups of the animal kingdom. Among these were Nemathelminthes, or round worms, and parasitic Copepoda or Crustacea. The round worms belong to a group—the Nematoda—which are very common in fish of different kinds, as well as in all other forms of Vertebrata. They were found chiefly in the swimming bladder and were present in considerable numbers and in all stages of development. They belong to the genus *Ascaris* of which there are 102 distinct species, and only a very few are known to produce fatal results. Each female individual produces thousands of eggs which are retained until the embryo has reached a considerable size. Each egg is surrounded by a thick capsule and is capable of resisting heat or chemicals for a considerable time. They are passed out of the body either through the mouth or the anus and ultimately get into a new host possibly after passing through an embryonic period in some lower form such as an insect or a mollusk.

The parasitic Copepod, *Trachcliastes* sp., is also frequently found upon fresh-water fishes where, especially in old or in diseased fish, they become attached to the gills, sometimes in great numbers (Plate I, figure of gill). When young, these parasites bore into the soft tissues of the gill, where they retain their position by an

PLATE II.—DISEASED FISH WITH ULCERS.

anchor-like enlargement at the extremity of the anterior appendages. The mouth is adapted for sucking and the parasite is nourished by the blood obtained from the gills.

None of these parasites were numerous enough to account for the trouble, and, although an occasional intra-cellular sporozoan parasite was found, they were not abundant enough to warrant continued search, for in fish with the most noticeable external indications of the disease, the organs within were apparently normal and cysts or other usual indications of Sporozoa were not forthcoming. In every section that was cut, however, a variable number of minute foreign bodies, which were so small that they were at first taken for bacteria, were found especially abundant in the lymph spaces surrounding the various organs and in the testis. These were so minute that it seemed hardly possible that they could be the cause of the disease and yet their numbers were so constant and they were so widely distributed throughout the entire body that I was forced to the belief that they were the cause of the epidemic. They were found in the body cavity surrounding the intestine and other visceral organs, in the lymph spaces, in many of the organs themselves, in the blood vessels including capillaries and veins, and in the gills, muscles, and connective tissue of the diseased fish. In short, they were found wherever there was a cavity, sometimes only occasionally, again in great multitudes.

As there were no satisfactory experiments in inoculating normal fish to show that this organism is the cause of the disease, I will give a brief description of each of the important organs of the body showing the appearance of the sporozoan in question and its wide distribution. The organs chosen are the intestine, including the pyloric cœca, the liver, kidney, gall bladder, blood vessels, testis, and muscles, especially those around the ulcers in the body wall. All of the organs were taken from young fish of not more than five inches in length, and all of the fish showed external evidences of the disease.

The stomach and pyloric cœca had only an occasional spore of the parasite but the intestine (Plate III) had many of them mixed in with the bacteria. Here, too, they were in reproductive stages and it was plainly evident that they had been taken in from the outside through the mouth. There is little doubt that this is the means of infection from fish to fish.

The liver showed no traces of disease either macroscopically or microscopically, the cells being perfectly normal and with no parasites among them. The kidney, on the other hand, frequently appeared swollen and discolored while numerous scattered parasites were seen in it, especially at the anterior end, where the tissue is more lymphatic than in the posterior part and has no excreting function. Only a few parasites were observed in the posterior region of the kidney and these at such rare intervals that the organ could scarcely be said to be diseased. I regard the discoloration of this organ as due to the general morbid condition of the fish rather than to a specific cause.

The spleen, unlike the liver, contained a varying number of parasites although they were never abundant enough to cause distortion of the organ nor to give to it a pathological appearance. They never appeared here in groups as in the intestine and their presence in this organ is probably accidental. The gall bladder contained a great number of spore-forming individuals but only a few of the free spores. Unlike the other organs, the testis contained countless numbers of the parasites and thick masses were formed, in some cases completely filling up the lobes of this organ, which thus appears to be the main seat of the disease. It was greatly enlarged, while the gonadel cells were abnormal and for the most part degenerate (Plate IV).

Among these various organs of the body, therefore, the only one which was found to harbor enough parasites to do injury was the testis, while, with the exception of the intestine, no other organ contained more than a few scattered ones. The outsides of all of the organs, however, that is, the surfaces which are exposed to the body cavity and its fluids, were in all cases covered with the parasites which, especially in the lymph spaces, frequently formed thick masses (Plates V, VI and VII).

The immense numbers of parasites in the testis, the body cavity, and in the lymph spaces, show that these are the principal seats of the organism. They are never absent from the body cavity and they settle upon all of the organs within it including the mesentaries, the fat bodies, and blood vessels as well as all of the organs mentioned above. From here, also, they are carried to all parts of the body and especially to the muscles of the body wall which are bathed in lymph. Here they penetrate the muscle bundles and accumulate in the spaces between them until the cavities are entirely blocked up (Plate VIII). This is, I believe, the cause of the ulcers and ultimate perforations in the body wall, the trouble being brought about by stoppage of the food supply, and the tissues finally disintegrate because of the lack of nutrition. The early stages of the localized trouble are always characterized by congestion of the region about an ulcer, the blood vessels at such places being gorged with blood. Not only the muscles but the cartilages also are apparently affected by the same conditions as seen in the loss of certain bones in the head of some fish (Plate I). The disease can be compared with leprosy in man where the bacteria which cause this disease are known to accumulate in the blood vessels and block up the normal food channels, causing abnormal growths or atrophy of the existing tissues through lack of nourishment, and so leading to ulcers and other external evidences of the disease, and even to the loss of bones.

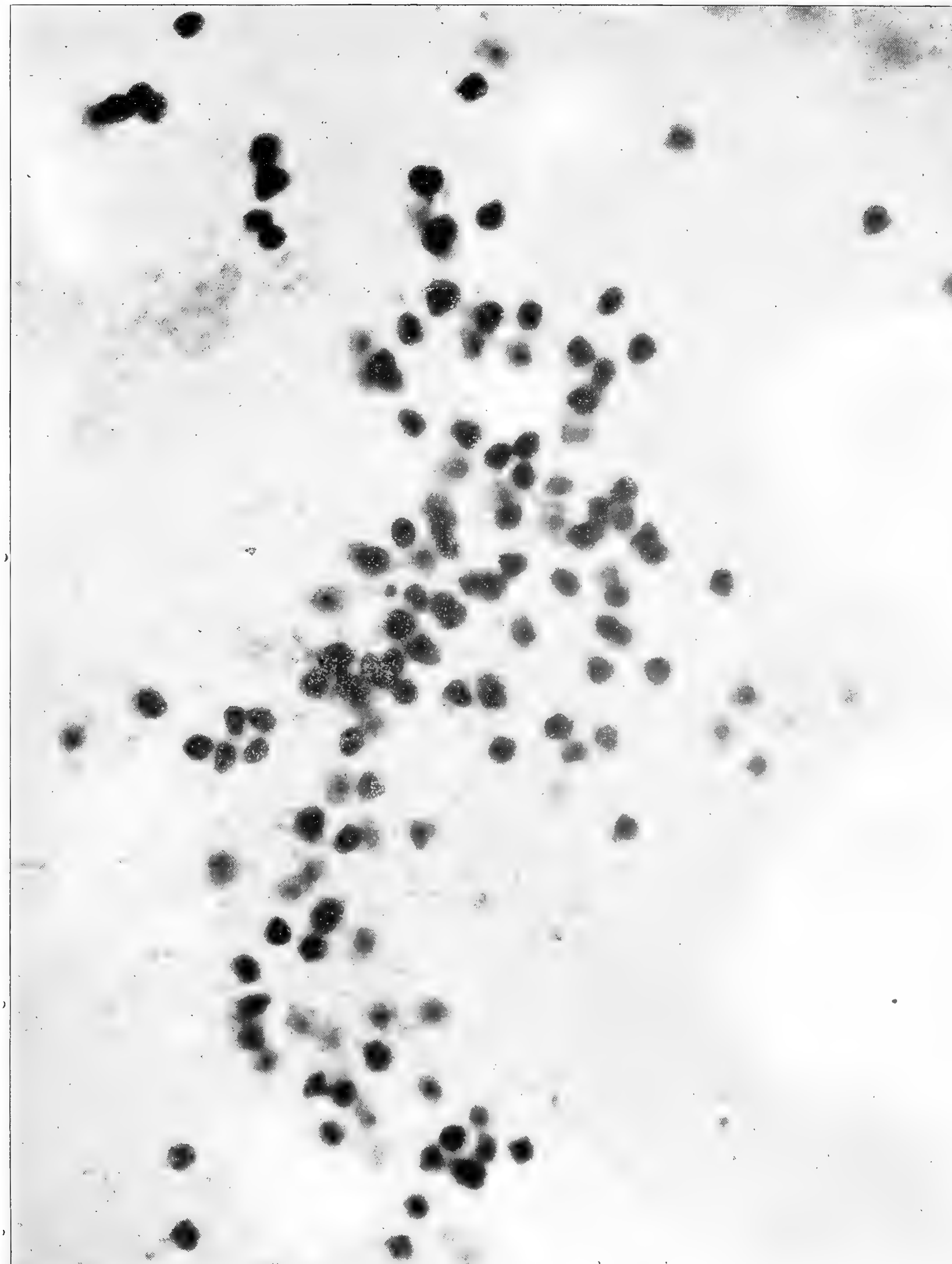


PLATE III.—SPORES OF LYMPHOSPORIDIUM TRUTTÆ IN THE INTESTINE.

PLATE IV.—SECTION THROUGH THE TESTIS OF A DISEASED FISH.

Description and Life History of the Parasite.

In all Sporozoa where the life history is fully known, the adult individuals give rise to a definite number of spores. Instead of developing at once into new organisms, these spores in turn give rise to progeny by dividing into a definite number of parts. The germs formed by this second division are called sporozoites and each is capable of developing into a new adult, and of repeating the cycle. The parasites in the spore stage are frequently taken into the stomach with the food. Here the digestive fluids dissolve the spore cyst and liberate the sporozoites which penetrate the epithelial cells and grow to full size. After a certain number of such cycles, however, there is a period of conjugation in which two individuals fuse together. In some unknown way the fusion leads to a renewal of vitality and, indirectly, to reproduction by spore-formation for a number of generations.

In the present investigation I have been able to follow the life history of the parasite which, I believe, is the cause of the present epidemic, and to which I have given the name *Lymphosporidium truttæ*, from the sporozoite stage, until sporozoites were again formed. But I have seen no trace of conjugating individuals and this page of its life history, for the present, at least, must remain closed.

I will begin the description of the life history with the spore stage. The spores are pyriform in shape but flattened upon the broader end. Under ordinary conditions of fixation and staining they appear homogeneous and without internal structures of any kind; they always stain intensely with the nuclear stains (basic stains). I was unable to determine whether the homogeneous appearance indicates a similar condition throughout the entire cell or whether it was due to incomplete extraction of the stain. In many cases, however, preparations were obtained in which the organism was differentiated into a peripheral deeply staining portion and a less stained part with a central, nucleus-like body. This condition, however, marks a stage in the life history and indicates the preparation for sporozoite-formation, while the intense homogeneous appearance indicates a young form or an unripe spore. In size the spores are never larger than 2.5 microns (.0025 mm., or .0001 inches) and never smaller than 2 microns. In some conditions, especially during and before sporozoite-formation they lose their pyriform shape and become circular in outline.

Great bunches of spores, as described above, are found in the intestine, and in such groups there are, here and there, certain individuals in which the body is divided up into eight parts. These parts are the sporozoites and in some cases, in certain divisions of the intestine, all of the individuals of a group are in some stage of sporozoite-formation. The first indication of the process is a noticeable cleft beginning at the broad end of the spore, while the entire periphery appears irregular and minutely lobed. The mass of protoplasm segregates into eight small spheres which are not confined by a membrane. The method of formation of these reproductive bodies could not be determined owing to the extremely minute size although various stages were seen, and it was conclusively proved that the groups of eight spheres were derived from single spores. Each sporozoite at this stage measures less than one half of a micron (.0001 inches). (Figure 1, J and K.)

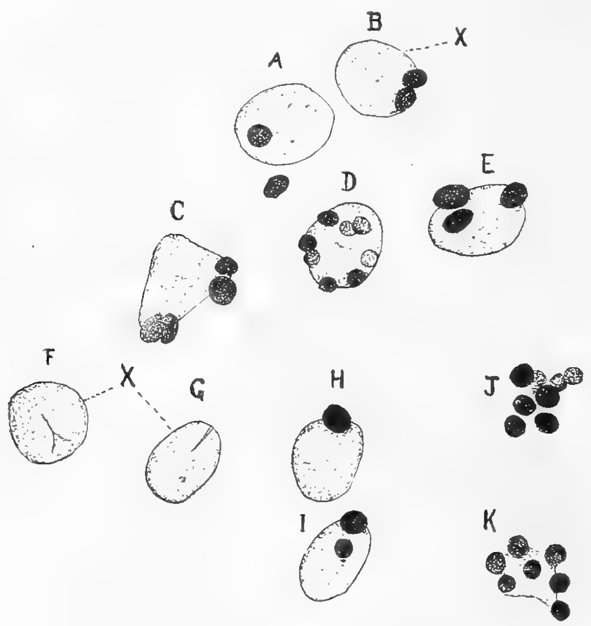


FIGURE 1.—A group of spores from the testis (A to I), and from the intestine (J and K). The cyst (X) is absent in the latter. Camera drawing, x 4000 diameters.

A similar process of sporozoite-formation was seen in the spores infesting the testis where, in one of the fish examined, almost every spore was in some stage of reproduction. Here also the spores were found to have a capsule or cyst about them. The capsules are spherical and no larger than the long axis of the spores. The protoplasm first segregates in a thin deeply staining rim about the inner side of the capsule, although a single spherical mass is always left within. (Figure 2.) This mass I consider homologous with the protoplasm (or possibly nucleoplasm) left over after sporozoite formation in Coccidia or Gregarinida (Reliquat de différentiation). The peripheral protoplasm next fragments into eight spheres or sporozoites similar in all respects to those from the intestinal spores. The sporozoites break through the capsule and collect around the outside (Figure 1, A, B, C, D, E, H, I), while empty spore cysts are often seen with minute apertures (Figure 1, F, G).

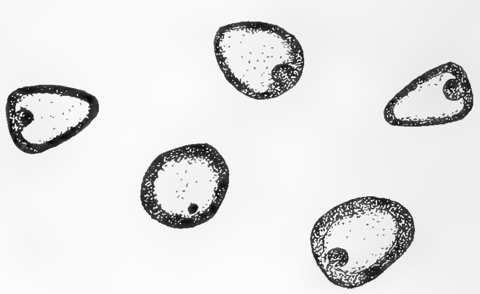


FIGURE 2.—A group of spores from the testis showing preparatory stages in sporozoite-formation. Cf. Figure 1. Camera drawing, x 4000 diameters.

The spores and sporozoites in the intestine and in the testis are apparently identical with the single exception of the cyst membrane or capsule. The absence of a membrane in the intestinal forms is undoubtedly due to its dissolution by the various digestive fluids of the alimentary tract, while in the testis there are no such solvents,

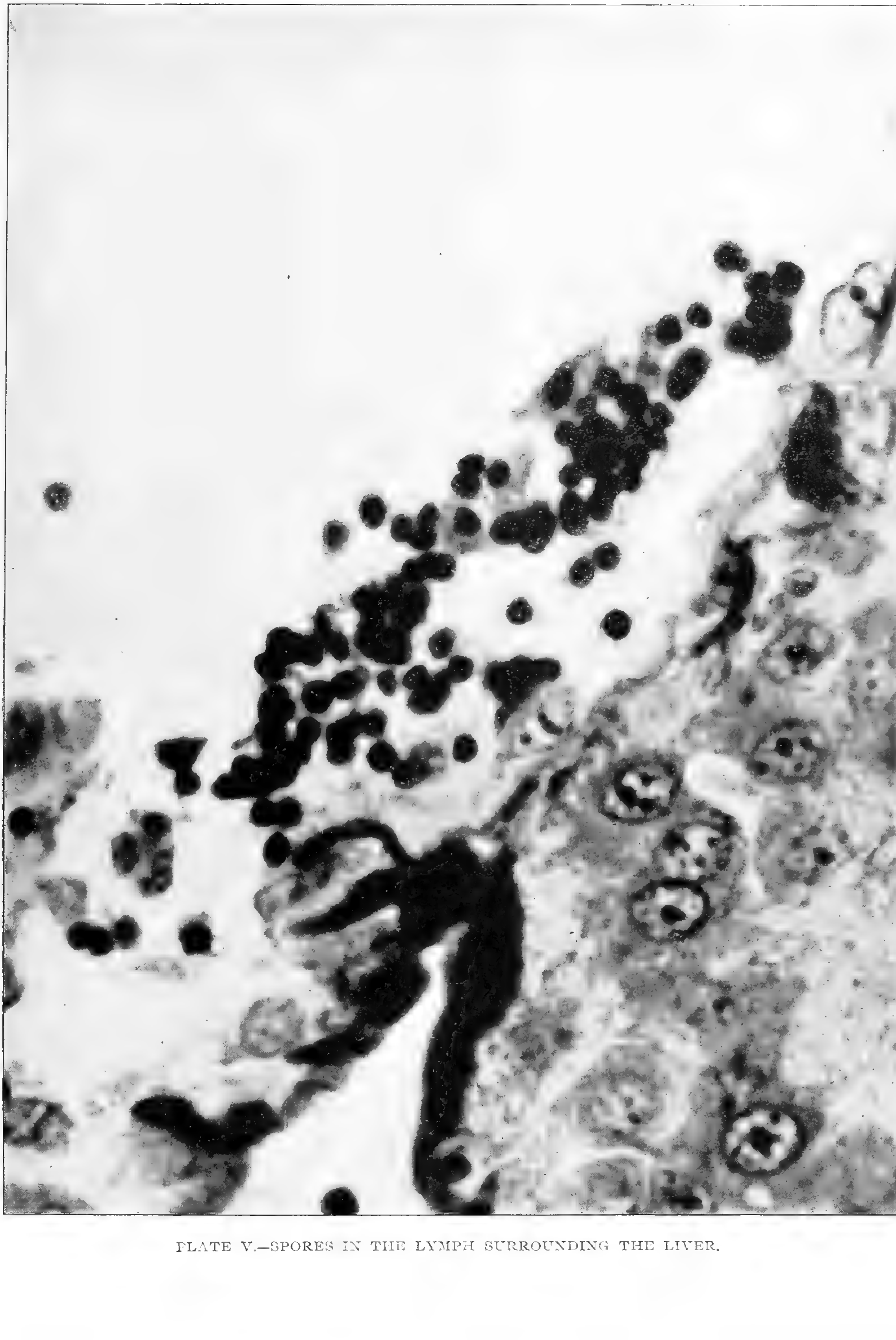


PLATE V.—SPORES IN THE LYMPH SURROUNDING THE LIVER.

the sporozoites escaping by rupture of the cyst. In no case were there thread-bearing capsules as in the spores of the Myxosporidia.

A nucleus could not be made out either in the spore or the sporozoite. The entire cell, however, acts like a nucleus in its staining reactions and I believe that neither the spore, the sporozoite, nor the adult organism has a morphological nucleus, but all possess chromatin distributed throughout the cell.

No trace of a motile organ could be found on the sporozoites, which, in the intestine, were lost in the hordes of bacteria, so that they could not be followed. In the testis, however, they were found in groups against the epithelial tissues and were often seen in the epithelial cells. In the digestive tract they also reach the epithelial cells and as intra-cellular parasites grow to homogeneous masses of about the same size as the spores (Figure 3). In this stage of growth it is impossible to tell, except by their further history, the sporozoite from the spore (Figure 4, A). As a rule,

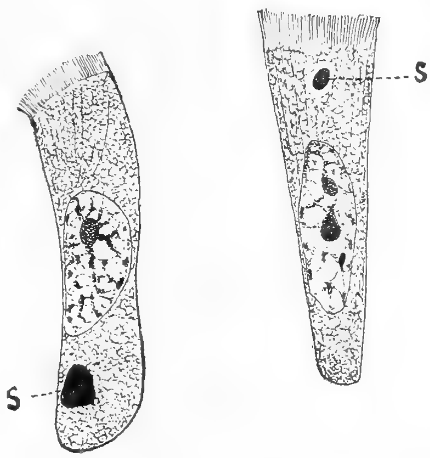


FIGURE 3.—Two epithelial cells from the pyloric cœca showing the sporozoites (S) in the cytoplasm. Camera drawing, x 2000 diameters.

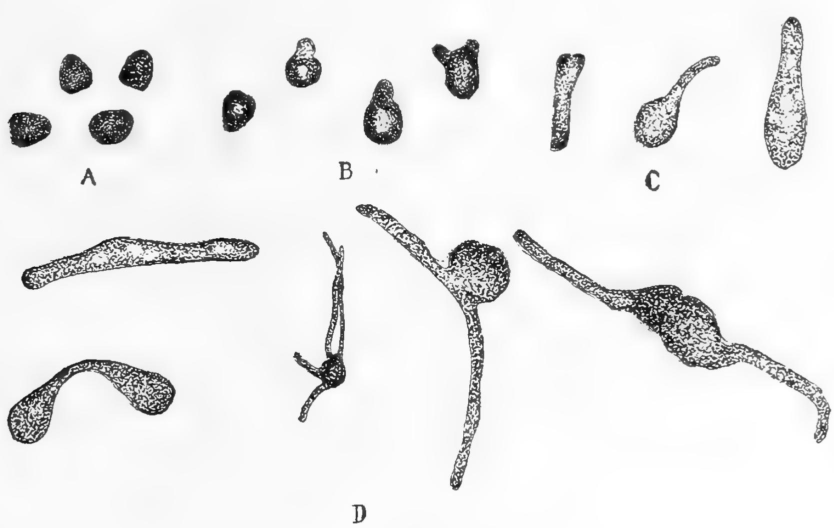


FIGURE 4.—Transformation of the sporozoite and growth into the adult form. *A*, a group of four sporozoites as they appear in the lymph. *B*, the beginnings of pseudopodia—formation and appearance of the vacuole. *C*, loss of the homogeneous appearance and beginning of the reticular condition. *D*, later stages showing disappearance of the reticulate structure and the increase of the densely staining cytoplasmic granules. The last two forms are twenty-two and twenty-five microns in length. Camera drawings, x 2000 diameters.

however, the sporozoites are common in the lymph around the intestine, pyloric cœca, etc., and they usually show some indication of amœboid motion which is never observed in the spore. They get into the lymph through the epithelial cells and here develop rapidly into amœboid forms, especially in the vicinity of the unstriped muscles surrounding the digestive tract. The first indication of this change is a small vacuole in the center of the sporozoite (Figure 4, B). This is almost always accompanied by a minute swelling at one end of the organism (Figure 4, B), and the swelling becomes a pseudopodium (Figure 4, C). The amœboid condition is then established and in this state the young parasite penetrates a muscle bundle and takes a position among the fibres. As it changes from the sporozoite into the amœboid form, the dense homogeneous appearance is lost and it becomes first vacuolated and then finely reticular in structure. In still later stages the protoplasm becomes densely granular and the reticulum difficult to make out. The parasite in the amœboid stage frequently reaches a considerable size, although I am not able to say whether the larger forms have been in muscle cells and have emerged preparatory to spore formation or have developed in the lymph. I am inclined to the former alternative because of the

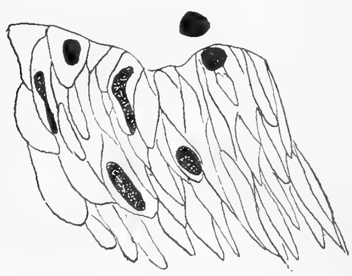


FIGURE 5.—Sporozoites entering muscle cells from the lymph space. Beginning of the amœboid stage. Camera drawing, x 1400 diameters.

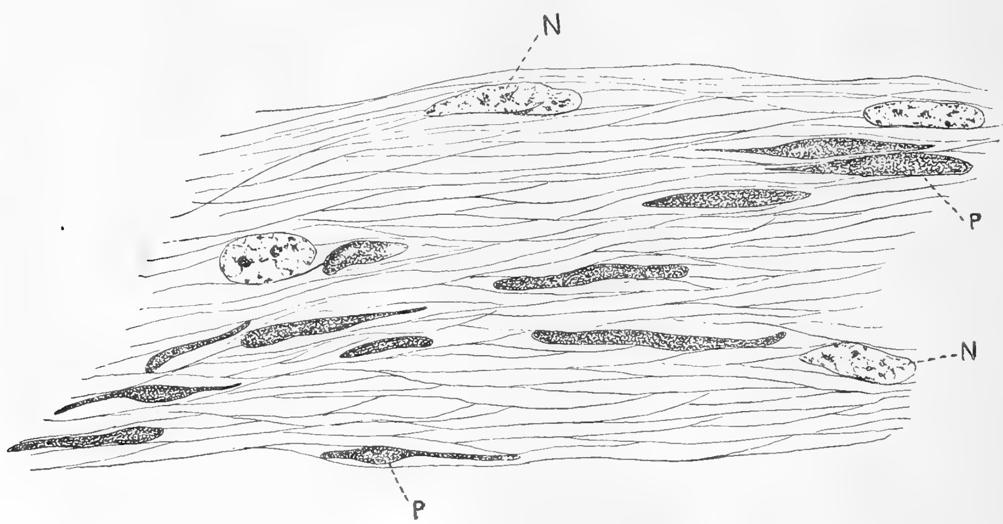


FIGURE 6.—Unstriped muscle fibres from the walls of a pyloric cœcum, containing the adult parasites (*P*) in the amœboid stage. *N*, *N*, nuclei of the muscle fibres. Camera drawing, x 1400 diameters.

densely granular protoplasm and because the only parasites that I have seen entering the muscle tissues were smaller forms. The largest amœboid individuals (Figures 4, D, and 7, B, D) measure from eighteen to twenty-five microns, while the sporozoites entering the muscle cells measure only from two to four microns (Figure 5). Here,

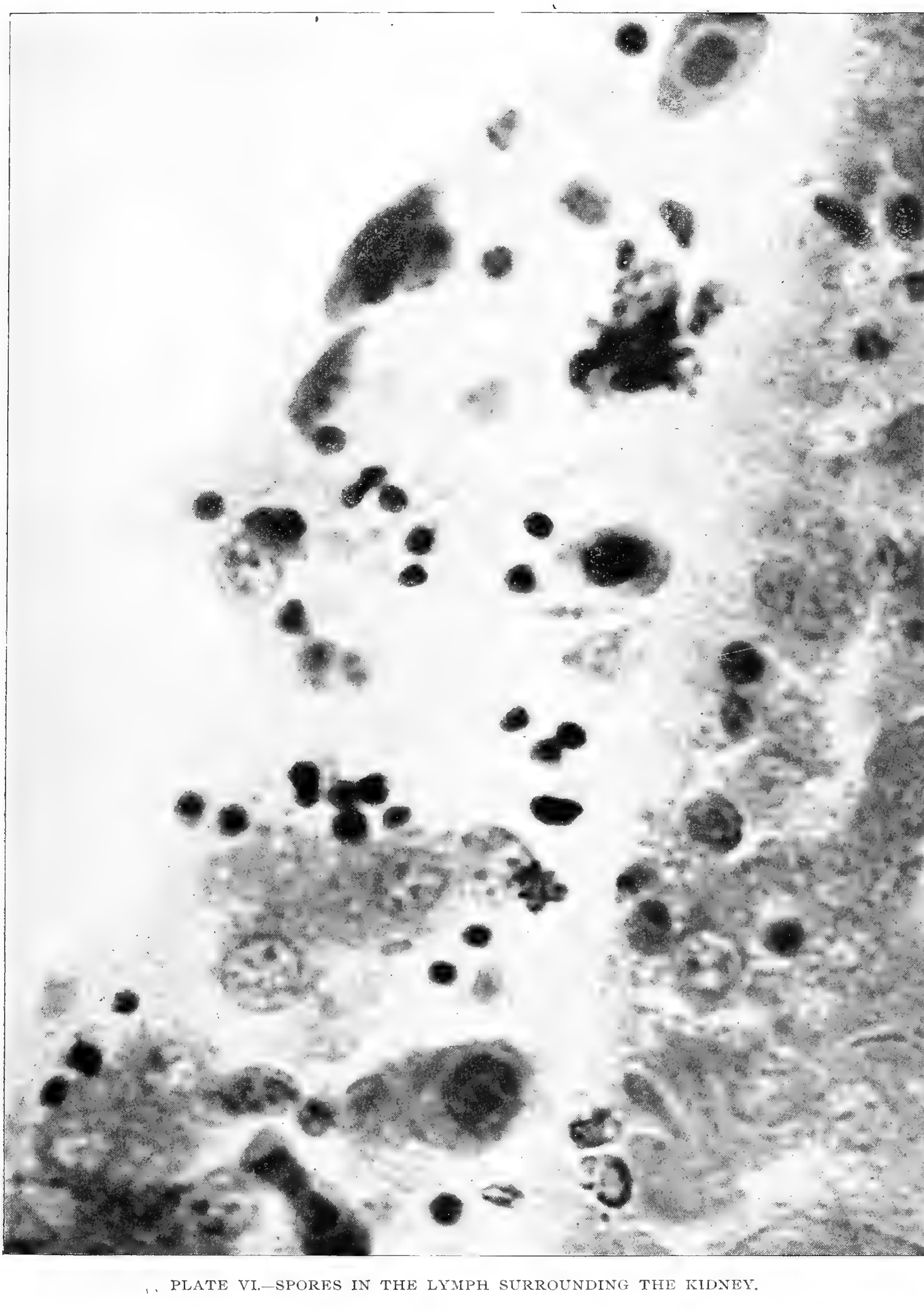


PLATE VI.—SPORES IN THE LYMPH SURROUNDING THE KIDNEY.

however, they rapidly grow in size until they attain their largest dimensions (twenty-five microns). While the amœboid forms assume any characteristic shape in the lymph, they have only one general form in the muscle cells. Here, constrained apparently by the tightly pressed muscle fibres, they are always elongate, sometimes fusiform, sometimes club-shaped (Figure 6). They can always be distinguished from the nuclei of the muscle cells by their characteristic shape and by their densely granular plasm.

Here, as in the spores and sporozoites, a nucleus could not be distinguished. But the deeply staining granules appeared like chromatin and in the older individuals they

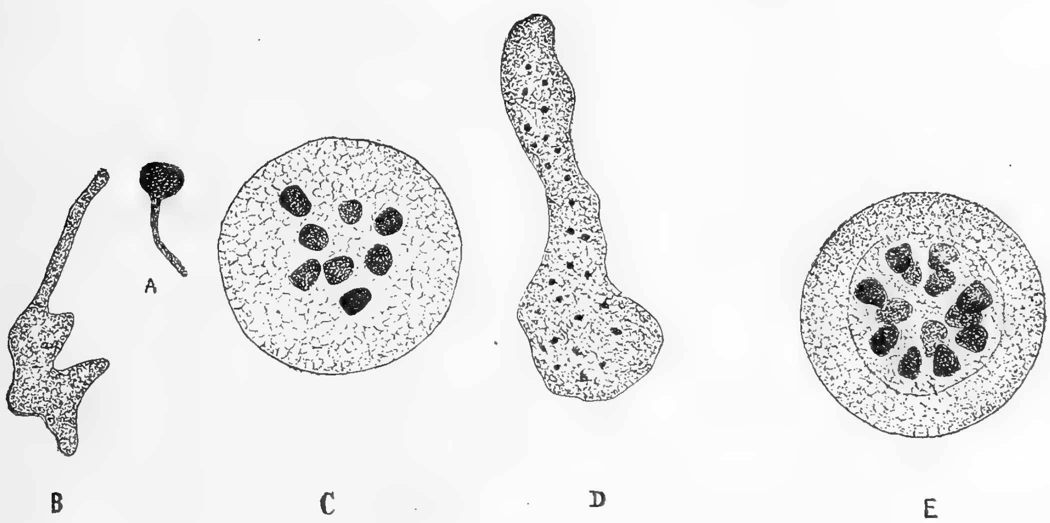


FIGURE 7.—Spore formation. *A*, Young sporozoite at the beginning of the amœboid stage. *B* and *D*, large amœboid forms prior to spore formation. In *D* the deeply staining granules have begun to collect in groups. *C* and *E*, spore-forming cysts. The protoplasm is again reticulate and the spores are completely formed. Camera drawing, x 2000 diameters.

were grouped together in small aggregates which formed the beginning of the spores (Figure 7, D).

Spore formation is always preceded by encystment of the animal within a delicate membrane. The cell leaves the muscle tissue, and in the lymph of the body cavity it rounds out into a sphere. The amœboid individuals, when ready to form spores, are comparatively large, and the cysts are of variable size, in some cases measuring twenty microns or more in diameter. The spores are formed by aggregation of the deeply staining granules (chromatin ?) instead of by nuclear division as in other Sporozoa (Figure 7, B, D). This leaves the protoplasm with a clearly marked reticular structure as in the early stages (Figure 7, C, E). A variable number of spores is the rule. In some cysts only twelve were seen, in others sixteen or even more. In some cases the cysts appear to be differentiated into a more hyaline ectoplasmic, and a denser endoplasmic region, the spores being in the latter (Figure 7, E). A more or less definite membrane separates the two regions. This membrane is not obligatory, however, and is often wanting.

The spores thus formed are liberated into the body cavity and are carried to all parts of the body with the lymph and blood. Whether they are voided to the outside or not, I do not know. In some cases the cysts, which are most often found in the body cavity, were observed in the intestine and I can account for their presence here on the assumption that they had been taken in as food or else derived from the gall bladder, for in no case have I found amœboid stages in the digestive tract. If they are voided to the outside it is probably by way of the gall bladder, for in this organ they were very abundant.

Briefly summarizing the above observations it appears that the parasites are 1) taken into the digestive tract with the food either in the cyst (adult) stage or in the spore stage; 2) the spores form sporozoites in the stomach and intestine; 3) these penetrate the epithelial cells and work their way to the lymph spaces; 4) in the lymph they develop amœboid processes and then penetrate muscle bundles; 5) here they grow to the adult stage, becoming comparatively large amœboid organisms of spindle or club shape; 6) they return to the lymph and there round out into spore-forming cysts; 7) the spores are apparently formed by the segregation of chromatin (?) granules which leave the remaining protoplasm with a distinctly reticular structure; they are variable in number; 8) the spores are liberated in the body cavity from which they find their way to all parts of the body, but accumulate especially in the testis. Or the cysts may be voided to the outside by way of the gall bladder; 9) in the testis these spores form sporozoites and thus lead to auto-infection. These spores, unlike those in the intestine, are covered by a capsule.

I am not satisfied to conclude, however, that the entire life history of the parasite is to be found in the trout. The absence of all traces of conjugation leads me to believe that some important stages in the life history are passed in some hosts other than this fish. I may digress from my immediate subject long enough to point out a case which illustrates this point and which has only recently been made known through researches of Major Ross in India, of Professors Koch, Grassi and others in Germany and Italy. The malaria-causing organism in man (*Plasmodium malariæ*) is a parasite belonging to the same group (Sporozoa) as the fish parasite here considered. Its life history was not completely known until within the last two years, when it was discovered that a very important stage in its development is passed in the digestive tract of a mosquito. Professor Koch and other scientists in Germany found that the malaria germs which are taken with the blood into a mosquito's stomach, conjugate there in pairs, a male germ fusing with a female. The copula which is formed by

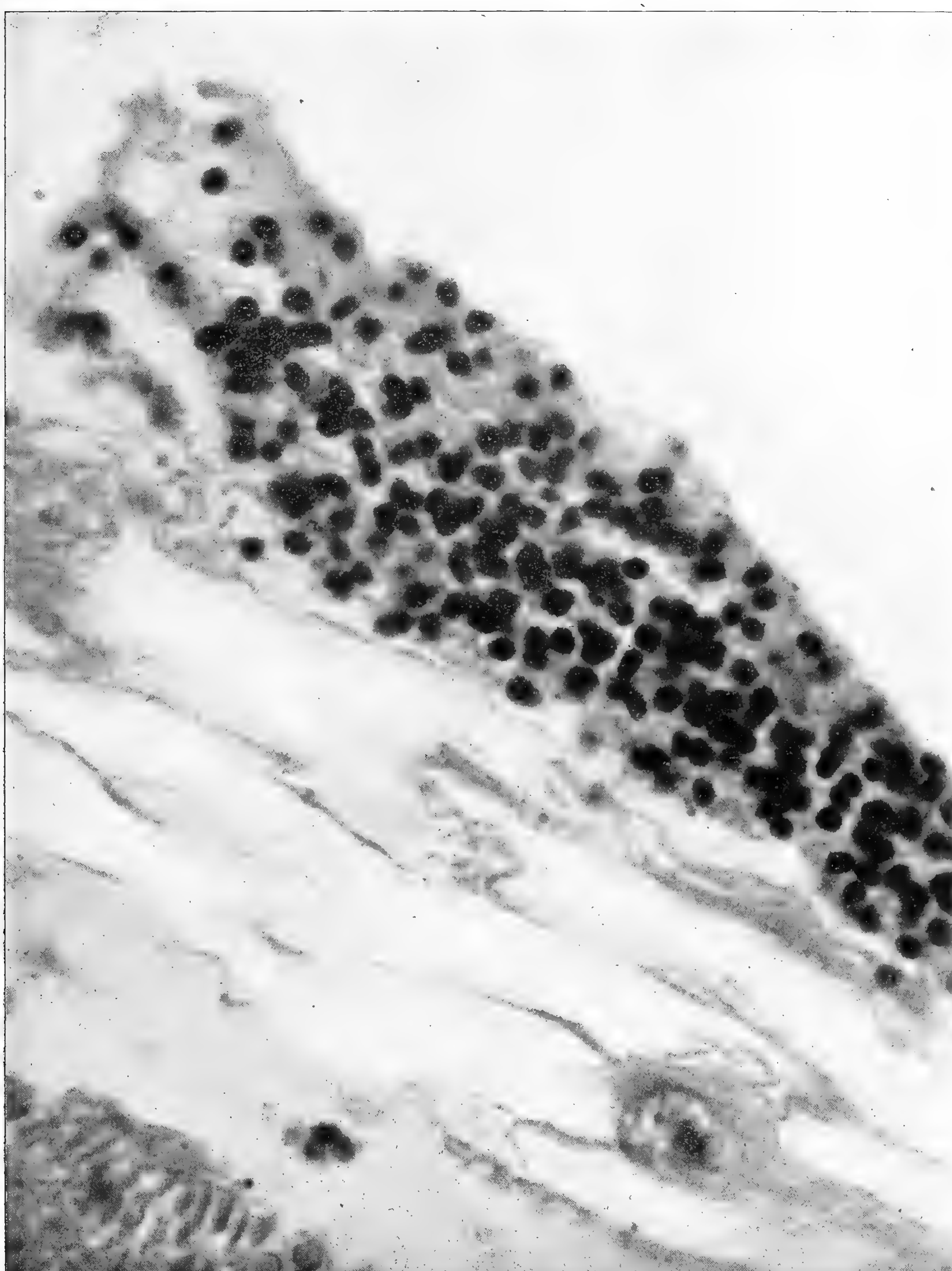


PLATE VII.—MASS OF SPORES ON THE OUTSIDE OF THE INTESTINE.

this union penetrates an epithelial cell of the gut where it forms spores. These spores migrate into the body cavity of the insect, ultimately finding their way into the salivary glands, and are injected into the blood of a new human host when the proboscis of the mosquito is forced into the flesh. Here is a change of hosts which are widely separated in the animal scale, one a warm-blooded vertebrate, the other an inferior invertebrate with body fluids of an entirely different nature.

A similar change of hosts may occur in other forms of Sporozoa as well as in the malaria germ, and although I do not want to insist upon it, it is certainly possible that the parasite which is causing the present epidemic is only one phase of some organism which is parasitic in some other form of animal life as well. What that form may be I have no means of knowing. The most probable hosts would be looked for among the arthropods such as flies, small crustacea, water beetles, and larvæ of various kinds or worms of various sorts. The arthropods are the most widely distributed hosts of Sporozoa while worms are almost equally affected.

On the other hand it may be possible that the form under consideration is a permanent parasite of the fish, becoming pathogenic only when the means of resistance of its host are weakened enough to permit it to increase to large numbers. Pfeiffer* regards this as a possible explanation of the epidemics among the barbels from the Rhine, Moselle and Saale, which are caused by the allied forms of Sporozoa, the Myxosporidia. I was unable to find them, however, in a presumably healthy fish from another part of the State and regard this view as improbable, although I am not prepared to say that they are not present in healthy fish in Long Island waters. The presence of the parasite in the intestine of the trout indicates that this is the means of infection from host to host, rather than through the gills where I found none, or directly from the outside through the skin. The vital question is: What is the original source of infection? This question, I regret to say, cannot be answered at the present time. The organism is newly discovered and its affinities are very uncertain. The nearest approach to it are the forms described by Pfeiffer† as Serosporidia. These are minute parasites occupying the body cavities of various Crustacea (*Daphnia*, *Gammarus*, *Cypris*, several species). Their form is spherical, oval or pyriform, and from four to ninety microns in diameter. The protoplasmic body is finely granular. Reproduction takes place in two ways: either the parasite changes into a cyst the contents of which break up into numerous amœboid spores, or it divides. The method of infection and the general distribution of these forms are quite unknown. The full life history of these Crustacean parasites is also unknown. It may be pointed out, however, that the hosts in which these parasites live are minute

* Protozoen als Krankheitserreger. Edition 1891.
† Sporozoen als Krankheitserreger. Edition 1895.

fresh-water forms which may easily be swallowed by the fish. The present parasite also resembles the form described by Thélohan and Henneguy* as a parasite of the crayfish, and although the spores of the latter do not contain thread capsules the authors regard it as one of the Myxosporidia. On similar grounds the present parasite might be regarded as one of the Myxosporidia. After one fish is affected the epidemic may spread throughout the entire hatchery by secondary infection; in the case of Myxosporidiosis, Megnin (see Pfeiffer), Pfeiffer, Ludwig, etc., believe that secondary infection is brought about by the extensive fouling of the water by fish corpses, and they recommend careful prophylactic measures such as removal of dead fish and weeding out of infected fish showing external signs of the disease. The most careful precautionary measures, however, cannot prevent a certain amount of contamination of the water from ulcers of infected fish.

Summary.

The cause of the disease can be safely assumed to be a minute parasite, *Lymphosporidium truttæ*, belonging to a great group of unicellular parasites, the Sporozoa. Its closest allies are the Serosporidia which infest and block up the body cavities of certain fresh-water Crustacea (*Cypris*, etc.). It forms sporozoites in the digestive tract of the trout; these penetrate epithelial cells and grow to forms similar to those in the intestine. They finally make their way into the lymph spaces and body cavity (probably by amœboid motion), where they penetrate muscle cells. No cysts comparable with those of the Myxosporidia are formed, but, as in the Myxosporidia, there is an amœboid adult stage which forms spores. Primary infection probably takes place by ingestion of the parasite, but whether these are in the free state or are parasites in some other hosts which are eaten as food, could not be determined. Secondary infection undoubtedly takes place by contamination of the water by dead fish and from ulcers on infected fish.

The cause of the epidemic at this particular time cannot be ascertained. I have every assurance from the director that the water was pure in every respect and never rose above sixty degrees Fahrenheit in temperature, while a constant flow from springs kept it fresh. Furthermore, his statements that interbreeding was not allowed and that fresh material was introduced through eggs and milt from other parts of the State leaves no reason for regarding the epidemic as due to the lack of vitality through this cause.

* Ann. d. Micrographie, 1890.

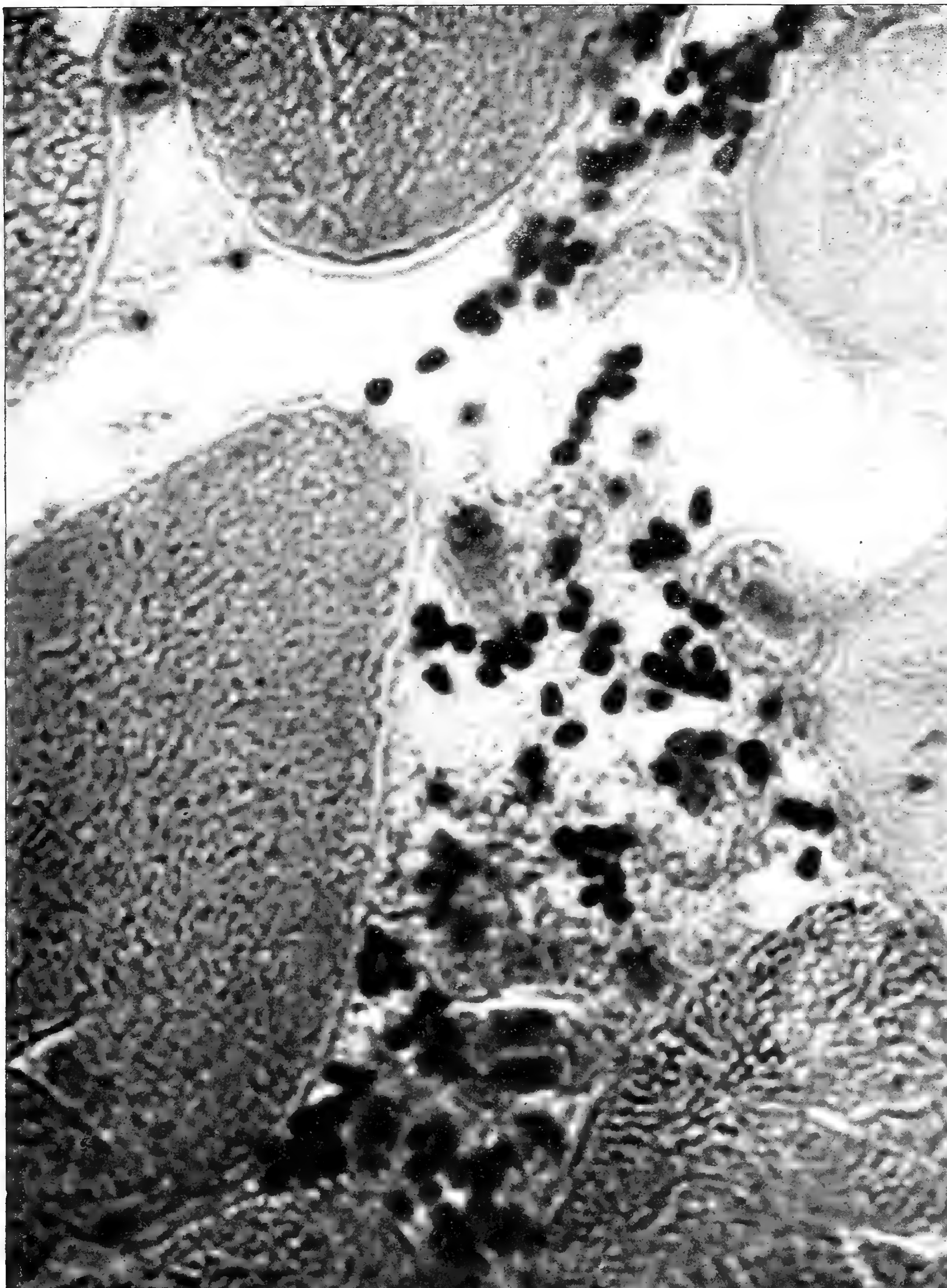


PLATE VIII.—SECTION OF MUSCLE BUNDLES OF THE BODY WALL.—SPORES IN THE LYMPH SPACES.

Recommendations.

My attention was first called to the epidemic in October, 1899, after it had been running for a period of five months and after thousands of fish had died. It was quite evident that the disease was then widespread and that nothing could be done to save the remainder. The question to be considered is how to prevent future outbreaks of like nature in this and in other localities. Unfortunately this cannot be answered until we know where the parasite lives when not in the body of the fish. A systematic examination of the suspended organisms in the waters, such as *Cypris*, *Daphnia*, *Gammarus*, *Cyclops* or other Crustacea, might throw some light on the question, but until this is ascertained the only recommendations that can be made are such as the director of the Northport hatchery has undoubtedly carried out in the present instance, viz.: 1) to exercise the most careful prophylactic measures. As soon as any fish shows the first evidence of the disease it should, of course, be removed and buried or burned (Pfeiffer, Ludwig and others recommended these methods in the case of Myxosporidiosis), the remaining fish should all be inspected at intervals and all sickly ones should be removed. 2) In the present case, before stocking the ponds anew, I should recommend that the water be drained off and the bottoms be left exposed to the sun for a few months. The runways should be scrubbed and all growths removed. Every fish now in the ponds should be removed and not allowed to contaminate the fish in neighboring streams. 3) Care must be taken not to interbreed with the diseased fish, for although it is perhaps improbable that the disease germ is transmitted in this way, yet it is possible, especially as the testis is the chief seat of reproduction of the parasite. 4) The water must be kept perfectly clean and cold; not only dead fish but refuse of all kinds should be carefully removed. 5) The vitality of the fish must be sustained; fungoid growths must be constantly watched for and removed. 6) Constant interbreeding of the same limited variety of fish should be avoided; new blood should be introduced frequently. 7) The food of the fish should be carefully inspected and should not be allowed to stand exposed to flies and other insects, but should be fresh.

These homely recommendations, which every fish breeder knows and probably applies, are the only precautionary measures that I can suggest, and even where they are most rigorously enforced the disease may spread until it becomes epidemic. The fish breeder must add this newly discovered organism to the many chances he takes in rearing fine fish.

DEPARTMENT OF ZOOLOGY,
COLUMBIA UNIVERSITY, NEW YORK.

Description of the Photographic Plates.

The photographs represented in the following plates were made by Dr. Edward L. Leaming, of the Department of Pathology, Columbia University, New York:

PLATE I. A diseased trout, showing loss of the lower jaw bones. The lower figure represents a gill from an adult fish covered with the parasitic Copepod *Tracheliastes.* Photograph magnified one and one-half diameters.

PLATE II. Two diseased trout, showing ulcers in the body wall. The testis is seen protruding through the anterior hole in the lower fish. Magnified one and one-quarter diameters.

PLATE III. A group of spores of the parasite *Lymphosporidium truttæ* from the intestine. Some rod-bacilli are seen near the center. Microphotograph, x 2000 diameters.

PLATE IV. Section of the testis to show the degree of infection. The black granular parts are groups of spores of the parasite, the light parts are the epithelial tissues of the testis from which the stain has been entirely extracted. Attention is directed also to the layer of spores around the left margin of the section. Microphotograph, x 80 diameters.

PLATE V. A group of spores in the lymph surrounding the liver. Microphotograph, x 2000 diameters.

PLATE VI. A group of spores in the lymph surrounding the kidney. Microphotograph, x 2000 diameters.

PLATE VII. A group of spores from the body cavity and in the lymph surrounding the intestine. Microphotograph, x 2000 diameters.

PLATE VIII. Spores in the lymph spaces between the muscles of the body wall. Microphotograph of a section from an ulcerated spot, x 2000 diameters.

Removal of Lampreys from the Interior Waters of New York.

By Prof. H. A. SURFACE, M. Sc.

A POOL IN THE RAQUETTE RIVER.

THE fishes in the interior waters of the State of New York have at least three serious enemies whose habits have not been fully studied from the economic standpoint. These are the Lake Lamprey (*Petromyzon marinus unicolor* De Kay), the Gar, Gar pike, Long-nosed Gar, or Billfish (*Lepisosteus osseus* Linnæus), and the Water dog, Mud Puppy or Necturus (*Necturus maculatus* Rafinesque).

Of course these have been studied by many scientific men and much has been written about them. They have been described and re-described, named again and again, dissected, drawn and photographed, kept alive in tanks, their eggs and various parts of their bodies have been sliced into pieces less than a thousandth of an inch in thickness, and a little has been published about their habits and destructiveness; but never has their destructive influence been made sufficiently prominent, nor has a rational word appeared in print about any practical method of exterminating or even reducing any of them, nor has the public yet awakened to the great necessity of the most serious efforts on the part of man in behalf of these very economic and eminently practical subjects.

There is no doubt in the mind of the writer but that we have named above, in order of destructiveness, the three most serious enemies of fishes in the interior of this State, each of which surely destroys more fishes annually than are caught by all of the fishermen combined.

The next important enemies of fishes, in order of destructiveness, according to our observations and belief, are spawn-eating fishes, water snakes, carnivorous or predaceous aquatic insects (especially larvæ), and piscivorous fishes and birds. We hope soon to see each of these and kindred economic subjects fully studied, not only in New York but also in other States, and proper remedies not only suggested by economic zoologists, but speedily put into practical and effective operation. However, economic application should be the end of all science, but that end should be final and not initial.

We cannot hope to be able to take practical steps toward making fish and game more abundant until we know their habits and the full life history and habits of all their enemies. This means an immense amount of field work for trained scientists who will always keep the definite economic ends plainly in mind.

The Lampreys.

The necessity of a complete knowledge of the subject is so plainly shown in the example of the lamprey that we here discuss it in detail. When we know as much about any creature as we now know about the lamprey it will be possible for the intelligent effort of mankind to avail in either increasing or reducing its numbers.

What is a Lamprey? Lampreys are not fishes, but fish-like Vertebrates with no paired fins, and neither spines nor bony rays in the fins which they do possess; no scales, no jointed appendages, and in fact no external appendages of any kind but the vertical fins of the back and tail, with only one nostril, and that found on the middle line of the head (see illustration No. 7); adults with a large circular suctorial mouth armed with a great number of sharp chitinous teeth, but with no true jaws; mouth surrounded by a fleshy membrane which insures perfect suction and is fringed around the entire margin with a close-set row of numerous fimbriæ; tongue rasp-like, containing many sharp chitinous teeth; larvæ with a contracted mouth, screened by a series of plates set at right angles to the entrance, forming a sieve; two pairs of eyes, perfect and functional in the adult, imperfect, sub-dermal, and perhaps perceiving only light in the larvæ; seven conspicuous holes (gill openings) in each side of the neck; no bones whatever in the body, cartilage surrounding the brain, spinal cord and respiratory chamber; breathing rapidly by means of the resiliency of the cartilaginous network surrounding the cardiac region, and also by the contractility of the attached muscles; purifying their rapidly circulating blood by means of gills, which are protected within gill pouches; undergoing transformation or metamorphosis from the larvæ into the adults; feeding in the larval stage upon minute organisms (especially diatoms) which live in the organic sediment beneath the water; adult representatives of nearly all species feeding in the adult stage solely upon the blood of fishes (the Brook Lamprey taking no food in the adult state); ascending streams to spawn; building spawning beds with pebbles, pairing, spawning once, and then evidently dying.

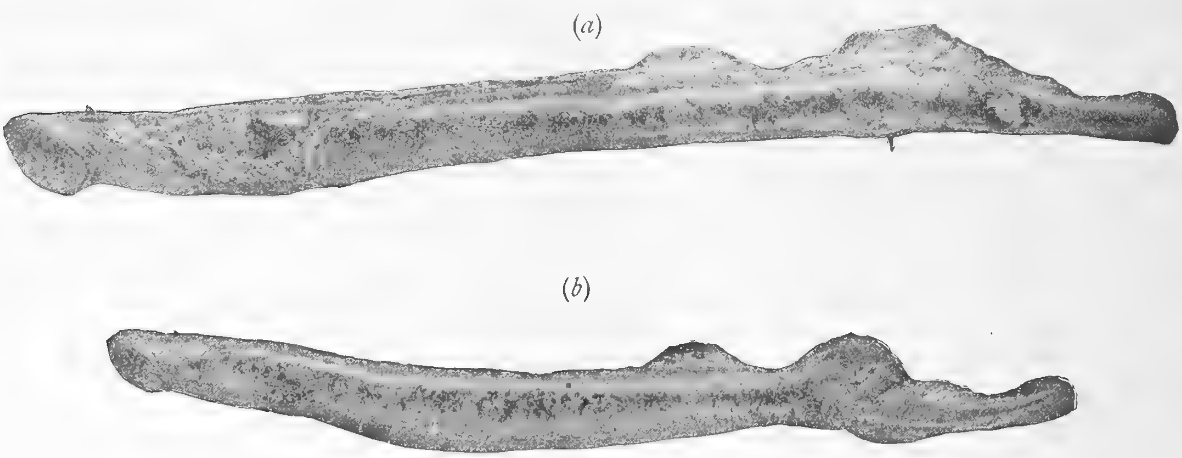
We wish to state here for the sake of exposing some bits of folk lore (based, as is most folk lore, upon ignorance), that they contain no venom whatever, and can inflict no injury whatever upon man, neither by bite nor sting; neither is the flesh poisonous to man in eating it, excepting after the alimentary canal has long been atrophied at spawning time and the bile and catabolic products being unable to escape become spread throughout the entire system of the lamprey and cause all the flesh to assume a green color, as will be explained later. It is thought by many persons that they will attack people while in the water, and that a new hole comes in the side of the neck each year, as the rattles are supposed to come on a rattler's tail, or as the wrinkles come on a cow's horn, but these suppositions are, of course, false. The holes in the sides of the neck are openings into the gill pouches through which the water flows to carry its dissolved air to the gills to purify the blood, and their number is always seven. Lampreys have no means whatever of inflicting any injury upon man, neither directly nor indirectly, excepting through their economic effect in destroying the fishes that he would use as food. This destruction, however, is very great.

There are fifteen species of lampreys known to scientists, from the waters (mostly rivers) of temperate regions. There are nine species and one variety represented in North America. An excellent account and descriptions of these by Messrs. Jordan and Fordice can be found in the Annals of the New York Academy of Sciences for 1886. The representatives of some of the American species are very rare, having been collected but a few times. Among these rare collections we can here chronicle a specimen of the Yellow Lamprey of the Mississippi Valley (*Ichthyomyzon castaneus* Girard), taken by us in the summer of 1899 in Meredosia Bay, Illinois River, Ill., while acting as Field Naturalist for the Illinois State Biological Station.

Kinds of Lampreys in New York. There are four species of lampreys found in the State of New York, as follows: The Silver Lamprey (*Ichthyomyzon concolor* Kirtland), found in Lakes Erie and Ontario of our waters, and doubtless spawning in their affluents.

The Sea Lamprey (*Petromyzon marinus* Linnæus), found in the Hudson River and in the Susquehanna far up into the State of New York. They come into these streams and their tributaries to spawn, and their larvæ are extensively taken from along the banks and used as bait in fishing. There is a great demand for them for this purpose along the Susquehanna River, although larval lampreys are not thus used in the central part of the State. The advantage of larval lampreys for bait is that they are lively, moving all the time and attracting the attention of such fishes as are hunting for moving and living material upon which to feed, and they are very tough. One young lamprey will often endure long enough to catch two or three or even more voracious fishes. If the fishermen in the central part of the State would learn to use this now neglected form of bait they would find it to their advantage, not only in availing themselves of an excellent fish bait, but also in reducing the numbers of the most serious fish parasite. (See methods of collecting them, described later). The adult Sea Lampreys are often three feet in length, and are captured in great numbers as they come into the shallow streams in the spring to spawn. They are dressed and preserved in barrels or "pickled down," being highly esteemed as food and having an equal exchange value with pork, a barrel of pickled lampreys being worth a barrel of pickled pork.

The Lake Lamprey (*Petromyzon marinus unicolor* Linnæus) [see illustration No. 1, *a* and *b*] is but a land-locked or lake-locked form or variety of its ancestor, the Sea Lamprey. It has become much smaller in size and darker and more uniform in color



NO. 1—ADULT SPAWNING MALE (A) AND FEMALE (B) LAKE LAMPREYS.

than the Sea Lamprey is at present. The representatives of this species average less than a foot and a half in length, although there is an extreme variation of at least a foot in length of mature individuals found on the spawning beds. As the Lake Lampreys in their adult stage feed upon nothing but the blood of fishes and thus become very destructive, they are to become the main feature of this article, and their discussion is reserved until after the following description of some features of the Brook Lamprey.

The Brook Lamprey (*Lampetra wilderi* Jordan and Evermann*) is to be found

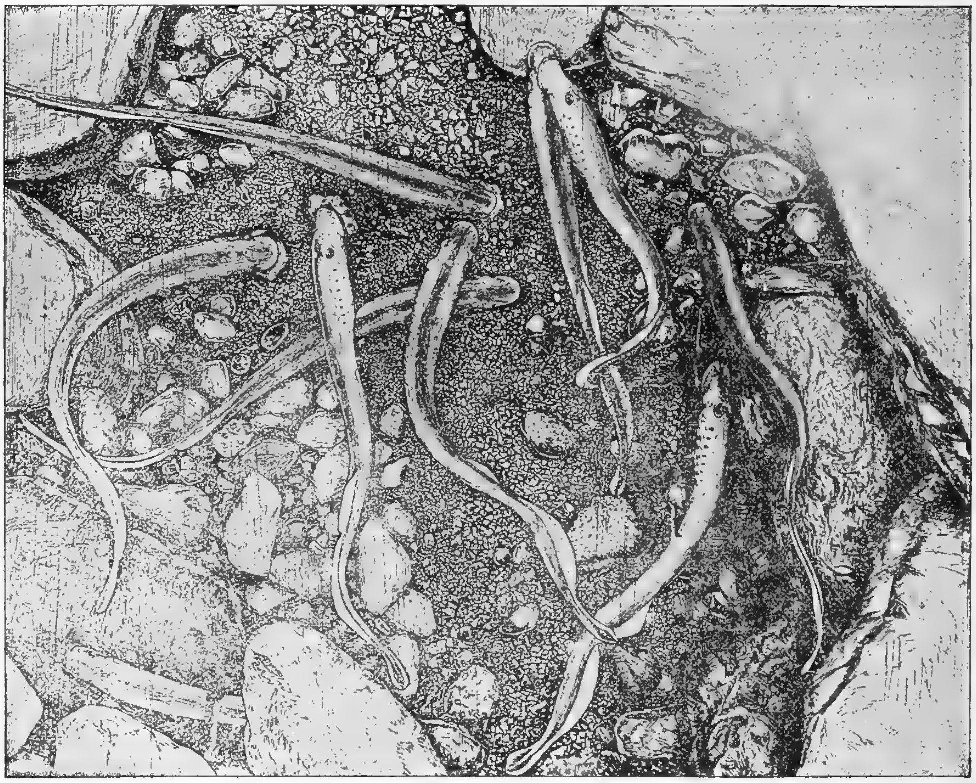
* In the excellent "Synopsis of Fishes of Middle and North America," Jordan and Evermann attribute the original description under above scientific name to S. H. Gage, but it is not at all described by him in the article referred to by them, and when we told him that the authors of the "Synopsis" had described it under the above name, referring to his authorship, he was very much in doubt; and finally after looking it up for himself he said: "Surely I am not the author of that name or description." Knowing thus that Jordan and Evermann are the authors of both name and description it is but right to refer to their proper source.

from New York city to Iowa. It takes its common name from the fact that it is never found in any other body of water than a small stream. In fact, recent investigations have shown that they have no cause to leave the stream that affords them spawning beds and food for their young, as they transform into adults, pass directly to their spawning beds, mate and spawn, and then die, without taking any food whatever in the adult stage. This feature is closely analogous to the general life histories of some insects, which do all their feeding in the larval stage and have no functional mouth part in the adult stage, but at the time of transformation are fully mature and are ready to mate and lay their eggs without taking any further nourishment. Of course, with such creatures, death ensues shortly after reproduction, and their existence in the immature stage extends through a much greater period of time than in the adult, the ephemeral existence of the adults enduring but long enough to permit the individuals to reproduce their kind. This prolonged larval state, in comparison with the length of the adult, is true of both species of lampreys found here, but is especially emphasized in the Brook Lampreys. For three years we have had the larvæ transform in our tanks and become fully adult within a short time. They transform in the latter part of March and during the month of April, owing to the temperature of the water over the sand and *débris* which they inhabit. The females are at once completely filled with well-formed eggs and present the same appearance as those that are commencing to form spawning beds in the streams. Their bodies are considerably distended with eggs and appear quite distinctly reticulated, or as though covered or rather lined with a fine network, because the white opaque eggs show plainly through the semi-translucent body wall.

In the adult Brook Lamprey the mouth is greatly contracted, the teeth are quite rudimentary and, indeed, functionless, and the alimentary canal is permanently atrophied, showing a generally degenerate form in comparison with the Lake Lamprey as a type. The mouth is yet perfect as a suctorial organ, although toothless for all practical purposes. It is used as a suctorial organ in constructing and tearing down its nests and in seizing and holding to the females while *in copulo*, and for holding the adults in place so currents of water cannot wash them away.

The very small teeth shown in illustration No. 5 are but points, or mere rudiments, and would not be at all adapted to cutting through the scales and skin of a fish, and, in fact, we have never known of a lamprey of this species having been collected upon a fish; and of the hundreds of fishes which we have collected at various times of the year in the stream where thousands of specimens of this lamprey abound and are found at the spawning period, we have never seen one that bore a mark that could possibly be construed as being the evidence of an attack of a Brook Lamprey, while the large scars of the Lake Lamprey are often conspicuous on fishes caught up the stream, miles from the lake. We do not hesitate to say that we feel thoroughly convinced that they do not attack fishes and, in fact, as stated, do not take food of any kind in the adult state.

The Brook Lampreys spawn from two to three weeks earlier than do the Lake Lampreys, or when the water is yet from ten to five degrees (Fahrenheit) colder than that in which the Lake Lampreys spawn. One of the most interesting accounts of their spawning habits is by Dr. Bashford Dean and F. B. Sumner, in the Transactions of the New York Academy of Science, Vol. XVI, December, 1897. It is by kind



NO. 2.—MALE AND FEMALE BROOK LAMPREYS, ON SPAWNING BED.

permission of the authors that we reproduce the very excellent drawing of the Brook Lampreys on their spawning bed (see illustration No. 2). The pair in the upper part of the picture is *in copulo*, and each of the two in the lower corners is trying to move a stone many times its own weight. Such a feat is, of course, impossible, although we have seen representatives of both species found here move stones thrice as heavy as themselves. We know that these lampreys do not come up the stream in numbers to spawn, as do the Lake Lampreys, as they were seen in immense numbers on the gravel above our weir after it was perfectly constructed of wire netting of only one-fourth inch square mesh. A very few were caught in the weir, but these were as nothing compared with the great numbers of this species seen spawning both above and below the trap.

Differences between the Brook and the Lake Lampreys. The Brook Lamprey not only differs from the Lake Lamprey in structure and in number, arrangement and size of teeth, but also in size, color and habits. They are very small, averaging not over eight inches in length and less than half an inch in diameter. Many of the adults weigh less than one half ounce each, and it is doubtful if they ever exceed an ounce in weight. They do not have as great range in size and color as do the Lake Lampreys. Their color is almost always dark above, slightly mottled with some darker and lighter washings, and light beneath.

The males do not have a distinctly marked dorsal ridge, as in the Lake Lamprey (see illustration No. 1, *a*), neither is the anal fin of the female as conspicuous. Besides the facts shown that they are not parasitic, do not feed in the adult state, live only a few days as adults, do not run up stream to spawn, but spawn at that part of the stream where they transform, if the conditions are favorable for spawning beds, and do not spawn at the same time as the Lake Lampreys,—they also differ in the size of their spawning beds, which are only one third or one fourth the size of those of the Lake Lamprey; also in their proximity to one another, being crowded even more closely together than are those of the larger species (Compare illustrations Nos. 9 and 10); also differing in the size of the material they move, being able to move material only about one fifth as large as that moved by the Lake Lamprey; in the selection of spawning sites, being satisfied with smaller pebbles in the sand and unable to use certain shallows where larger stones are found on the bottom, but which afford ideal sites for the larger lampreys. If there are to be found pebbles as large as ordinary playing marbles mixed with the sand the Brook Lampreys will be able to establish spawning beds there and will be satisfied with the site, while the Lake Lampreys will not spawn unless there are also pebbles at least as large as hens' eggs. As a consequence it often happens that shallows which, on account of the nature of the bottom, are not at all suitable for one kind may be perfectly well adapted for the spawning requirements of the other. Our illustrations show this plainly. Illustrations Nos. 8 and 9 are of the spawning site of the Brook Lamprey. Here there were scores of these lampreys spawning, the stakes in the water marking their spawning beds, but a few weeks later we visited the same site and found only two beds of the Lake Lamprey. This was because the condition of the stream bed, while favorable to one was unfavorable to the other, the bottom being covered with sand and small pebbles. At the first riffles or shallows below the site above mentioned the current and depth of water presented perfect conditions for a spawning site, but not one spawning bed or lamprey was found there during the entire spawning season. The reason it was not used was that the bottom of the stream bed there was covered with stones not smaller than a man's hand. These were too large to be readily moved by even the representatives of the larger species of lamprey. Again, a quarter of a mile further down stream, where there was a strong current and an abundance of good water in proper condition, there was not a spawning bed of either species to be found. A closer examination of the stream bed here showed that this was because there were no stones or pebbles whatever, although there was an abundance of sand.

On the other hand, illustration No. 10 shows the great abundance of the spawning beds of the Lake Lamprey at a place where earlier in the season scarcely a bed of the Brook Lamprey was to be found. It was plainly evident that the abundance of the larger-sized species of lamprey and the scarcity of the smaller spawning at this site, is due to the presence of only medium-sized and larger stones here, which are too large to be used by one kind but are of a suitable size to be used in the spawning beds of the other.

Another difference between them is seen in the number and size of the eggs they lay. The female Brook Lamprey lays from 800 to 1,000 eggs, of a smaller size than those laid by the Lake Lamprey, while the latter lays fully thirty or forty times that number. They also differ in their relative abundance on a single spawning bed. In most instances more than one pair of Brook Lampreys are found on a spawning bed, while with the Lake Lampreys one pair for each spawning bed is the general rule. In fact, the Brook Lampreys appear to be truly gregarious, while the Lake Lampreys show a distinct tendency to be averse to any kind of socialism. This may be due to the degenerate and enfeebled or rudimentary teeth of the former, by which it loses its only weapon of offense and defense, and which may render it docile after the manner that irascible cattle are rendered docile and social, or closely gregarious, by dehorning. It is well known that the habits of the cattle change after they are deprived of their weapons by this process.

As shown above, through the degeneration of the teeth (see illustrations Nos. 5 and 6) the Brook Lamprey is incapable of inflicting a wound, and we have never seen one attack or strike another (excepting for mating) while on the spawning bed; but we have seen a male Lake Lamprey battle with another for the lordship of a spawning bed which contained a spawning female, and when the first male struck the intruder the latter writhed with all the evidence of pain. It struck back viciously, but with no avail, as it was speedily driven away. While, as a rule, the spawning beds of this lamprey are less than a foot in diameter, we have seen them formed contiguous across a favorable site in the stream in a continuous row or line from ten to fifteen feet long. It is not unusual to see them from two to three feet in diameter and containing from ten to fifteen lampreys, and we have counted as many as forty-five on one large spawning bed. They do not confine themselves to any one part of the bed, but move about continuously, busily engaged in carrying small stones from one place to another. As far as visible results are concerned, an observer might think that their one intent and object is to move as many stones as possible from one place to another, and that this is accomplished in the most haphazard and indefinite manner, with evidence of lack of any preconceived plan or co-operation. If this were the primary object such inference would indeed be well founded, but we are now convinced that the important result achieved by moving the stones is the stirring and loosening up of the sand to more completely cover and protect the eggs. The sand is also well stirred by the rapidly vibrating tails of both sexes while in copulation. By bringing the sand into contact with the eggs and partially covering them this temporarily prevents minnows from getting them when freshly expelled. The eggs being adhesive are thus also brought into contact with the grains of sand which weight them down and cause them to sink in the bottom of the nest, where they can be further covered instead of being carried down stream to perish. The continuous moving of the stones in the edge of the nest and over the sand of the nest is necessary in order to cover the eggs well with sand; and it can be seen that a concerted action in moving all the stones from one part of the nest to another definite part, especially in the same direction, would defeat the very important end of covering the eggs in all parts of the nest with sand. (For a description of the construction of the nest, see the discussion of the Lake Lamprey.)

The proportionate numbers of the sexes represented on the spawning beds may vary from fewer males than females to five or six times as many of the former as of the latter, but in general we have observed from two to three times as many males as females. By watching them very carefully, we have observed that they are not only polygamous but polyandrous, one male mating with several females, and several males mating with the same female. Although they spawn in the latter part of April and in the early part of May when the temperature of the water becomes between forty and fifty degrees Fahrenheit, we wish to record here the remarkably interesting fact that on June 12, 1899, fully a month after the last specimens of this species had disappeared from their spawning beds, and when even the most careful search revealed but very few of the Lake Lampreys yet on their beds, we found a fresh plump, female Brook Lamprey, full of eggs and ready to spawn, evidently just transformed. This interesting specimen, with a pair of Lake Lampreys, was sent to Mr. S. F. Denton, the famous fish artist at Wellesley, Mass., to use in an illustration, but it died and spoiled before reaching him. There is no doubt of the specific identification, and the interest attached to it arises from the very late metamorphosis and appearance upon a spawning bed, without the presence of a male. They commence to spawn shortly after the water reaches a temperature of forty degrees Fahrenheit for the average of the day, which is generally about May 1, although we have found them upon their beds as early as April 18.* If the weather keeps warm, in a few days thousands of them will be found on their little spawning beds, extending in general over the range of the stream that is to be occupied later by the lampreys of the larger species. They remain on their spawning beds about two weeks, more or less, depending upon temperature; the warmer it is, the shorter the duration of the spawning period. They then become covered with fungus, drift down stream and are either eaten by carnivorous birds and mammals, or die and settle in the depths of the quiet pools and are covered with *débris* (see illustration No. 13). In such places we have often found their remains.

The bitterns (*Botaurus lentiginosus*) and smaller herons (*Ardea virescens*) are especially abundant in the stream during the spawning time of these lampreys and are their particular enemies. (See further discussion of this subject under the heading "Lake Lamprey.")

The Lake Lamprey (*Petromyzon marinus unicolor* Linnæus).

Life History. Let us begin the life history of the lamprey with the egg, as nearly all animal life begins. Adult female Lake Lampreys lay between 25,000 and 30,000 eggs, according to size, the average being about 27,500. The eggs are laid in "nests," to be described later, and hatch in from one to three weeks, according to temperature. The warmer the water the sooner they hatch, the water at time of hatching varying (for the two seasons observed) from sixty to sixty-two degrees or more.

When first laid the eggs are adhesive and stick to grains of sand and pebbles. Thus they are held to the bottom and are covered with sand by the adults in the manner described elsewhere. They are at first nearly white and translucent, but soon become sulphur yellow and entirely opaque. When first hatched the young look like minute light yellow worms, not over an eighth of an inch in length. They lie in the sand at the bottom of the old spawning bed, and burrow still deeper, feeding on the micro-organisms that are found there. Of course the quantity of their food is limited in such a place, and their growth is very slow. They may not attain a greater length than one and one half inches during the first year, as that is the smallest size we have found in the sand in the spring time when eggs are again being deposited. Specimens can be found ranging in length from this size to five or six inches, all taken from the

* It is interesting to note that Dr. Dean and Mr. Sumner have found them spawning in numbers in New York city as early as April 16.

same sand-bar and showing no evidence of grouping in sizes according to age. It would appear that their growth depends upon their food supply, and the largest of last year may be as large as the smallest of the preceding year. The duration of the larval period is not known, but we believe that it is three or four years. The current frequently shifts the sand of their bed and washes them down and into the sediment along the shore. The best place to find larval lampreys is some distance below the spawning beds, in the deposit of light silt and organic material near the shore, where the stream is filling up in the concave side of a curve in its channel (see illustrations Nos. 11 and 12). We have often found them abundant and of various sizes in such a place, fully a mile down stream below the lowest favorable place for a spawning bed. Such is the location of the place here shown, where we have found scores of immature lampreys.

The mouth of the young is covered with fimbriæ or lamellæ, which are so close together as to act as a sieve and prevent the passage of grains of sand. This makes it possible for the young lamprey to eat only the most minute organisms, and the latter must be taken while the larva is blindly making or following its sinuous path through the sand, or they are taken in with water.

The larvæ of the two species found here are so nearly alike that constant characteristic differences have not yet been pointed out. It is known, however, that at the time of metamorphosis the larvæ of the Brook Lamprey are much smaller than those of the Lake Lamprey.

The Transformation. The transformation is remarkable and interesting, and finds its parallel only in the wonderful changes that ensue in the metamorphosis of a tadpole to an adult frog or toad.

The larval lamprey is entirely blind, toothless, externally segmented, and lives altogether beneath the surface of the sand, feeding only upon microscopical organisms, through a mouth that is covered and sieve-like. Of course, as their food is such minute material and is captured in such small quantities, the amount of their nourishment is limited and their growth is necessarily slow. It is not known just how long they remain in the larval stage, but it must surely be three years at least, and possibly four. This should be determined. If we had a State Biological Station, such questions that are of real economic value could be readily determined. The necessity of such knowledge is apparent when we realize that any experiments toward exterminating these pests must be continued through as many years as there are in the life history of the lamprey, from the egg to the spawning adult. If this is five years, and we believe it is, it means that there are five generations in existence at any one time, overlapping one another, and each differing from the other by at least one year's growth.

It is not known if the time of duration of the larval period is the same in the two species of lampreys found here, or if the Brook Lamprey has a shorter larval stage than the Lake Lamprey. We have a number of specimens in tanks and shall doubtless be able to determine some of these features in time. These larvæ can be found in almost any sand-bank or drift of dirt and *débris* from near the source of the stream (the highest spawning beds) to its very mouth, having been carried far below the lowest spawning beds by the high water. Their food is most abundant in the concave side of a turn in the stream where the current causes a whirlpool and quiet water, and where there is a consequent deposit of sediment and fine organic material. They

NO. 3.—HEAD OF LAKE LAMPREY.

NO. 4.—MOUTH OF LAKE LAMPREY.

appear to greatly prefer such a place to a bare sand-bank, doubtless because their food is more abundant where the finely comminuted organic material is also deposited with the mud and sand.

Along the Susquehanna River the "Sand Lampreys," as the larvæ are there called, are in great demand. They are taken from the sand with shovels and used quite extensively for fish bait. When a shovelful of wet sand and mud containing the young lampreys is thrown upon the bank, they can be seen wriggling, to find concealment, like pink and white worms of various sizes. It is singular that the line fishermen of central New York have not generally learned the excellency of this kind of bait. While it would be quite impossible to hope to exterminate them by digging up all the young lampreys in the sand, their common use by fishermen would be effective in reducing their numbers.

Some writers have called the immature stage of the lamprey the "Ammocœtes Stage," because the generic name *Ammocœtes* was first given by Cuvier to an immature European lamprey in 1817. We cannot see why the term should be made an adjective and continued as a common word.

In the latter part of the fall the young lampreys metamorphose and assume the form of the adult. They are now about six or eight inches long and differ greatly from their appearance and condition when younger. The segmented condition of the body disappears. The eyes appear to grow out through the skin and become plainly visible and functional. The mouth is no longer filled with vertical membranous sheets to act as a sieve, but it contains nearly one hundred and fifty sharp and chitinous teeth, arranged in rows that are more or less concentric and at the same time presenting the appearance of circular radiation (see illustrations Nos. 3 and 4). These teeth are very strong, with sharp points, and in structure each has the appearance of a hollow cone of chitin placed over another cone or papilla. A little below the center of the mouth is the oral opening, which is circular and contains a flattened tongue which bears finer teeth of chitin set closely together, and arranged in two interrupted (appearing as four) curved rows extending up and down from the ventral toward the dorsal side of the mouth. Around the mouth is a circle of soft membrane finally surrounded by a margin of fimbriæ or small fringe. This completes a wonderful and perfect apparatus with which the lamprey attaches itself to its victims, takes its food, carries stones, builds and tears down its nest, seizes its mate, holds itself in position in a strong current, and climbs over falls. (See the interesting article by Dr. H. M. Smith, on "The Three-toothed Lamprey," in the *Scientific American* for April, 1900.)

The Adult (see illustration No. 1, *a* and *b*). It is not known how long the lamprey lives as an adult in the lake before it goes up stream to spawn, but this must be at least two years, probably three. Here is another very important feature that should be determined, but can be worked out only by very careful biological work and the proper equipment. We know that during the spring time when there were many adult and ripe lampreys on the spawning beds in the stream, we have caught others that were adult but not sexually mature, feeding on the blood of fishes in the lake. Having reached the lake in the form of the fully grown lamprey, they are, of course, ready to adapt themselves to the changed condition and assume changed habits. The most prominent economic feature in the entire life history of these animals is their feeding habits in this stage, their food now consisting wholly of the blood of fishes. A lamprey is able to strike its suctorial mouth against a fish and in an instant become so firmly attached that it is very rarely, indeed, that the efforts of the fish will avail to rid itself of its persecutor. It is said that the large-mouth black bass (*Micropterus dolomieu*), the perch (*Perca flavescens*), and the rock bass (*Ambloplites rupestris*) rid themselves of this pest by swimming between stones and scraping it off, but we cannot believe such statements. When a lamprey attaches itself to a person's hand in the aquarium it can only be freed by lifting it from the water. As a rule it will drop the instant it is exposed to the open air, although often it will remain attached for some time even in the open air, or may attach itself to an object while out of water.

The stories that are told of certain fish, when attacked, coming to the surface of the water and lying in such a position as to expose their foe, are to be doubted, although reliable eye-witnesses have told us that in the spring of 1897 a black bass weighing perhaps less than a pound was seen to jump out of the water in Fall Creek and shake itself. As it jumped again it was seen that a lamprey was attached to it. A third time it rushed to the surface of the water and appeared to stand upright on its tail and shake itself in the air. This time its efforts were rewarded, for its enemy dropped off and the successful fish darted down stream with a velocity that showed it meant to leave that spot as soon as possible.

Nearly all lampreys that are attached to fish when they are caught in nets will escape through the meshes of the nets, but some are occasionally brought ashore and may hang on to their victim with bulldog pertinacity.

Natural Enemies of the Lamprey.

[N.B. Nothing has ever before been published on this subject.]

1. *Mammals.* It is not usually thought that lampreys can be captured by mammals, but we have seen conclusive evidence that they are eaten by several species of carnivorous mammals, especially raccoons, muskrats, rats, minks, weasels, foxes and perhaps skunks and house cats. The two periods in the lives of the lampreys at which they are liable to attack, and really are attacked by these animals, is when they are transforming and when spawning. The transforming lampreys lie in the sand with their heads or portions of their bodies uncovered, along the banks of the stream, where the water is only one or two inches deep. Their presence can be detected by holes in the sand where they have withdrawn, or by their sudden movement when the ground is shaken, or as they observe a moving object. In the early spring we have often seen the tracks of the animals named, in the mud or sand of the shore at vacated burrows and disturbed sand from which the young lampreys had been removed (see illustra-

tion No. 14). We have also found pieces of adult lampreys that had been partially devoured, not only on the banks near the spawning beds, but also some distance from the creek banks.

2. *Birds.* The predaceous birds, hawks and owls, take lampreys from the spawning beds, as the following evidences show. On May 25, 1899, we found, on a stump near Cayuga Lake Inlet, a piece of skin, masses of eggs and fresh blood of a lamprey that had evidently been eaten by a bird of prey. On June 2 we found, on a spawning bed on the Pierson farm, a lacerated and bleeding lamprey, through whose freshly cut sides

Nos. 5 and 6.—HEADS OF BROOK LAMPREY.

No. 7.—HEAD OF BROOK LAMPREY. (BACK VIEW.)

the eggs were oozing from two holes, and another gash indicated the work of claws that were too sharp to hold their intended victim.

On April 19, 1898, Mr. Spicer, my assistant, shot a little green heron (*Ardea virescens*), in which was found the body of a Brook Lamprey. The tracks of herons and bitterns, as well as of the true shore birds, are very common in the mud along the banks of the stream inhabited by lampreys (see illustration No. 7), and shore birds and waders are common inhabitants of those portions of the stream where the lampreys occur. In Illinois we have been able to determine the abundance of fishes in a pond before seining it by observing the unusual numbers of piscivorous birds to be seen near it. We have found several adult lampreys with cuts or marks that were undoubtedly made by the spear-like bill of the great blue heron (*Ardea herodias*).

Such injuries are not rare in true fishes in regions where this bird abounds. The wound made in fishes by the kingfisher (*Ceryle alcyon*) is similar to that made by the heron, though smaller.

3. *Reptiles.* We have here to chronicle the almost incredible story of snakes eating adult spawning Lake Lampreys. On June 3, 1898, in company with Mr. A. B. Spicer and another assistant, we saw in the water a serpent of unusual diameter. Upon landing it with a dip net we found it to be a large water snake (*Tropidonotus sipedon*), and dissection proved it to contain a large adult female Lake Lamprey full of eggs. It had been swallowed head first, and most of the cephalic portion was already digested. Upon two or three occasions we have known snakes of the species named above to have fed upon lampreys, and we have proven their depredations upon fishes of different species to be very common. In the summer of 1898 we found a water snake several feet from the water of Cayuga Lake with a wriggling bull-head or horned pout (*Ameiurus nebulosus*) in its mouth. In the spring of 1900 we took from the stomach of another a fair-sized brook trout.

[Since the manuscript for this article was prepared Professor Fuertes has killed a water snake at the shore of Cayuga Lake which disgorged an entire lake lamprey. This was in August, and shows that mature lampreys suffer from enemies at other times than when on spawning beds.]

4. *Amphibians* or *Batrachians.* The most nearly direct evidence that we have of this class of vertebrates destroying lampreys in natural conditions, is that a water dog (*Necturus maculatus*) was seen to eat a Brook Lamprey in an aquarium, but the artificial conditions surrounding such an occurrence do not fully justify the inference that such an episode would be likely to occur in unmodified natural surroundings.

5. *Fishes.* Here is published, for the first time, as far as we can learn, the fact that fishes destroy lampreys in great numbers. It is indeed a case where "turn about is fair play," as the lampreys destroy many fishes and the latter have at least some influence in keeping down the numbers of the former. This is chiefly through the agency of minnows in eating the fertilized eggs of lampreys whenever they can find it possible. We have seen scores of schools of minnows (chiefly species of *Rhinichthys* and *Notropis*) lying in wait just below the beds of spawning lampreys, and when the eggs are exuded these minnows dart forward and eat as many of them as possible before the lampreys shall have had time to stir up the sand sufficiently to cover all their spawn. Upon dissecting some of the minnows we have found their stomachs filled with the lampreys' eggs. When lampreys of either species have been removed from their spawning beds, we have often seen many minnows soon busily engaged in the effort to pick up every egg that the current may have uncovered; and we have often determined real fresh spawning beds—the adults perhaps having been removed

by enemies during the night—by the presence of a school of minnows in the fresh beds, while the older beds, with the eggs covered deeper and commencing to hatch, would have no minnows over them. By digging in the sand and determining the stage of development of the eggs or larvæ, it is possible to ascertain how long the beds have been deserted. Although it is well known in some places that young lampreys (often called "Sand Lampers") are excellent bait for certain voracious fishes, yet they are not used much in this region for that purpose; and, although the piscivorous fishes readily take larval lampreys when they can get them, it cannot be said that the larger fishes naturally destroy many lampreys in this stage, as this is manifestly rendered impossible by the habitat of the young marsipobranchs. We have seen a bowfin (*Amia calva*) eat an adult lamprey in an aquarium, but these conditions were too unnatural to justify us in the conclusion that in untrammeled nature fishes destroy adult lampreys. We have never known or heard of a definite example of this.

6. *Fungus.* The attack that attends the end of more lampreys than does any other is that of the fungus (*Saprolegnia* sp.). This looks like a gray slime, and eats into the external parts of the animal, finally causing death. It covers the skin, the fins, the eyes, the gill pouches and all parts, like leprosy. It starts where the lamprey has been scratched or injured or where its mate has held it, and develops very rapidly when the water is warm. It is found late in the season on all lampreys that have spawned out, and it is almost sure to prove fatal, as we have repeatedly seen with attacked fishes or lampreys kept in tanks or aquaria. With choice aquarium fishes a remedy, or at least a palliative, is to be found in immersion in salt water for a few minutes or in bathing the affected parts with listrine. Since these creatures complete the spawning process before the fungoid attack proves serious to the individual, it can be seen that it effects no injury to the race, as the fertilized eggs are left to come to maturity. Also, as it is nature's plan that the adult lampreys die after spawning once, we are convinced that death would ensue without the attack of fungus; and in fact this is to be regarded as a resultant of those causes that produce death rather than the immediate cause of it. Its only natural remedy is to be found in the depths of the lake (450 feet), where there is a uniform or constant temperature of about thirty-nine degrees Fahrenheit, and where the light of the noonday sun penetrates with an intensity only about equal to starlight on land on a clear but moonless night.

As light and heat are essential to the development of the fungus, which is a plant growth and properly called a water-mold, and as their intensity is so greatly diminished in the depth of the lake, it is probable that if creatures thus attacked should reach this depth they might here find relief if their physical condition were otherwise strong enough to recuperate. However, we have recently observed a distinct tendency on the part of fungussed fishes to keep in the shallower, and consequently warmer, parts of the water, and this of course results in the more rapid growth of the sarcophytic plant, and the death of the fishes is thus hastened.

All kinds of fishes and fish eggs are subject to the attacks of such fungus, especially after having been even slightly scratched or injured. As a consequence the lamprey attacks on fishes cause wounds that often become the seat of a slowly spreading, but fatal, fungus. We have seen many nests of the bullhead or horned pout (*Ameiurus nebulosus*) with all the eggs thus destroyed, and we have found scores of fishes of various kinds thus killed or dying. It is well known that in many rivers this is the apparent cause of great mortality among adult salmon. Yet we really doubt if it ever attacks uninjured fishes that are in good, strong physical condition which have not at least had the slime rubbed from them when captured. It is contagious, not only being conveyed from one infested fish to another, but from dead flies to fishes. (For a further discussion of this subject, see the interesting and valuable Manual of Fish Culture, by the United States Fish Commission, 1897.)

Kinds of Fishes Attacked.

We have personally observed, or have received reliable reports of, the following species of fishes being attacked by the Lake Lamprey:

1. Rock or red sturgeon (*Acipenser rubicundus* Le Sueur).
2. Long-nosed gar, gar pike, or gar (*Lepisosteus osseus* Linnæus).
3. Bowfin or dogfish (*Amia calva* Linnæus).
4. Bull-head, horned pout or catfish (*Ameiurus nebulosus* Le Sueur).
5. Common sucker or white sucker (*Catostomus commersonii* Lacépède).
6. Chub sucker or creek fish (*Erimyzon sucetta* Lacépède).
7. Oblong chub sucker (*Erimyzon sucetta oblongus* Mitchill).
8. Mullet or golden sucker (*Moxostoma aureolum* Le Sueur).
9. Large-scaled sucker (*Moxostoma macrolepidotum* Le Sueur).
10. Carp, German carp (*Cyprinus carpio* Linnæus).
11. Golden bream (*Abramis chrysoleucas* Mitchill).
12. Smelt of the New York lakes (*Argyrosomus osmeriformis* H. M. Smith)
13. Cisco, lake herring, chameau (*Argyrosomus artedi* Le Sueur).
14. Whitefish (*Coregonus clupeiformis* Mitchill).
15. Lake trout (*Cristivomer namaycush* Walbaum).
16. Pickerel or eastern pickerel (*Lucius reticulatus* Le Sueur).
17. Pike, also called "pickerel" (*Lucius lucius* Linnæus).
18. Muscalonge or great pike (*Lucius masquinongy* Mitchill).

19. Pumpkin Seed Sunfish (*Eupomotis gibbosus* Linnæus).
20. Rock bass (*Amblopites rupestris* Rafinesque).
21. Small-mouthed black bass (*Micropterus dolomieu* Lacépède).
22. Large-mouthed black bass (*Micropterus salmoides* Lacépède).
23. Wall-eyed pike or sand pike (*Stizostedion vitreum* Mitchill).
24. Northern pike or sand pike (*Stizostedion canadense* Smith).
25. Perch, yellow perch or common perch (*Perca flavescens* Mitchill).
26. White sea bass or striped bass (*Roccus chrysops* Rafinesque).
27. Fresh-water drum, silver perch or sheep-nose (*Aplodinotus grunniens* Rafinesque).
28. Burbot, ling, aleky trout, lawyer (*Lota maculosa* Le Sueur).

It will be seen that this list includes practically all of the fresh-water species of fishes of New York that are large enough to be attacked by this blood-thirsty parasite, and among them are almost all of the desirable food and game fishes of the inland waters of the State. It will be observed that the brook trout* and a few others of streams are not in the above list. This may be due to the fact that the adult lampreys are rare in the streams at the time when they can take food. However, on March 31, this year, we dissected an adult female lamprey with unripe eggs, which was caught on a white sucker some distance up the inlet, and of which the alimentary canal was yet large and functional and filled with the blood of its victim.

The fishes that are mostly attacked are of the soft-rayed species, having cycloid scales; the spiny-rayed species with ctenoid scales being most nearly immune from their attacks. We think there may be three reasons for this: 1st, the fishes of the latter group are generally more alert and more active than those of the former, and may be able to more readily dart away from such enemies; 2d, their scales are thicker and stronger and appear to be more firmly imbedded in the skin, consequently it is more difficult for the lampreys to hold on and cut through the heavier coat of mail to obtain the blood of the victim; 3d, since the fishes of the second group are wholly carnivorous, and in fact almost exclusively fish-eating when adult, in every body of water they are more rare than those of the first group, which are more nearly omnivorous. According to the laws and requirements of nature, the fishes of the first group must be more abundant, as they become the food for those of the second, and it is on account of their greater abundance that the lamprey attacks on them are more observed.

There is no doubt that the bull-head or horned pout (*Ameiurus nebulosus*) is by far the greatest sufferer from lamprey attacks in Cayuga Lake. This may be due in part to

* Since this manuscript was prepared Mr. Charles Carr, of Union Springs, N. Y., has reported to us an unquestionable instance of the brook trout (*Salmo fontinalis*) having been attacked by a lamprey; and Mr. Perry, of Ithaca, showed us a rainbow trout (*Salmo irideus*), in Cayuga Lake, killed by a lamprey.—H. A. S.

the sluggish habits of the fish, which render it an easy victim, but it is more likely due to the fact that this fish has no scales and the lamprey has nothing to do but to pierce the thick skin and find its feast of blood ready for it. There is no doubt of the excellency of the bullhead as a food fish and of its increasing favor with mankind. It is at present the most important food and market fish in the central part of the State, being caught by bushels in the early part of June when preparing to spawn. As we have observed at times more than ninety per cent. of the catch attacked by lampreys, it can readily be seen how very serious are the attacks of this terrible parasite which is surely devastating our lakes and streams.

The white sucker (*Catostomus commersonii*) is surely next in line in order of lamprey attacks. We have seen nearly eighty per cent. of the catch of fishes of this species attacked by lampreys, and although we would not consider them desirable fish, there is always a ready sale for them at a fair price. However, we must admit that we believe the removal of the suckers and carp from all waters of the State would be attended with very general good results for fishes of other species, on account of the great number of eggs of better fishes destroyed by the Catostomids and Cyprinids.

The lake trout (*Cristivomer namaycush*) is one of our very best food and game fishes very seriously attacked by lampreys. We have rarely seen a lake trout that did not bear two or more marks of this fish foe, and we have seen several with as many as eight or ten of these characteristic scars. Last October we counted twenty-three lamprey scars upon the body of one lake trout, of which several were fresh. Where such attacks do not prove fatal the drain upon the system of the fish must greatly impair its vitality and limit or reduce its reproductive ability. We feel certain that if it were not for the ravages of lampreys the lake trout would be much more abundant in this lake than it is, as its natural food—the ale-wife or saw-belly (*Clupea pseudo-harengus*)—is here in such great abundance that in the spring time when they come from the deep cold water into that which is shallow and warm the increased temperature and consequent lessened supply of dissolved air kill them by thousands and thousands.

Of course our fresh-water American fish with heaviest armor is the gar or bill-fish, and the only place where we have seen a lamprey able to successfully attack this obnoxious ganoid is just behind one of the paired fins. It might be added that this is a favorite spot for attacking many fishes, as the parasite seems to realize that here the scales are thinnest. Fortunately the gar is very rare in Cayuga Lake, although it seems to be increasing in numbers. It is the curse of Chautauqua and Black lakes, being there the destructive fish foe equal to the lamprey here. We have demonstrated that it is possible to remove gars and not injure other fishes by stretching gill nets of one inch square mesh across their spawning places in May and June.

No. 8.—WHERE THE BROOK LAMPREYS SPAWN.

The attacks of the bowfin (*Amia calva*) are also infrequent, but are generally made, as described above, just back of one of the paired fins. This is another voracious fish that is worthless to mankind, excepting as a water scavenger, and it is increasing rapidly in the waters of this State. If the lamprey would attack none but the gars, suckers, and bowfins, it would be well, for the interests of man, to protect it and aid its increase.

Although the perch (*Perca flavescens*) and black bass (chiefly the small-mouth) are fairly abundant in Cayuga Lake, they are not often found injured. They of course belong to the second group of fishes (*Acanthopteri*) named above, and the probable reasons for their immunity from attacks are given there. Of the hundreds of perch which we have seen taken from this lake not more than three or four bore distinct and characteristic scars from the fish parasite. Hon. D. F. Van Fleet, of Ithaca, has caught a black bass with a lamprey clinging to it, and two or three others have been as definitely reported, while one was recently collected by us.

The several dams without fishways in the Seneca and Oswego rivers now prevent many anadromous fishes that were formerly abundant here from coming into the interior lakes of this State. Among these are the salmon and white fish, both of which were very abundant here before the river was obstructed, the wall-eyed pike, mascalonge, cisco and others which are now found in Lake Ontario and adjacent waters, but do not often occur here. Owing to the exclusion of these fishes from the Cayuga Lake basin during the recent years that we have studied the subject, we cannot personally testify to having found them attacked by lampreys, but the evidence of old residents upon this subject is so unquestionable and unanimous that we have unhesitatingly added the above-named species to the list of those attacked.

We know of a sturgeon having been caught with six lampreys clinging to it, and it is reported that some years ago, a Captain Van Order caught one with twenty-one lampreys (perhaps lamprey scars) on it. Although we have caught lampreys on fishes at all times of the year, there is no doubt that the period of most severe attacks is during the latter part of winter and early spring (February and March). This season of feasting may be to strengthen them for the long period of fasting during the period of migration and spawning. In short, it appears to be their last opportunity to eat, and they improve it. When a lamprey attacks a fish it at once attaches to it by suction, the fleshy edge of the circular mouth being especially fitted for this. It then commences, by a slightly swaying or oscillatory and circular movement, to cut away the scales and skin under its mouth, using its one hundred and fifty teeth as rasps in this process. This makes the characteristic circular scar the size and shape of the mouth, which is usually about as large as a quarter of a dollar. The tongue is also used as a rasp, and the four sets of teeth on it are arranged in crescents, which come together somewhat after the manner of the toothed jaws of a steel trap. Such an arrangement is especially effective in working the center of the wound deeper. The teeth are placed in such a circular radial position (see illustration of mouth of Lake Lamprey) that all solid parts (skin, scales, flesh, etc.) are worked to the center of the mouth and then ventrad or downward and out at the ventral margin. Since the lamprey swallows no solids whatever, it is essential that they should have some such provision for the elimination of the waste material or solids which result from tearing through their victims.

We have often seen wounds which completely penetrated the body cavity, and through which the internal organs had been attacked. Wounds are shown piercing the heart in the third and fifth specimens from the left in the illustration of "Eight Bullheads," and from the second and sixth specimens of the same illustration the intestines were protruding when collected and photographed. We had a specimen in which the stomach was pierced, and in an aquarium all the food given it escaped through the orifice in its side. The fact that bullheads are dressed before being exposed for sale enables thousands of pounds of them to be retailed which would not otherwise find purchasers. The great festering sores in the flesh of the fishes as they come from the water render them so repulsive in appearance that no one would want to purchase them in that condition, but when the fish are dressed such wounds are not conspicuous.

A fish that has been attacked by a lamprey, if not killed at once, becomes bloodless, thin, pale and colorless both as to skin and flesh, and insipid to the taste. Naturally a strong, healthy fish has a rich golden tinge, but when attacked by a lamprey its color and appearance are so altered that we have been able to readily identify those that were injured, while yet alive, by merely observing them, after an assistant had spread the entire catch on the bank and turned the sides bearing the scars downward so that no marks would be visible. It is true that the wounds often become healed, but scars remain, and with the scale-bearing fishes these wounds are generally quite conspicuous on account of the very irregular arrangement of the scales that grow over them. If the attacks do not prove directly fatal they generally become the sites for the sarcophagus fungus to start, and from this cause death may soon ensue during any time of the year when the water is warm; or they weaken the fish and destroy its vitality, reducing its reproductive capabilities and often preventing it altogether from reproducing. Also, by the removal of the blood the flesh is left white and insipid or tasteless and really unfit food for man.

Our collecting records show that at the height of the feeding season fully eighty-four per cent. of all fishes that are large enough are thus injured. We have no doubt that in this region the lampreys destroy more fish than do all the other enemies of fish or all of the fishermen combined.

Migration or "Running."

After thus feeding to an unusual extent, their reproductive elements (gonads) become mature and their alimentary canals commence to atrophy. This duct finally becomes so occluded that from formerly being large enough to admit a lead pencil of average size when forced through it, later not even liquids can pass through, and it becomes merely a thread closely surrounded by the crowding reproductive organs. When these changes commence to ensue, the lampreys turn their heads against the current and set out on their long journeys to the sites that are favorable to spawning, which here may be from two to eight miles from the lake. In this migration they are true to their instincts and habits of laziness in being carried about, as they make use of any available object, such as a fish, boat, etc., that is going in their direction, fastening to it with their suctorial mouths and being borne along at their ease. During this season it is not infrequent that as the Cornell crews come in from practice and lift their shells out of the water, they find lampreys clinging to the bottoms of the boats. Mr. H. Carr, former State Game Protector, at Union Springs, N. Y., recently told us that as many as fifty lampreys had been seen at one time clinging to the side of his yacht as he sailed toward the head of the lake in the spring time, but they would drop off when he turned to come down the lake. They are likely to crowd up all streams flowing into the lake, inspecting the bed of the stream as they go. They do not stop until they reach favorable spawning sites (described later), and if they find unsurmountable obstacles in their way, such as vertical falls or dams, they turn around and go down stream until they find another, up which they go. This is proven every spring by the numbers of adult lampreys that are temporarily seen in Fall Creek and Cascadilla Creek. In each of these streams, about a mile from its mouth, there is a vertical fall over thirty feet in height which the lampreys cannot surmount, and in fact they have never been seen attempting to do so. After clinging with their mouths to the stones near the foot of the falls for a few days, they work their way down stream, carefully inspecting all the bottom for suitable spawning sites. They do not spawn in these streams because there are too many rocks and no sand (see "Requisite Conditions for Spawning"), but finally enter the only stream (the inlet) in which they find suitable and accessible spawning sites.

The three-toothed lampreys of the West Coast climb low falls or rapids by a series of leaps, holding with their mouths to rest, then jumping and striking again and holding, thus leap by leap gaining the entire distance. (see illustration No. 15, the reproduction of Dr. Smith's photograph of three-toothed lampreys climbing falls, and his interesting article in the *Scientific American* for April, 1900.) The lampreys here have never been known to show any tendency or ability to climb, probably because there are no rapids or mere low falls in the streams up which they would run. In fact, as the inlet is the only stream entering into Cayuga Lake in this region which presents suitable spawning conditions and no obstructions, it can be seen at once that all the lampreys must spawn in this stream and its tributaries.

In "running" they move almost entirely at night, and if they do not reach a suitable spawning site by daylight they will cling to roots or stones during the day and complete their journey the next night. This has been proven by the positive observation of individuals. Of the specimens that run up early in the season, about four fifths are males. Thus the males do not exactly precede the females, because we have found the latter sex represented in the stream as early in the season as the former, but in the earlier part of the season the number of males certainly greatly predominates. This proportion of males gradually decreases, until in the middle of the spawning season the sexes are about equally represented, and toward the latter part of the season the females continue to come until they in turn show the greater numbers. (See tables of weir catch, given later.) Thus it appears very evident that in general the reproductive instinct impels the most of the males to seek the spawning grounds before the most of the females do so. However, it should be said that neither the males nor the females show all of the entirely sexually mature features when they first run up streams at the beginning of the season, but later they are perfectly mature and "ripe" in every regard when they first appear in the stream. When they migrate they stop at the site that seems to suit their fancy, many stopping near the lake, others pushing on four or five miles further up stream. We have noted, however, that later in the season the lower courses become more crowded, showing that the late comers do not appear to attempt to push up the stream as far as those that came earlier. Also, it thus follows from what was just said about late running females, that in the latter part of the season the lower spawning beds are especially crowded with females. In fact, during the early part of the month of June we have found, not more than half a mile above the lowest spawning bed, as many as five females on a spawning nest with but one male; and in that immediate vicinity many nests indeed were found at that time with two or three females and but one male.

Having arrived at a riffle or shoal which seems to present suitable conditions for a spawning nest, the individual (or pair) commences at once to move stones with its mouth from the center to the margin of an area one or two feet in diameter. When many stones are thus placed, especially at the upper edge, and they are cleaned quite free of sediment and algæ, both by being moved and by being fanned with the tail, and when the proper condition of sand is found in the bottom of the basin thus formed, it is ready to be used as a spawning bed or nest. A great many nests are commenced and

No. 9.—WHERE THE BROOK LAMPREYS SPAWN.

deserted. This has been left as a mystery in publications on the subject, but we are well convinced that it is because the lampreys do not find the requisites or proper conditions of bottom (rocks, sand, etc., as given below) to supply all their needs and fulfill all conditions for ideal sites. In the illustration of the spawning sites of the Lake Lamprey (see illustration No. 10) the stakes without papers were placed in nests that were never completed or used. This desertion of half-constructed nests is just what would be expected and anticipated in connection with the explanation of "Requisite Conditions for Spawning," given below, because some shallows contain more sand and fewer stones, and others contain many larger stones but no sand, while others contain pebbles lying over either rocks or sand. The lampreys remove some of the material and if they do not find all the essentials for a spawning nest, the site is deserted and the creatures move on.

Requisite Conditions for Spawning.

For a spawning site two conditions are immediately essential—proper conditions of water and suitable stream bed or bottom. Of course with these it is essential that no impassable barriers (dam or falls) exist between the lake and the spawning sites to prevent migration at the proper "running" season. They will not spawn where there is no sand lying on the bottom between the rocks, as sand is essential in covering the eggs (see remarks on the "Spawning Process"); neither will they spawn where the bottom is all sand and small gravel, as they cannot take hold of this material with their mouths to construct nests or hold themselves in the current, and they would not find here pebbles and stones to carry over the nest while spawning, as described elsewhere. It can thus be seen that, as suggested above, the reason they do not spawn in Fall Creek and Cascadilla Creek, between the lake and the falls, is that the beds of these streams are very rocky, being covered only with large stones and no sand. There is no doubt that the lampreys find here suitable conditions of water, but they do not remain to spawn, on account of the absence of the proper conditions of stream bed. Again, they do not spawn in the lower course of the inlet for a distance of nearly two miles from the lake, because near the lake the bed of the stream is composed of silt, while for some distance above this (up stream) there is nothing but sand. Farther up stream are found pebbles and stones commingled with sand, which combination satisfies the demands of the lampreys for material in constructing nests and covering eggs. The accessibility of these sites, together with their suitable conditions, render the inlet the great and perhaps the only spawning stream of the lake; and, doubtless, all the mature lampreys come here to spawn, excepting a few which spawn in the lower part of Six-mile Creek, a tributary of the inlet.

As the course of the stream where the beds abound is divided into pools, separated by stony riffles or shallows, the nests must be made at the ends of the pools. Of the spawning beds personally observed during several seasons, nine tenths of the entire number were formed just above the shallows (at the lower ends of the pools), while only a few were placed below them (see illustrations Nos. 8, 9, and 10). An advantage in forming the nest above the shoals rather than below is that in the former place the water runs more swiftly over the lower and middle parts of such a bed than at its upper margin, since the velocity decreases in either direction from the steeper part of the shallows; and any organic material or sediment that would wash over the upper edge of the nest is thus carried on rather than left as a deposit. When formed below the shallows, owing to the decreased velocity at the lower part of the nest compared with that at the upper, the sediment is likely to settle in the hollow of the nest, and, through the process of decay of the organic material, prove disastrous or unfavorable for the developing embryos.

The necessity of sand in the spawning bed indicates the explanation of why we see so many shallows that have no spawning lampreys upon them, while there are others in the same vicinity that are crowded. There will be no nests formed if there is too little or too much sand, not enough or too many stones, or stones that are all too small or all too large. The stones must vary from the size of an egg to the size of a man's hand, and must be intermingled with sand without mud or rubbish.

The lampreys choose to make their spawning nests just where the water flows so swiftly that it will carry the sand a short distance, but will not sweep it out of the nest. This condition furnishes not only force to wash the sand over the eggs when laid, but also keeps the adult lampreys supplied with an abundance of fresh water containing the dissolved air needed for their very rapid respiration. Of course, in such rapid water the eggs are likely to be carried away down stream, but Nature provides against this by the fact that they are adhesive, and the mating lampreys stir up the sand with their tails, thus weighting down the freshly laid eggs and holding them in the nest. Hence the necessity of an abundance of sand at the spawning site.

Description of Spawning Lampreys.

The mature spawning lampreys (see illustration No. 1, *a* and *b*) differ not only internally but also externally from those that remain in the lake and are adult but not sexually mature. All of the former of both sexes have a conspicuous swelling or œdema at the base of the dorsal fin. This swelling is always present in both sexes when they first swim up stream to their spawning grounds, and it is the only constant external feature that characterizes the sexually mature lampreys of both sexes at all parts of the running and spawning season. In their internal features they agree at this time in the atrophy of the alimentary canal, the very extraordinary development of the organs of reproduction (ovaries and testes), and in the cessation of feeding and digestion. It is singularly interesting that the alimentary canal becomes so constricted that nothing whatever can pass through it, and even the katabolic or waste products cannot pass out. The atrophy commences at the posterior part of the alimentary canal and continues forward until the entire tract is but a mere thread.

Although at first the liver presents the ordinary normal color of that organ, it soon becomes greenish, and later turns as green as grass. This is due to the prevention of the exit of the bile by the occlusion of its duct. The green substance and color soon spread to the flesh, which finally becomes entirely greenish. We believe that if it is eaten in quantities at this time it would prove poisonous, and we offer this as an explanation of the death of one of the kings of England from eating lampreys. By the time that the liver has become green (often sooner) both sexes of this species of lamprey present external features that are characteristic of complete reproductive ripeness. The males have a dorsal ridge extending from the gill openings or branchiopores to the second dorsal fin, and giving the two dorsal fins the appearance of being connected at this time. This becomes so conspicuous that one can readily distinguish the males while on their nests without disturbing them. At the time of running many do not have this ridge, but later in the season it is exhibited by all male specimens. The females do not have the dorsal ridge, but sooner or later they all exhibit a fold of the skin from the vent to the true caudal fin. This anal fin which characterizes the females may not be present in the specimens running early. It has no rays, and appears to be but a fleshy fold of the skin. At this time the male can also be readily recognized upon close examination by the protruding genital papilla, as shown in the illustration.

Color of Spawning Lampreys.

Bright colors, which are conspicuous in some parts of the stream, are also characteristic of the strongest and most mature lampreys. No creature that lives in the water is more somber and inconspicuous in coloration than the lamprey during ordinary seasons. While the larval lamprey is yellowish and pinkish white, the ordinary adult feeding lamprey is dark above and light to dusky beneath, with or without darker or lighter mottlings above. However, it is the spawning lamprey, in its height of perfection and vigor, which presents a coloration of comparatively bright yellowish or reddish, varying from lemon yellow to orange, russet, fuscous or rufous, mottled with dark or light spots. A remarkable feature about this is that all spawning lampreys are not highly colored, and the coloration presents no regular characteristic or diagnostic attribute of sex, season, or condition. All that can definitely be said is that representatives of either sex may or may not be thus highly colored, and after having carefully watched them for some consecutive years, we are prepared to say that a greater number of males than females regularly possess this coloration, and in the early part of the season there is a much larger percentage that is highly colored than later. Nearly all that run early are well colored, while the percentage of those of somber or dark appearance gradually increases until the end of the season. This may be due to the fact that the coloration is most marked in the largest and most vigorous specimens of each sex — although there may be seen many very large individuals of either sex that are not highly colored — and the individuals with greatest vitality are those that first mature and run up to spawn. This is but an example of a law of all organisms. The most perfect blossoms expand first and exhibit the brightest colors; the finest fruits ripen earlier than those that are less perfect, even on the same tree, and have the brightest colors and best flavors; the most vigorous animals of any kind are the first to arrive at complete maturity, and they are the individuals that present the best colors and finest appearance.

We know of no kind of animal of which the individual representatives exhibit such widely differing coloration when at the same stage of reproductive maturity as do those of the Lake Lamprey. It is so marked, with such absence of intergrading forms, that it almost amounts to a dichroism, such as is seen in the screech owl. In the same nest there may be found mating lampreys, either sex of which may present the high coloration while the other may not; or they may both be rufous or both very dark or quite somber. The larger individuals are very likely to be colored, while the smaller ones are very rarely so. Toward the end of the spawning season the color gradually fades out. It has not been found to especially predominate in either sex, and during the past four years it certainly has not shown any tendency to alternate in accordance with the sex of the lamprey.

What ends of the creature can be served by this rufous coloration? This has been asked, but not answered. We believe it to be protective coloration, especially when lampreys swim over the bottom that is covered with brown algæ and iron rust, as is most of the bed of the stream. Their color is such that as they lie upon the kind of a bottom mentioned it is almost impossible for even a careful observer to discover them, and a glint of sunshine, broken by the rippling waters, renders them especially inconspicuous. While the darker or more somber-hued individuals do not thus blend with the color of the undisturbed bottom, they in turn are less conspicuous while in the nests, which are darker than the undisturbed stones. We have observed highly colored individuals, when pursued, leaving their nests, and later returning and clinging to the reddish brown stones in the bed of the channel near them.

No. 10.—WHERE THE LAKE LAMPREYS SPAWN.

An Albino Lamprey.

One of the most interesting discoveries that we made in connection with our lamprey investigations of 1899 was a genuine Albino Lamprey. This was an adult male Lake Lamprey (*Petromyzon marinus unicolor*). It was found on a spawning nest with a dark rufous female, on the Pierson farm, near the white schoolhouse, about three miles southwest of Ithaca, on the afternoon of May 26. The general color of this unique specimen was pinkish cream, with decidedly pink eyes, and considerable pink to red showing in the dorsal ridge, especially in the œdema at the base of the dorsal fin. This plainly indicated the congested condition of the capillaries in the dorsal ridge and especially in the œdema.

When we found this unusually interesting specimen, we had with us no apparatus for keeping it alive, and being impressed with the desirability of preserving it for photographs, we left it until we could return with a suitable vessel for transporting it alive. It is impossible to chronicle the regret with which we learned, upon returning to this site, that the Albino Lamprey had disappeared forever. The most careful search along the entire Inlet failed to reveal its presence. Some large footprints of a bird and the marks of a wing stroke in the sand told the probable story of its removal by a bird of prey—perhaps an owl.

The Size of Spawning Lake Lampreys.

The spawning Lake Lampreys vary greatly in size. While the largest may be twenty inches in length, the shortest may be not half that long, and those of the largest size may be three times as heavy as the smallest. It may be said that in general the larger individuals run up stream before the smaller ones; but we have collected some very large lampreys as late as the middle of June, and they were the last to be found. We have also collected some of but medium size early in the season. It appears that there is less range or extreme variation in the sizes of the males than of the females; although any certain size is no constant feature or indication of sex whatever. Upon the same spawning nest may often be found a very large male with a very small female, or vice versa, or an approach at equality in size. The Brook Lampreys do not exhibit the bright rufous colors or the great variations in size that are shown by the Lake Lampreys.

The Spawning Process.

There is much of interest in the study of the spawning process, as it is for the maintenance of the race that the lampreys risk and end their lives; and as they are by far the lowest forms of vertebrates found within the United States, a consideration of their actions and apparent evidences of instinct becomes of unusual attraction. Let us consider one of those numerous examples in which the male migrates before the female. When he comes to that portion of the stream where the conditions named above are favorable, he commences to form a nest by moving and clearing stones, and making a basin with a sandy bottom about the size of a common washbowl. Several nests may be started and deserted before perfect conditions are found for the completion of one. The male may be joined by a female either before or after the nest is completed. There is at once harmony in the family; but if another male should attempt to intrude, either before or after the coming of the female, he is likely to be summarily dealt with and dismissed at once by the first tenant. As soon as the female arrives she, too, commences to move pebbles and stones with her mouth.

Sometimes the nest is made large enough to contain several pairs, or often unequal numbers of males and females; or they may be constructed so closely together as to form one continuous ditch across the stream, just above the shallows. Many stones are left at the sides and especially at the upper margin of the nest, and to these both lampreys often cling for a few minutes as though to rest. While the female is thus quiet, the male seizes her with his mouth at the back of her head, clinging as to a fish. He presses his body as tightly as possible against her side, and loops his tail over her near the vent and down against the opposite side of her body so tightly that the sand, accidentally coming between them, often wears the skin entirely off of either or both at the place of closest contact. (This is plainly illustrated at the side of the tail of the male Lake Lamprey, shown as No. 1*a* in this article. For an illustration of the positions of the sexes at the instant of spawning, see the picture of the pair in the upper right corner of "Brook Lampreys on Spawning Nest.") In most observed instances the male pressed against the right side of the female, although there is no unvarying rule as to position. The pressure of the male thus aids to force the eggs from the body of the female, which flow very easily when ripe. The vents of the two lampreys are thus brought into close proximity, and the conspicuous genital papilla of the male (plainly shown in the illustration) serves to guide the milt directly to the issuing spawn. There appears to be no true intromission, although definite observation of this feature is quite difficult and, in fact, impossible. During the time of actual pairing, which lasts but a few seconds, both members of the pair exhibit tremendous excitement, shaking their bodies in rapid vibrations, and stirring up such a cloud of sand with their tails that their eggs are at once concealed and covered. As the eggs are adhesive and non-buoyant, the sand that is stirred up adheres to them immediately, and covers most of them before the school of minnows in waiting just below the nest can dart through the water and regale themselves upon the eggs of these enemies of their race; but woe to the eggs that are not at once concealed. We would suggest that the function of the characteristic anal fin, which is possessed only by the female, and only at this time of year, may be to aid in this vastly important process of stirring up the sand as the eggs are expelled; and the explanation of the absence of such a fin from the ventral side of the tail of the male may be found in the fact that it could not be used for the same purpose at the instant when most needed, since the male is just then using his tail as a clasping organ to give him an essential position in pairing. As soon as they shake together they commence to move stones from one part of the nest to another, to bring more loose sand down over their eggs. They work at this from one to five minutes, then shake again; thus making the intervals between mating from one to five minutes, with a general average of about three and one half minutes.

Although their work of moving stones does not appear to be systematic in reference to the placing of the pebbles, or as viewed from the standpoint of man, it does not need to be so in order to perfectly fulfill all the purposes of the lampreys. As shown above in the remarks on the spawning habits of the Brook Lampreys, the important end which they thus accomplish is the loosening and shifting of the sand to cover their eggs; and the more the stones are moved, even in an apparently indiscriminate manner shown, the better is this purpose achieved. Yet, in general, they ultimately accomplish the feat of moving to the lower side of the nest all the stones they have placed or left at the upper margin. At the close of the spawning season, when the nest is seen with no large pebbles at its upper side, but quite a pile of stones below, it can be known that the former occupants completed their spawning process there; but if many small stones are left at the upper edge and at the sides, and a large pile is not formed at the lower edge, it can be known that the nest was forsaken or the lampreys removed before the spawning process was completed. The stones they move are often twice as heavy as themselves, and are sometimes even three or four times as heavy. Since they are not attempting to build a stone wall of heavy material, there is no occasion for their joining forces to remove stones of extraordinary size, and they rarely do so, although once during the past spring (1900) we saw two Lake Lampreys carrying the same large stone down stream across their nest. This was at the spot which we had photographed a few weeks earlier, and here reproduce as Nos. 8 and 9. Although this place was occupied by scores of Brook Lampreys, there were but three pairs of Lake Lampreys seen here. It is true that one of these creatures often moves the same stone several times, and may even attempt many times to move a stone that has already been found too heavy for it; but sooner or later the rock may become undermined so the water will aid them, and they have no way of knowing what they can do under such circumstances until they try. If this were to be likened to a quality of the human mind, it could as well be called perseverance as forgetfulness. Also, the repeated moving of one stone may subserve the same purpose for the lamprey in covering its eggs with sand as would the less frequent removal of many.

When disturbed on the spawning nest, either of the pair will return to the same nest if its mate is to be found there; but if its mate is at another place, it will go to it, and if its mate is removed or killed, it is likely to go to any part of the stream to another nest. When disturbed, they often start up stream for a short distance, but soon dart down stream with a velocity that is almost incredible. They can swim faster than the true fishes, and after they get a start are generally pretty sure to make good their escape, although we have seen them dart so wildly and frantically down stream that they would shoot clear out on the bank, and become an easy victim of the collector. This peculiar kind of circumstance is most likely to happen with those lampreys that are becoming blinded from long exposure to the bright light over the clear running water. If there is a solitary individual on a nest when disturbed, it may not return to that nest, but to any that has been started, or it may stay in the deep pool below the shallows until evening, and then move some distance up stream. When the nest is large and occupied by several individuals, those that are disturbed may return to any other such nest. We have never seen any evidence of one female driving another female out of a spawning nest; and from the great number of nests in which we have found the numbers of the females exceeding those of the males, we would be led to infer that the former live together in greater harmony than do the males.

Under the subject of the number of eggs laid, we should have said that at one shake a female spawns from twenty to forty. We once caught in fine gauze twenty-eight eggs from a female at one spawning instant. In accordance with the frequency of spawning stated, and the number of eggs contained in the body of one female, the entire length of time given to the spawning process would be from two to four days. This agrees with the observed facts, although the lampreys spend much time in moving stones and thoroughly covering the nests with sand. Even after the work of spawning and moving stones is entirely completed, they remain clinging to rocks in various parts of the stream, until they are weakened by fungus and general debility, when they gradually drift down stream.

In forming nests, there is a distinct tendency to especially utilize those sites that are concealed by overhanging bushes, branches, fallen tree tops, or grass or weeds,

No. 11.—WHERE THE YOUNG LAMPREYS LIVE AND THE OLD LAMPREYS DIE.

probably not only for concealment, but also to avoid the bright sunlight, which sooner or later causes them to go blind, as it does many fishes when they have to live in waters without shade. Toward the end of the spawning season, it is very common to see blind lampreys clinging helplessly to any rocks on the bottom, quite unable to again find spawning beds. However, at such times they are generally spent, and merely awaiting the inevitable end.

As with the Brook Lamprey, the time of spawning and duration of the nesting period depend upon the temperature of the water, as does also the duration of the period of hatching or development of the embryo. They first run up stream when the water reaches a temperature of forty-five or forty-eight degrees Fahrenheit, and commence spawning at about fifty degrees. Note, in the following table, how a rise in temperature is accompanied by an increase of the numbers migrating during the early part of the season. A temperature of sixty degrees finds the spawning process in its height, and at seventy degrees it is fairly completed. It is thus that the rapidity with which the water becomes heated generally determines the length of time the lampreys remain in the stream. This may continue later in the season for those that run later, but usually it is about a month or six weeks from the time the first of this species is seen on a spawning nest until the last is gone.

What Becomes of Them After Spawning!

There has been much conjecture as to the final end of the lampreys, some writers contending that they die after spawning, others that they return to deep water and recuperate; and yet others compromise these two widely divergent views by saying that some die and others do not. The fact is that the spawning process completely wears out the lampreys, and leaves them in a physical condition from which they could never recover. They become stone blind; the alimentary canal suffers complete atrophy; their flesh becomes very green, from the katabolic products, which find the natural outlet occluded; they lose their rich yellow color and plump, symmetrical appearance; their skin becomes torn, scratched and worn off in many places, so that they are covered with sores, and they become covered with a parasitic or sarcophytic fungus, which forms a dense mat over almost their entire bodies, and they are so completely debilitated and worn out that recovery is entirely out of the question. What is more is that the most careful microscopical examinations of ovaries and testes have failed to reveal any evidence of any new gonads or reproductive bodies. This is proof that reproduction could not again ensue without a practical rebuilding of the animals, even though they should regain their vitality. A. Mueller, in 1865, showed that all the ova in the lamprey were of the same size, and that after spawning no small reproductive bodies remained to be developed later. This is strong evidence of death after once spawning.

One author writes that an argument against the theory of their dying after spawning can be found in the fact that so few dead ones have been found by him. However, many can be found dead if the investigator only knows where and how to look for them. We should not anticipate finding them in water that is shallow enough for the bottom to be plainly seen, as there the current is strong enough to move them. It is in the deep, quiet pools, where sediment is depositing, that the dead lampreys are dropped by the running water, and there they sink into the soft ooze. Such a place as this is shown in Illustration No. 12, just in line with the lower part of the fork of the Y-shaped stick. It is from this spot that we dipped the pail full of *débris:* young lampreys, dead lampreys, and dead fish shown in Illustration No. 13. Here we found, later, five dead lampreys and three dead fishes. By carefully searching in the proper, inconspicuous places, with suitable apparatus, we have found scores of dead lampreys. However, as their bodies are very soft and boneless, and their flesh decays quite soon, their remains would not long keep in any place.

On the 8th of June we killed one hundred lampreys, and marked them by cutting off their heads. They were then dropped in the shallow waters of the spawning beds, in various stretches of the stream. On the following morning only six were to be found in the stream, after a careful inspection from the shore, and the next day only two were visible, although several unmarked lampreys were found dead. This shows what a very small percentage of those that have recently died we should expect to see, and also that the absence of great numbers of dead lampreys from visible portions of the streams cannot be regarded as important evidence against the argument that they die soon after spawning once. In the weir that we maintained in 1898, a number of old, worn-out and fungussed lampreys were caught drifting down stream; some were dead, some alive, and others dying and already insensible, but none were seen going down that appeared to be in condition to possibly regain their strength.

Structures and Origin.

There are many peculiar and interesting structural features shown in the lampreys, but these belong to the subject of their anatomy, which we cannot take time and space to discuss in the present article. Besides, we have aimed to deal here mostly with the unfamiliar or formerly unknown features of their habits or life histories, and with those points that are of greatest importance in connection with their economic effects, which might throw light upon methods of their removal. However, attention should be called to the single median nostril, and the pineal body, supposed to represent a degenerate third eye, shown in Illustration No. 7; also to the sense organ, in the enlarged picture, No. 6. A comparison of the arrangement and development of the teeth in the two species, as shown in Nos. 3 and 5, shows that the teeth of the Brook Lamprey are rudimentary in comparison with those of the Lake Lamprey, but it does not indicate that the latter has reached a further stage of development than the former. The fact is that the Brook Lamprey has developed far beyond the present stage of the Lake Lamprey, and instead of the teeth of the former being but rudiments to indicate what is to appear, they are vestiges of what has been. Thus the smaller species is an example of the anomalous condition of having degenerated from a parasitic life and condition to a free and independent life, and has suffered atrophy of organs in accordance. All evidences indicate that the Brook Lamprey has descended from a true parasitic form similar to the Lake Lamprey at present, while the latter has reached its present form through having been landlocked, and consequently considerably modified in comparison with the present Marine Lamprey (*Petromyzon marinus* L.). The modifications consist chiefly of a reduction in size and an alteration (darkening) of color. Such changes are often seen in the true fishes when they become landlocked from the marine forms, and learn to live permanently in the fresh (sweet) waters. Such changes are seen in the ouninanche, or landlocked salmon, and even in the alewife, or sawbelly (*Pomolobus pseudoharengus*), of our own lake. Our Lake Lamprey, like these fishes, is a descendant of a true anadromous marine form, and has learned to live throughout the entire year in inland waters without returning to the sea; but, like them, in so doing, it has undergone changes, in consequence of which systematic zoologists place it as but a variety of the ancestral species. There is no doubt that the Lake Lamprey is the descendant of the Marine Lamprey (*Petromyzon marinus*), which is abundantly found at present on both sides of the Atlantic Ocean, and far up the streams that flow into it. It occurs in numbers in the Susquehanna River, within twenty miles of the Cayuga Lake basin. There is all evidence needed to establish the belief that the drainage from the latter region was once southward through the river named, and this is doubtless the route, rather than through Lake Ontario, by which the objectionable fish parasites came into these waters. Even at the present time there is a plateau swamp near the village of Dryden, in Tompkins county, which is so situated and connected that at one end the water flows toward the northwest, into Cayuga Lake, and at the other end it flows toward the southeast, into the Susquehanna River. In the stream between this swamp and Cayuga Lake there is to be found a certain species of fish (*Semotilus corporalis*), the fall fish or corporal, which is peculiar to the southeastern fauna. If one fish or fish-like creature is able to come over the divide by this route, another should be able to do likewise.

Practical Efforts at Extermination.

When the full life history of any animal is as well known as is that of the lamprey, as given above, mankind is in position to take practical measures for either its cultivation or repression. There is no animal or plant that cannot be made to either increase or decrease by the intelligent effort of man. Each has its weak point at which it must be assailed to exterminate it, or during which time it should be given especial help or protection to lead to its increase. However, if this vital period is not known, it is impossible to suggest practical measures that will prove effective. Hence, to make fishes more abundant in our State, it is essential that we should have greater knowledge not only of them, but also of all their enemies.

Practical fish farming is the most neglected of all possible important industries of man, and there is no single jurisdiction on earth that is as well provided by Nature for the development of this promising resource as is the State of New York, with all her many fine bodies of pure and fresh water. Yet it is unfortunate that little besides the so-called "fish culture" of hatcheries and the planting of young has been done in this State. Illinois, Indiana, and other western States are leading at present in practical investigations along this line. Notwithstanding the good work of several hatcheries, we cannot expect to have fish abundant in this State while the young that are thus produced are turned loose to starve in barren waters, where intelligent efforts might make their food abundant, and while the nature of the food and needs of the young fish are not known, and while in the waters there remain to multiply unmolested such serious enemies of our best fish as we have just shown the lampreys to be.

No person who has any knowledge of this subject realizes this more fully than does Hon. A. N. Cheney, the able State Fish Culturist of the State of New York, and it is due to his efforts, combined with those of the writer and other interested persons at Cornell University, and especially Senator E. C. Stewart, that an item was inserted in the Annual Supply Bill, in the spring of 1897, providing $500 "to be expended by the New York State Fish, Game and Forest Commission for the extermination of lampreys and noxious fishes of Cayuga Lake, and investigations of fishes by the Biological Department of Cornell University." As Fellow in Vertebrate Zoology and Teacher of Systematic and Economic Vertebrate Zoology in Cornell University, the writer was given entire charge of the experiments and investigations, without pay, but with two paid assistants. The appropriation was made too late in the spring of 1897 to permit the work being undertaken that year, but plans were made for beginning the work early the next spring.

In considering the known life cycle of the lamprey, it can be seen that its weakest point for attack is when it exposes itself at the spawning season. But to exterminate

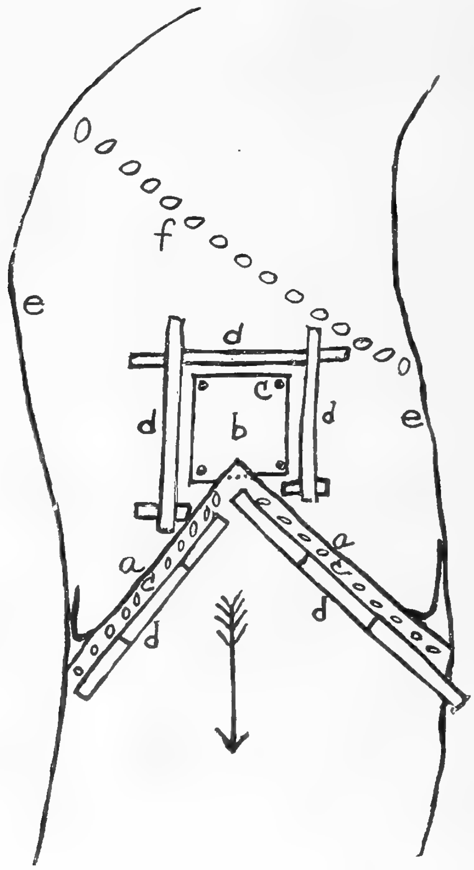
No. 12.—WHERE THE YOUNG LAMPREYS LIVE AND THE OLD LAMPREYS DIE.

the race, the individuals should be killed before they spawn. This means that they should either be caught while running up stream or taken from the nests while first constructing them, and before spawning. Even knowing this, the subject of "How it is to be done" is of the utmost importance. One savant writes: "Nothing could be easier. Simply catch them while going up to spawn," etc. But when we consulted with him about the details of his plans, he could offer none excepting the probable one of constructing a pond beside the stream, and turning the lampreys into it as they run up stream. Since the lampreys, in running, always work against the current, and

NO. 13.—LIFE AND DEATH.

as there is no current in such a place, it can be seen that this plan would be impracticable. In searching literature for help out of our dilemma, we were forced to conclude that the printed suggestions upon the practical side of this subject, and the degree of ease and certainty with which these suggestions can be executed, reminded us of the story of the mice that planned to bell the cat.

From a suggestion of Dr. H. M. Smith, of the United States Fish Commission, that the principle of the fyke might be used in this work, we decided to construct a weir with wings extending entirely across the Inlet, and catch everything that ran up. Selecting a suitable site about three miles from the lake, and at the lowest point the lampreys spawn, we obtained permission of the Messrs. Van Orman Brothers to construct a weir and erect a watchman's house on their property. We also computed the amount of material to be required, and went to Cortland to select wire netting. The first order of Wickwire Brothers was for $37.50 worth of galvanized woven wire, part of which was of one-half inch square mesh, and part was of one-fourth inch square mesh. A small house was purchased for $5, and moved to the site of the weir. This was used for storage rooms and watchmen's cabin. It was decided to make the weir somewhat after the principle of a combined pound net and fyke, with the wings meeting like the sides of the letter "V," with the apex up stream and at the middle of the channel, where the box, trap, or pound was placed. The box was made of woven wire of one-fourth inch square mesh, and was sewed together with copper wire. A bottom of wire netting was also sewed in it, and care was taken to close all holes. The only opening in the box, besides the top, which was left uncovered, was at the lower side, where the ends of the wings were inserted into it. The pound was held in its place in the stream by means of long sections of iron pipe, put through iron rings, fastened to its corners and driven firmly into the ground. An elevated board walk, placed on stakes, was built around the pound, and also along the place for the wings. The lower tier of the wings was made of one-fourth inch mesh wire netting, and the upper tier was of half-inch mesh. They were fastened to the bottom with a horizontal sheet of wire and timbers covered with sand, and they were kept in place by iron pipes driven upright in the sand through rings fastened to their lower (down stream) sides. In this way, any creature running against the current would find itself directed toward the center of the stream by the wings, and finally up into the trap or pound. With a large, square-framed net, made to fit the pound, the catch was lifted out at regular periods every morning and evening. At these times the writer regularly visited the weir to determine the important features of the catch. If any reader thinks it was no effort and sacrifice to go up through the low, damp valley three miles every morning at five o'clock and every evening at six, for over two months, he is

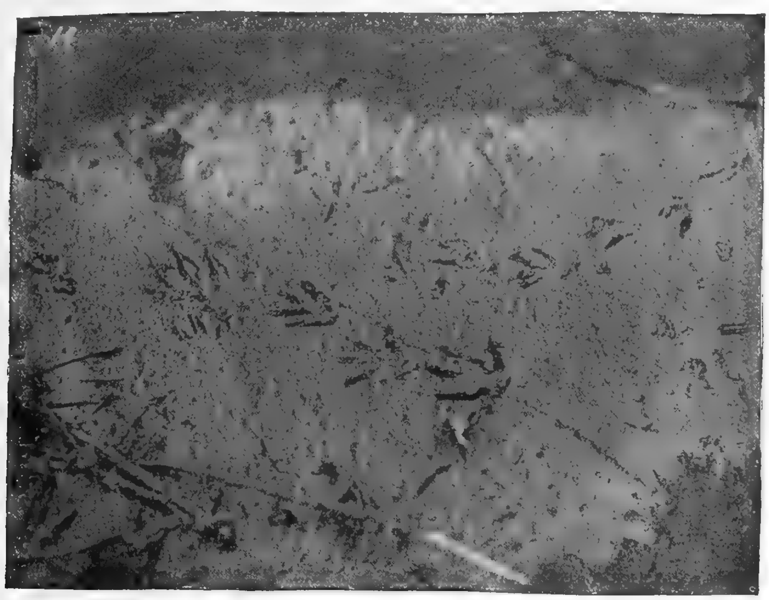


LAMPREY WEIR.

a.—Wings of wire netting. *b.*—Wire trap or pound. *c.*—Iron pipes for posts. *d.*—Board walk over water. *e.*—Banks of stream. *f.*—Posts to catch drift. *Arrow* indicates direction of current.

greatly mistaken, and should try it in order to fully appreciate its true meaning. The result to the writer was a long period of serious illness with malaria, and the prevention from doing much valuable work.

It is a singular fact that, owing to the unusual number of very heavy late rains, the spring of 1898 was the worst that has been known here for fifteen years for just this kind of an experiment. Our weir was entirely submerged no less than six times, and completely washed out three times, so the attendants had to leave it, and could reach the cabin only in a boat. Of course, each freshet of this kind caused a break of several days in the records, as is shown in the following tables. Another source of serious annoyance was the efforts which the misguided persons who lived above the



No. 14.—TRACKS OF BIRDS AND MAMMALS ALONG THE SHORE WHERE LARVAL LAMPREYS LIVE.

weir made to thwart our plans, because they had been told that we intended to kill all of the fish that ran up stream, and they were accustomed to fishing in the Inlet with seines at times when the game warden was not likely to appear. The antagonism of these persons, for whose interests we were so earnestly working, reached such a stage that at one time they threw several barrels of feathers into the stream, above the weir, for the express purpose of stopping it up. At another time we were treated to a wagon load of old onions, and at other times to piles of brushwood, leaves, *débris*, etc.

Although the following table shows twenty-one species of true fishes caught, none but suckers were ever killed. We do not even think it necessary to openly deny the ridiculous story started by persons of no principle, to the effect that many pounds of trout were sold from the weir. It is unfortunate that the experiment could not have been conducted during such a season as the present (1900), when all conditions of Nature have been quite propitious, and we have not had one rain during the entire spring that would have been strong enough to have vitiated in the least any of the desired results. We were anxious to make as much of a study as possible of the movements of fishes as well as of the lampreys, and consequently kept the following records very carefully. A summary is given at the end. Beginning with May 1st, two columns are given to each date. The first is for the morning catch, which was taken out about 6 A.M., having run into the trap during the night; the second is for the evening catch, taken out about 6 P.M., and having run into the trap during the daytime. It will be observed that most fishes and lampreys move up at night. "Clearness of water" is given in relative numerals, "1" meaning quite clear, and "5" extremely muddy; intermediate numbers stand for grades of turbidity. "Height of water" is also according to an optional standard. In the tables "m" is used to designate male, and "f" is used for female. Where no sign is prefixed, the surface of the water was above this mark, and where the minus (—) sign is prefixed, it was below the mark.

RECORDS OF WEIR FOR MONTH OF APRIL.

Day of Month	16	17	20	21	22	23	24	30
A. M. Record	X	X	X	......	......	......	......	......
P. M. Record	......	......	......	......	......	......	......	......
Trap Washed Out	......	X	......	......	......	......	X	X
Temperature of Water	42	......	44	43	44	42	......	......
Clearness of Water	1	5	3	2	2	2	5	5
Height of Water	1	......	4	3	2	2	......	......
Brook Lampreys	1	......	......	3	2	......	......	......
Lake Lampreys in Weir	....	....	....	....	....	....	....	....
Lake Lampreys in Hand Nets	....	....	....	....	....	....	....	....
226. Bullheads	......	......	......	......	......	......	......	......
300. White Suckers	1 m 3 f	....	...... 2 f	4 m 1 f	1 m 2 f	1 m 1 f	....	....
362. Blackhead Minnow	......	......	......	......	......	......	......	......
368. Horned Dace	......	......	......	......	......	......	......	......
410. Golden Shiners	......	......	......	......	1	......	......	......
443. Shiners	......	......	......	......	......	......	......	......
463. Silver Fins	......	......	......	18	13	7	......	......
471. Red Fins	......	......	......	......	......	......	......	......
559. Cut Lips	......	......	......	......	......	......	......	......
707. Ale Wife	......	......	......	......	......	......	......	......
799. Rainbow Trout	......	......	......	......	......	......	......	......
801. Brook Trout	......	......	......	......	......	......	......	......
942. Pike	1 f	......	......	......	......	......	......	......
959. Barred Killifish	......	......	......	......	......	......	......	......
1169. Trout Perch	......	......	......	......	3	5	......	......
1413. Rock Bass	......	......	......	......	......	......	......	......
1436. Common Sunfish	......	......	......	......	......	......	......	......
1438. Large-mouth Black Bass	......	......	......	......	......	......	......	......
1443. Yellow Perch	......	......	......	......	......	......	......	......
1474*a*. Tessellated Darter	......	......	......	......	......	......	......	......
2335. Miller's Thumb	......	......	......	......	......	......	......	......

RECORDS OF WEIR FOR MONTH OF MAY.

Day of Month	1	2	4	5		10		11	
A. M. Record	....	....	....	X	....	X	....	X	....
P. M. Record	....	....	....	....	X	....	X	....	X
Trap Washed Out	....	X	....	....	X	....	....	....	....
Temperature of Water	45	....	48	48	....	48	....	51	51
Clearness of Water	2	....	3	1	....	2	....	1	1
Height of Water	....	....	9	6	....	1	....	1	1
Brook Lampreys	1	....	1	....	....	....	....	....	....
Lake Lampreys in Weir	1 m 1 f	....	3 m 1 f	1 f	....	....	....	3 m 5 f	....
Lake Lampreys in Hand Nets	....	....	....	....	....	....	....	15 m 4 f	....
226. Bullheads	1	....	....	....	....	....	....	....	....
300. White Suckers	3 m 4 f	....	3	7 m 10 f	4	....	....	....	....
362. Blackhead Minnow	....	....	....	....	....	....	....	....	....
368. Horned Dace	....	....	....	....	....	....	....	3	....
410. Golden Shiners	....	....	....	....	....	2	....	....	2
443. Shiners	2	....	....	....	....	1	....	....	2
463. Silver Fins	....	....	....	....	....	1	....	1	....
471. Red Fins	....	....	....	....	....	....	....	3	2
559. Cut-Lips	....	....	....	....	....	....	....	....	....
707. Ale Wife	....	....	....	....	....	....	....	....	....
799. Rainbow Trout	....	....	....	....	....	....	....	....	....
801. Brook Trout	2	....	1	1	....	....	....	1	....
942. Pike	....	....	....	....	....	....	....	....	....
959. Barred Killifish	....	....	....	....	....	1	....	....	....
1169. Trout Perch	4	....	5	1	....	....	....	1	....
1413. Rock Bass	2	....	2	2	....	4	....	1	2
1436. Common Sunfish	....	....	....	....	....	....	....	....	....
1438. Large-mouth Black Bass	....	....	....	....	....	....	....	....	....
1443. Yellow Perch	....	....	....	....	....	....	....	....	....
1474a. Tessellated Darter	....	....	....	....	....	....	....	....	....
2335. Miller's Thumb	....	....	....	....	....	....	....	....	....

RECORDS OF WEIR FOR MONTH OF MAY.—Continued.

Day of Month	12		15		16		17		18	
A. M. Record	X	....	X	....	X	....	X	....	X	....
P. M. Record	....	X	....	X	....	X	....	X	....	X
Trap Washed Out	....	X	....	....	....	....	....	....	....	....
Temperature of Water	52	....	50	52	51	55	48	58	46	63
Clearness of Water	2	....	3	2	2	2	2	2	1	1
Height of Water	8	....	15	5	4	6	6	3	2	1
Brook Lampreys	2	....	....	....	....	....	....	....	....	....
Lake Lampreys in Weir	12 m 4 f	....	1 m 2 f	9 m 7 f	....	....	2 f	....	1 m	3 m 1 f
Lake Lampreys in Hand Nets	....	....	23 m 15 f	....	....	....	....	....	....	....
226. Bullheads	....	....	....	....	....	....	....	....	....	....
300. White Suckers	4 m	....	....	1 m	1 m 2 f	1 f	2 m 1 f	....	2 f	1 m 2 f
362. Blackhead Minnow	....	....	....	....	....	....	....	....	....	....
368. Horned Dace	1	....	1	....	....	....	....	....	....	....
410. Golden Shiners	....	....	....	....	1	....	....	....	....	....
443. Shiners	....	....	1	....	1	....	....	....	....	12
463. Silver Fins	....	....	....	....	2	2	....	....	....	....
471. Red Fins	....	....	....	....	....	....	1	....	....	....
559. Cut-Lips	....	....	....	....	....	....	....	....	....	....
707. Ale Wife	....	....	....	....	....	....	....	....	....	1
799. Rainbow Trout	....	....	....	....	....	....	....	....	....	....
801. Brook Trout	....	....	1	....	1	....	....	....	1	1
942. Pike	....	....	....	....	....	....	....	....	....	....
959. Barred Killifish	....	....	....	....	....	....	....	....	....	....
1169. Trout Perch	1	....	1	....	2	....	1	....	2	....
1413. Rock Bass	6	....	3	1	1	1	1	....	1	....
1436. Common Sunfish	....	....	....	....	....	....	....	....	....	....
1438. Large-mouth Black Bass	....	....	....	....	....	....	....	....	....	....
1443. Yellow Perch	....	....	....	....	....	....	....	....	....	....
1474*a*. Tessellated Darter	....	....	....	....	....	....	....	....	....	....
2335. Miller's Thumb	....	....	....	....	....	....	....	....	....	....

RECORDS OF WEIR FOR MONTH OF MAY.—Continued.

Day of Month	19		23		24		25		26	
A. M. Record	X	....	X	....	X	....	X	....	X	....
P. M. Record	....	X	....	X	....	X	....	X	....	X
Trap Washed Out	....	X	....	....	....	....	....	....	....	....
Temperature of Water	55	....	59	61	55	64	58	60	57	62
Clearness of Water	1	....	3	3	3	2	2	1	2	2
Height of Water	3	....	3	6	12	10	8	4	8	2
Brook Lampreys	....	....	....	....	....	....	....	....	....	....
Lake Lampreys in Weir	22 m 16 f	....	19 m 10 f	....	7 m 12 f	9 m 4 f	19 m 18 f	....	2 m 1 f	....
Lake Lampreys in Hand Nets	....	....	43 m 35 f	....	....	39 m 32 f	....	51 m 67 f	....	....
226. Bullheads	....	....	2	....	....	....	....	....	....	....
300. White Suckers	9 m 5 f	....	....	....	....	1	....	....	....	....
362. Blackhead Minnow	....	....	....	....	....	....	....	....	....	....
368. Horned Dace	....	....	....	....	....	....	....	....	....	....
410. Golden Shiners	....	....	2	....	....	....	....	....	....	....
443. Shiners	....	....	....	....	....	....	....	....	....	....
463. Silver Fins	....	....	....	....	....	....	....	....	....	....
471. Red Fins	....	....	....	....	....	....	....	....	....	....
559. Cut-Lips	....	....	....	....	....	....	....	....	....	....
707. Ale Wife	....	....	10	95	4	....	....	....	1	1
799. Rainbow Trout	....	....	....	....	....	....	....	....	....	....
801. Brook Trout	....	....	....	....	....	1	....	....	....	....
942. Pike	....	....	....	....	....	....	....	....	....	....
959. Barred Killifish	....	....	....	....	....	....	....	....	....	....
1169. Trout Perch	1	....	10	3	....	....	....	....	2	2
1413. Rock Bass	2	....	5	1	1	....	....	....	1	....
1436. Common Sunfish	....	....	....	....	2	3	....	....	....	1
1438. Large-mouth Black Bass	....	....	....	....	....	....	....	....	....	....
1443. Yellow Perch	....	....	....	....	....	....	....	....	1	....
1474*a*. Tessellated Darter	....	....	1	....	1	....	....	....	....	....
2335. Miller's Thumb	....	....	....	....	....	....	....	....	....	....

RECORDS OF WEIR FOR MONTH OF MAY.—CONCLUDED.

Day of Month	27		28		29		30		31	
A. M. Record	X	....	X	....	X	....	X	....	X	....
P. M. Record	....	X	....	X	....	X	....	X	....	X
Trap Washed Out	....	....	....	....	....	....	....	....	....	....
Temperature of Water	55	60	56	63	60	66	58	64	61	66
Clearness of Water	3	3	2	2	2	1	1	1	1	1
Height of Water	6	5	3	2	2	1	....	....	....	−1
Brook Lampreys	....	....	....	....	....	....	....	....	....	....
Lake Lampreys in Weir	1 m	....	2 m 2 f	3 m	7 m 9 f	4 m 7 f	17 m 23 f	....	2 m 3 f	1 m ....
Lake Lampreys in Hand Nets	....	....	43 m 29 f	....	....	....	....	47	171	63 ....
226. Bullheads	1	2	1	....	....	....	....	....	....	....
300. White Suckers	....	.... 1 f	....	....	....	....	....	2 yng.	....	....
362. Blackhead Minnow	....	....	....	....	....	....	....	....	....	1
368. Horned Dace	1	....	....	....	....	....	....	....	....	....
410. Golden Shiners	....	....	....	....	....	....	....	1	....	....
443. Shiners	....	....	....	....	....	2	....	1	2	1
463. Silver Fins	....	....	....	....	....	....	....	....	....	....
471. Red Fins	....	....	....	....	....	1	2	1	1	....
559. Cut-Lips	....	....	....	....	....	....	....	....	....	....
707. Ale Wife	....	....	....	1	....	....	....	....	....	....
799. Rainbow Trout	....	....	....	....	....	....	....	....	....	....
801. Brook Trout	....	....	....	....	....	....	....	....	1	....
942. Pike	....	....	....	....	....	....	....	....	....	....
959. Barred Killifish	....	....	....	2	....	....	....	....	....	....
1169. Trout Perch	3	2	3	....	2	....	....	....	....	....
1413. Rock Bass	....	....	3	2	3	....	6	....	2	2
1436. Common Sunfish	....	....	....	....	....	....	....	....	....	....
1438. Large-mouth Black Bass	....	....	....	1	....	....	....	....	....	....
1443. Yellow Perch	....	....	1	....	....	....	....	....	....	....
1474*a*. Tessellated Darter	....	....	....	....	....	....	....	....	....	....
2335. Miller's Thumb	....	....	....	....	....	1	....	....	....	....

RECORDS OF WEIR FOR MONTH OF JUNE.

Day of Month	1		2		3		4		5	
A. M. Record	X	....	X	....	X	....	X	....	X	....
P. M. Record	....	X	....	X	....	X	....	X	....	X
Trap Washed Out	....	....	....	....	....	....	....	....	....	....
Temperature of Water	54	62	59	68	60	69	59	66	60	69
Clearness of Water	1	1	1	1	1	1	1	1	1	1
Height of Water	−1	−2	−3	....	−4	−4	−5	−5	−5	−6
Brook Lampreys	....	....	....	....	....	....	....	....	....	....
Lake Lampreys in Weir	8 m 4 f	1 m 2 f	3 m 3 f	....	42 m 27 f	3 m 5 f	13 m 24 f	.... 1 f	4 m 6 f	1 m 4 f
Lake Lampreys in Hand Nets	84 m 69 f	....	37	....	93	....	135	....	16 m 25 f	....
226. Bullheads	....	....	....	....	....	5	....	....	....	....
300. White Suckers	....	....	....	....	....	....	....	....	1	....
362. Blackhead Minnow	....	....	1	....	....	....	....	....	....	....
368. Horned Dace	....	....	....	....	....	1	....	....	....	....
410. Golden Shiners	1	....	....	....	....	....	....	....	....	....
443. Shiners	....	5	....	....	....	....	....	....	....	14
463. Silver Fins	....	....	....	....	1	1	....	....	....	....
471. Red Fins	2	....	2	3	6	4	5	3	4	17
559. Cut-Lips	....	1	....	....	....	....	....	....	....	....
707. Ale Wife	....	....	....	....	....	....	....	....	....	....
799. Rainbow Trout	1	....	....	....	....	....	....	....	....	....
801. Brook Trout	....	....	....	....	....	....	....	....	....	....
942. Pike	....	....	....	....	....	....	....	....	....	....
959. Barred Killifish	....	....	....	....	....	....	....	....	....	....
1169. Trout Perch	....	....	....	....	2	1	1	....	....	1
1413. Rock Bass	1	....	....	1	1	2	2	1	1	2
1436. Common Sunfish	1	....	1	....	1	....	....	....	....	....
1438. Large-mouth Black Bass	....	....	....	....	....	....	....	....	....	....
1443. Yellow Perch	3	....	....	1	....	....	....	....	1	1
1474*a*. Tessellated Darter	....	....	....	....	....	....	....	....	....	....
2335. Miller's Thumb	....	....	....	....	....	....	....	....	....	....

RECORDS OF WEIR FOR MONTH OF JUNE.—CONTINUED.

Day of Month	6		7		8		9		10	
A. M. Record	X	....	X	....	X	....	X	....	X	....
P. M. Record	....	X	....	X	....	X	....	X	....	X
Trap Washed Out	....	....	....	....	....	....	....	....	....	....
Temperature of Water	57	68	59	65	64	71	63	69	62	67
Clearness of Water	1	1	1	1	2	3	4	3	2	1
Height of Water	-6	-6	-6	-6	-1	3	6	5	2	1
Brook Lampreys	....	....	....	....	....	....	....	....	....	....
Lake Lampreys in Weir	....	5 m 3 f	.... 1 f	4 m 5 f	3 m 4 f	....	7 m 3 f	1 m 1 f	2 m 5 f	....
Lake Lampreys in Hand Nets	....	10 m 7 f	....	5 m 12 f	....	....	....	....	....	16 m 29 f
226. Bullheads	....	10	....	3	....	....	6	30	1	3
300. White Suckers	....	....	....	....	....	....	....	4	....	....
362. Blackhead Minnow	1	....	....	....	....	....	....	....	....	....
368. Horned Dace	....	....	....	....	....	....	....	4	....	1
410. Golden Shiners	....	....	....	....	....	2	....	....	....	....
443. Shiners	....	2	....	....	....	....	....	....	....	....
463. Silver Fins	....	3	....	....	....	....	....	....	1	....
471. Red Fins	5	5	....	1	2	7	6	12	5	6
559. Cut-Lips	....	....	....	....	....	....	....	....	....	....
707. Ale Wife	....	....	....	....	....	....	....	....	....	....
799. Rainbow Trout	....	....	....	....	....	....	....	1	....	....
801. Brook Trout	1	....	....	....	....	....	2	3	1	....
942. Pike	....	....	....	....	....	....	....	....	....	....
959. Barred Killifish	....	....	....	....	....	....	....	....	....	....
1169. Trout Perch	....	....	....	....	....	....	1	1	....	....
1413. Rock Bass	3	4	....	2	....	1	1	1	4	1
1436. Common Sunfish	....	....	....	....	2	1	....	1	....	....
1438. Large-mouth Black Bass	....	....	....	....	....	....	....	....	....	....
1443. Yellow Perch	3	....	....	....	....	....	....	....	1	1
1474*a*. Tessellated Darter	....	....	....	....	....	....	....	....	....	....
2335. Miller's Thumb	....	....	....	....	....	....	....	....	....	....

RECORDS OF WEIR FOR MONTH OF JUNE.—Concluded.

Day of Month	11		12		13		14		15
A. M. Record	X	....	X	....	X	....	X	....	X
P. M. Record	....	X	....	X	....	X	....	X	....
Trap Washed Out	....	....	....	....	....	....	....	....	....
Temperature of Water	62	68	63	70	65	70	66	72	68
Clearness of Water	1	2	2	2	1	1	3	1	1
Height of Water	1	2	2	2	−5	−7	−2	−5	−8
Brook Lampreys	....	....	....	....	....	....	....	....	....
Lake Lampreys in Weir	1 m	....	....	....	....	....	....	....	....
	....	1 f	....	....	....	....	....	....	....
Lake Lampreys in Hand Nets	....	....	....	....	....	....	....	....	....
	....	....	....	....	....	....	....	....	....
226. Bullheads	....	....	....	1	2	3	5	....	....
300. White Suckers	....	....	....	....	....	1	1	....	....
362. Blackhead Minnow	....	....	....	....	....	....	....	....	....
368. Horned Dace	....	2	....	....	....	....	....	....	....
410. Golden Shiner	....	....	3	....	....	....	....	....	....
443. Shiners	....	....	2	9	2	3	1	....	....
463. Silver Fins	....	....	....	....	....	....	....	....	....
471. Red Fins	3	3	2	3	3	3	3	....	4
559. Cut-Lips	2	....	1	....	....	....	....	....	....
707. Ale Wife	....	....	....	1	....	....	....	....	....
799. Rainbow Trout	....	....	....	....	....	....	....	....	....
801. Brook Trout	....	1	....	....	....	....	....	....	....
942. Pike	....	....	....	....	....	....	....	....	....
959. Barred Killifish	....	....	....	....	....	....	....	....	....
1169. Trout Perch	....	....	....	....	....	....	....	....	....
1413. Rock Bass	1	....	2	....	2	1	2	....	8
1436. Common Sunfish	....	....	....	1	1	....	1	....	8
1438. Large-mouth Black Bass	....	....	....	....	....	....	....	....	....
1443. Yellow Perch	....	....	....	1	....	....	....	....	....
1474*a*. Tessellated Darter	....	....	....	....	....	....	....	....	....
2335. Miller's Thumb	....	....	....	....	....	....	....	....	....

The above detailed tabulation of the catch of the weir for the spring of 1898 contains the bare facts from which any person can, with proper study, derive many conclusions concerning the migrations of not only the lampreys, but also the various species of fishes enumerated; but our notebook also contains the specific records of many significant observations which cannot well be tabulated. Some of these we give in this text. The numbers used before the name of a fish, both in the tables and in this part of the discussion, refer to the numbers of the respective species in Jordan and Evermann's "Check List of Fishes and Fishlike Vertebrates of North and Middle

NO. 15.—LAMPREYS CLIMBING FALLS.

America," published in the "Report of the Commissioner of the United States Commission of Fish and Fisheries for 1895." The catch of each species is treated in proper serial order.

8a. The Lake Lamprey (*Petromyzon marinus unicolor* De Kay).—The table shows a destruction of 1,686 specimens of this kind of lamprey, of which 589 were known to be males, 551 females, and 546 of undetermined sex. Of these, 471 were caught in the weir, of which 244 were males, and 227 females. Owing to the very unusual amount of late rain and high water, the trap was washed out six times, and other unavoidable difficulties were encountered which permitted many lampreys to pass on up stream. A fairly successful effort was made to capture these before they spawned.

By the use of hand nets, 1,215 were caught up stream, of which 345 were known to be males, 324 females, and 546 of undetermined sex. There is no doubt that the first Lake Lampreys ran up on the last evening of April. On the morning of the 1st of May there was a pair of this species in the trap. Although they were both large, the male did not yet have the dorsal ridge which characterizes the full sexual maturity, nor did the female yet possess the anal fin. The attendant who spent the night in the cabin by the weir said: "The lampreys got into the trap early in the evening, and did more splashing and jumping than any other kind of fish." The lamprey that was caught on the morning of May 5 was seen in both the forenoon and afternoon of May 4, hanging to a stump in the water about half a mile below the weir. By far the greater number of both lampreys and fishes are recorded in the forenoon catch, because they were the ones that were caught running up during the night-time. Most of them ran between sunset and midnight. The attendant reported that the female recorded on May 21 was the first lamprey that got into the trap after midnight, most of them having arrived at this place (about three miles from the lake) at about nine or ten o'clock at night.

The first male to possess the dorsal ridge, described elsewhere, which was caught in the weir, was the one recorded on May 27, and the first female thus caught possessing the anal fin, characteristic of the sex at spawning maturity, was caught on May 28. Others showing these features had been taken from the spawning beds for some days, and, after the latter date, nearly all that ran up bore these characters which marked them as being fully adult and mature. On May 30 a ball of about forty lampreys was taken from a gigantic spawning nest on the sandy and stony shallows just below the weir, and on the same date two old females, which had spawned out, drifted down stream and lodged in the upper part of the weir. They were placed in a wire box, in a shady place in the stream, but it was impossible to keep them alive longer than three days. Others, of both sexes, occasionally drifted blindly down stream, but they were nearly dead. On June 5 two females were caught which did not have the anal fin, and one male had the dorsal ridge but very slightly developed. These were the last caught from which these structures were absent.

It will be observed that in the beginning of the season the number of males caught was greatly in excess of the number of females, while in the latter part of the season the females predominated; also, with the water becoming muddy, the number of running lampreys decreased. This is doubtless because their gills are even more sensitive than the gills of fishes, and foreign particles lodging in the gill pouches would cause very great annoyance and real suffering. Further, the numbers running increased as the water became warmer, and decreased as it became cold. This is especially noticeable in the records for the 11th, 15th, 23d and 24th of May, when the temperature rose to above fifty degrees Fahrenheit, and the records show increased numbers of lampreys running then; but on the 18th of May the temperature of the water fell to forty-six degrees Fahrenheit, and there was a decided cessation in the running.

15. Brook Lamprey (*Lampetra wilderi* Jordan and Evermann).—At the time work was commenced on the weir (April 9), transforming Brook Lampreys were seen partly out of the sand all along this part of the stream, and their nests were soon crowded with them, both above and below the trap. The very small number of these creatures actually caught (only ten) in the weir would appear to indicate that, through the spawning of many generations on the same sand-bars in which they lived as larvæ, they have practically lost the migratory instinct.

SUMMARY OF THE SPECIES OF TRUE FISHES IN WEIR.

226. Bullhead or horned pout (*Ameiurus nebulosus* Le Sueur).—Seventy-six caught. These fishes spawn in this region during the early part of the month of June, and it can be observed that it was at this time that nearly all of the specimens were captured. Some of the adults were doubtless on their way up to some lagoons near the Inlet to spawn, but most of those captured, especially of the thirty taken on June 9th, were immature. This would indicate that the migratory instinct impels fishes that are not mature as well as those that are, and from this we could infer that a search for spawning grounds is not the only motive in "running." It may also be due to a desire to change feeding grounds or conditions of water.

300. White suckers (*Catostomus commersonii* Lacépède).—Ninety caught—thirty-five males, thirty-seven females, and eighteen sex undetermined. The undetermined suckers were small and immature, and these, with the young of nearly all other species of fishes, show a distinct tendency to "run" at the time when older specimens of the same kind are spawning. It is seen that, compared with the time of spawning of the lampreys, the bullheads are late, while the suckers are early. A few female suckers that had entirely spawned out were caught still pressing on up stream. The "run" of these fishes commenced about the last of March and ended at the middle of May.

362. Black-headed minnow (*Pimephales notatus* Rafinesque).—But four caught. Many others are to be found here at times.

368. Horned dace (*Semotilus atromaculatus* Mitchill).—Fourteen caught, most in the month of June.

410. Golden shiner or bream (*Abramis chrysoleucas* Mitchill).—Twelve caught.

443. Shiner (*Notropis hudsonius* Clinton).—Seventy-three caught, most in the first half of June.

463. Silver fins (*Notropis whiplii* Girard).—Fifty caught, most in the latter part of May and the first half of June.

471. Red fins (shiner, dace) (*Notropis cornutus* Mitchill).—One hundred and thirty, nearly all of which were taken during the first half of June.

559. Cut-lips (*Exoglossum maxillingua* Le Sueur).—Four collected. Common.

707. Alewife or sawbelly (*Pomolobus pseudoharengus* Wilson).—One hundred and fourteen, most of which were taken in one school on the afternoon of May 23.

799. Rainbow trout (*Salmo irideus* Gibbons).—Only two of these were captured, but one was fifteen inches long, and others even longer were caught in the Inlet by various anglers. This indicates gratifying success in the efforts of the United States Fish Commission to introduce this species of fish from the West Coast.

801. Brook trout (*Salvelinus fontinalis* Mitchill).—Nineteen were taken from the trap. They evidently were not in schools, and were not "running" at this time of year, but were merely passing from one feeding ground to another.

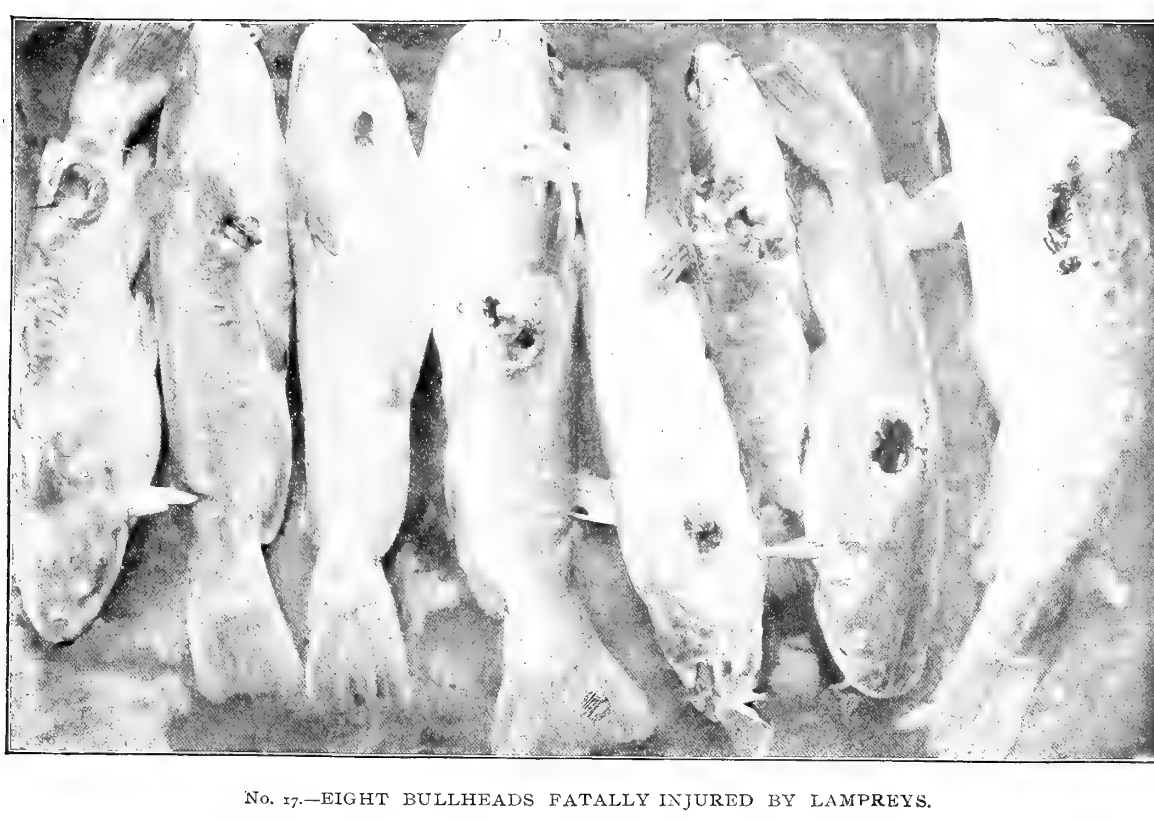
942. Pike (*Lucius lucius* Linnæus).—Only one was seen, but this was remarkable for the fact that it was a large female measuring over three feet in length, and was filled with ripe eggs, which stripped readily. As this was at the close of the pike's spawning season for this region, this definite observation was enough to prove that the representatives of this species may ascend streams to spawn here as late as the middle of April.

959. Barred killifish (*Fundulus diaphanus* Le Sueur).—Three caught.

1169. Trout perch (*Percopsis guttatus* Agassiz).—Sixty caught. Light is here for the first time thrown upon the spawning habitat and period of this unusually interesting and generally rare fish. The trout perch is so named because it has many features that partake of the trout, on one side, and ally it to the perch on the other. It thus stands intermediate between the soft-rayed and the spiny-rayed fishes. It is a living vestige of the fish fauna of a past geological age. Nearly all that were caught were taken during the month of May, at which time they were in ripe spawning condition, showing that they run up streams here to spawn during that month. It is so rare that many naturalists of high reputation who visited our weir had never before seen it alive. In fact, in Dr. Meek's "Fishes of the Cayuga Lake Basin," published in the "Annals of the New York Academy of Science," in 1889, he said: "I have seen no specimens of this species from the lake."

1413. Rock bass (*Amblopites rupestris* Rafinesque).—Ninety-nine, caught mostly in the latter part of May and the month of June, which indicates their time and place of spawning here. Many taken at this date were adult males or females, and were evidently going up stream to spawn.

No. 16.—TWELVE BULLHEADS, HORNED POUT, OR "CATFISH," FATALLY INJURED BY LAMPREYS.



No. 17.—EIGHT BULLHEADS FATALLY INJURED BY LAMPREYS.

1436. Common sunfish (pumpkin seed) (*Eupomotis gibbosus* Linnæus).—Fourteen, all caught in the latter part of May and in June. They spawn in this region in June and July. Many of these taken were immature.

1438. Large-mouthed black bass (*Micropterus salmoides* Lacépède).—One.

1443. Yellow perch (*Perca flavescens* Mitchill).—Fourteen. It should be noted that the spiny-rayed fishes were caught in greater numbers in the latter part of the season, while the soft-rayed fishes (notably the suckers) were caught earlier. This agrees with their general periods of spawning.

1474a. Tessellated darter (*Boleosoma nigrum olmsteadi* Storer).—But two were caught, although this darter is very common in the stream. They are so small that, like many other fishes of the smallest sizes, they are able to go through the meshes of the netting.

2335. Star-gazer or miller's thumb (*Cottus ictalops* Rafinesque).—Only specimen of this species was caught, although at times they are not very rare in the lake. They spawn in the shallow water of the lake, in the latter part of April.

Although this completes the list of fishes, mention should be made of the facts ascertained concerning the habits of the Batrachian (*Necturus maculatus*), mud puppy or water dog. These serious enemies of our fishes go up stream to spawn in the latter part of March and the early part of April. Their eggs were taken from the water on April 16, and on June 16 two young necturi, each one and one fourth inches in length, were taken from beneath the trap.

Owing to the many washouts, it cannot be said that the weir this year was a marked success, although it surely would have proven satisfactory during ordinary seasons.

In order to see what could be done with hand nets alone, the writer engaged an assistant during the spring of 1899, and waded the stream every one or two days, removing all lampreys possible. Over eighteen hundred were killed in this way, but as we did not see all of those which were collected by the assistant, it was impossible to make an accurate record of the proportions of the sexes represented.

Explanation of Illustrations.

All the illustrations for this article, excepting Nos. 2, 15 and 16, are reproductions of original photographs by the writer.

Illustration No. 1.—*Adult Spawning Male* (a) *and Female* (b) *Lake Lampreys*, taken from the same spawning nest. The male (*a*) plainly shows the following characters: The dorsal ridge, the edema or swelling at the anterior end of the base of each dorsal fin, the male organ of intromission, the absence of the anal fin, and at the middle of the tail a sore spot which was made raw by sand coming between the bodies of the pair when they were closely appressed at the instant of spawning. The female (*b*) shows the shorter but thicker body, distended with eggs, and the anal fin which is distinctly characteristic of the sex. Both show the single median nostril, the seven branchiopores or gill openings on one side, the numerous chitinous teeth, eyes, anal and two dorsal fins, etc.

Illustration No. 2.—*Male and Female Brook Lampreys, on Spawning Bed.* (Reproduced from a drawing by Dr. Bashford Dean and Mr. B. F. Sumner, in the "Transactions of the New York Academy of Science," Vol. XVI, Dec. 1897.) The pair at the top of the picture are in mating position, and the one in the lower left-hand corner is trying to move a stone many times its own weight.

Illustration No. 3.—*Head of Lake Lamprey* (two thirds of natural size). The neck is twisted, but the gill openings are plainly shown, and one sees the circularly radiate arrangement of the numerous chitinous teeth, and the oral cavity.

Illustration No. 4.—*Mouth of Lake Lamprey* (twice natural size). Showing the fimbriæ or papillæ (at the left) which fringe the outer margin of the oral disk.

Illustration No. 5.—*Head of Brook Lamprey* (one and one half times natural size). Showing teeth, eye, gill openings, sense organ, sense papillæ, tongue, etc.

Illustration No. 6.—*Head of Brook Lamprey* (twice natural size). Showing the fringe of fimbriæ all around the mouth; also the numerous sense papillæ and the larger sense organ on the neck (the latter on the median line).

Illustration No. 7.—*Head of Brook Lamprey, back view* (one and one fourth natural size). Showing the single median nostril, and caudad (toward the tail) from the nostril is shown the pineal body, supposed to represent the rudiment of a third eye.

Illustration No. 8.—*Where the Brook Lampreys Spawn.* Looking directly up stream from a point on the bank back of which the water flows. The sticks were set in the spawning beds by the writer purposely to take this picture. Each stake marks a spawning bed. At the extreme right of the picture is the spot where the camera stood in taking No. 9.

Illustration No. 9.—*Where the Brook Lampreys Spawn.* Looking across the stream. Each stake marks a spawning bed. At the extreme left of the picture is the spot where the camera stood in taking No. 8. All of the illustrations of this nature here shown were taken in the Inlet of Cayuga Lake, within three miles of Ithaca, N. Y.

Illustration No. 10.—*Where the Lake Lampreys Spawn.* Looking diagonally across and up stream. The boy standing in water shows depth across here. Each stake marks a nest, but the stakes without papers mark nests that had been deserted without spawn having been deposited in them. The stream here is twice as wide as in Nos. 8 and 9; note that the nests are much further apart than in the preceding.

Illustration No. 11.—*Where the Young Lampreys Live and the Old Lampreys Die.* Looking up stream. The pail is on a sand-bar in the water from which many young (larval) lampreys were taken, and just at the left of it is the shore that was photographed for No. 14. It was to this spot that *débris*, living larval lampreys, dead adult lampreys, dead fish, etc., were carried from the stream bed (water two feet deep, silt three feet) of the lower right-hand corner of this illustration (No. 11) and photographed for No. 13. In the edge of the bushes directly over the pail was where the camera stood in taking No. 12.

Illustration No. 12.—*Where the Young Lampreys Live and the Old Lampreys Die.* Looking down stream toward the middle of the bottom of No. 11, from the point at the shore just above the center of No. 11. At the right of the pail is where Nos. 13 and 14 were taken; the *débris*, etc., for No. 13 being carried from near the middle of the pool just over the pail shown here.

Illustration No. 13.—*Life and Death. Débris* containing many larval lampreys and dead lampreys and fishes. Carried from near the center of No. 12. Photographed on the shore at the left of the pail in No. 11, after the exposure was made for No. 14. The sunken leaves, sticks and silt in which so many young lampreys were found, show that these larvæ prefer to live where there is an abundant organic deposit or sediment rather than in a mere sand-bank. The several spawned-out dead lampreys, not visible until the mud was taken out, indicate that such a site as this becomes their final resting place. In short, this *débris* was from a place where the force of the current is lost and all kinds of organic material sinks. Here is where the larval lampreys find the greatest amount of food, consequently they occur here in greatest numbers.

Illustration No. 14.—*Tracks of Birds and Mammals along the Shore Where Larval Lampreys Live.* Some of these animals have been known to destroy the young lampreys, and undoubted proof is often found of their having taken them from the sand. Photograph of a portion of the shore just at the left of the pail in No. 11.

Illustration No 15.—*Lampreys Climbing Falls.* Reproduction (by permission) of a photograph of the three-toothed lamprey of the West Coast, climbing Falls in the Willamette River, Oregon. Taken by Dr. H. M. Smith, United States Fish Commissioner. (See article in the *Scientific American*, for April, 1900.)

Illustration No. 16.—*Twelve Bullheads, Horned Pout, or "Catfish" fatally injured by Lampreys.* Collected and photographed by the writer.

Illustration No. 17.—*Eight Bullheads* (Ameiurus nebulosus) *fatally injured by Lampreys, and showing characteristic Lamprey scars.* Collected in Cayuga Lake and photographed by the writer.

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On the Dogfish *(Amia calva)*, Its Habits and Breeding.

By BASHFORD DEAN.

IN THE SHADOW OF THE PINES

THE dogfish (*Amia calva*) is a troublesome occupant of many of the waters of the northern and western portion of New York State; it is, in fact, one of the commonest as well as one of the least desirable of our fishes. It is voracious, exceedingly hardy, large in size, and is well known to feed upon other fishes, as well as upon their food. It is itself valueless as a food fish. Its raw flesh is pinkish in color and peculiarly soft and pasty; when cooked, it is stringy and tasteless. In certain localities, as at Black Lake, St. Lawrence county, its meat is said to be poisonous, but there seems to be no adequate foundation for this belief. In South Carolina, where it also occurs abundantly, the writer has known the dogfish to be used as food by the negroes; but as far as the writer is aware, it is never eaten in the northern States. On account of its many unfavorable qualities, therefore, the fish is one which can well be spared in our State waters. And the Fish Commission believes it desirable, and even important, to collect data as to its habits and spawning, which can be used for the purpose of reducing its numbers in localities where it is over-abundant. For evidently the lakes and waterways of many localities can be made to yield a greater number of useful fishes by destroying their most rapacious enemies. And it is even possible that by such means a greater good to the fisheries might be done than by the more difficult and costly expedient of restocking the waters; for by the latter measure, in certain localities at least, a greater supply of food stuff is given to the predatory and useless fishes (of which the dogfish is an excellent type), and thus these forms, instead of the useful ones, increase and multiply.

Accordingly, in the present paper my purpose will be to call attention to the especial features in the natural history of *Amia* which suggest a means of reducing its numbers, where this shall be found expedient. We may refer to (1) the usual habits of the fish, (2) the peculiarities in its spawning, and (3) the means which can be devised for its destruction. The writer might state, by way of parenthesis, that the dogfish, in spite of its bad reputation among fishermen, is a creature of high esteem among zoologists, and that its extermination and extinction would be regarded by them in the light of a public calamity. For it is the sole and but little modified survivor of a great race of fishes which in the mesozoic times gave rise to most, if not all, of our living types (teleosts). To the zoologist, therefore, the extinction of such forms as the bison, Rocky Mountain goat or bighorn would be a matter of far less significance than the loss of this much-despised fish. The former means but the extinction of a *species*, the latter of an entire zoological *order*. The zoologist may, however, console himself with the reflection that it will prove a practical impossibility to exterminate the dogfish, whose hardiness is attested by the fact that of all its kindred it alone has been able to survive the calamities of innumerable years, and that under the natural conditions in North American waters (where it alone survives), it has even competed favorably with the more modern types of fishes.

I. Habits.

Many notes have been published regarding the habits of the dogfish. They are, however, usually brief, and are scattered through the literature mainly in connection with anatomical and embryological studies, or in remarks added to faunal lists. The following will serve as examples of these descriptions:

Dr. Kirtland states "that the dogfish is found in Lake Erie, where it is frequently called the Lake Lawyer. It is distinguished by a ferocious look and voracious habits (*unde nomen?*) The flesh is rank, tough, and not eatable. To the anglers it is a troublesome nuisance by taking their bait, and often breaking their hooks and lines, which they can readily do by means of their large teeth and long jaws."

Charles Hallock, as quoted by G. Brown Goode, refers to the food and habits of the dogfish thus: "They take frogs, minnows and sometimes the spoon. Their habitat is deep water, where they drive everything before them. They are very voracious and savage. Their teeth are so sharp and their jaws so strong that they have been known to bite a two-pound fish clean in two, at the very first snap. They are as tenacious of life as the eel." He further adds: "The young when about six inches long make a famous bait for pickerel and pike. . . . . Put one hundred in a rain barrel and you can keep them all summer without change of water. For the aquarium the young have no equal, and on account of the spot in the tail are quite attractive. But nothing else but snails can live in the tank. He will kill a lizard or any other living thing the instant it touches the water."

Dr. Estes, also quoted in Goode's work, deserves the credit for the earliest known observations on the nesting habits of *Amia*. His notes are in the main confirmed by later authors. He describes the splashings of the fish "on certain days"—*i. e.*, when spawning—the position of the spawning places, the season of oviposition, the duration of hatching, the attendance of the mate, and the later history of the young fish. A portion of his account deserves to be given in detail: "I have sent these young dog-fish hundreds of miles for the aquarium. It is only necessary to keep them in water, a change scarcely being required. The adults are the great "jumpers" of the lake. On certain days they are to be seen in all directions jumping clean out of the water, and turning complete somersaults before again striking. They spawn in May and June among the grass and weeds of the sloughs, if they can reach them in time. As soon as the spring rise comes, usually in May and June, and connects the inland sloughs with the lake [Pepin], they run up and over into the sloughs, deposit their eggs, and remain near the beds and young just as long as they can and not be shut in by the receding water. The eggs hatch in eight and ten days, the parents remaining with the brood two or three weeks, if possible, but will leave them much sooner, if necessary, to save themselves. The young will not make any effort to escape to the lake until the next season, when, if an opening occurs, they come pouring out in countless numbers. At this time we take them by stretching the minnow seine across the opening and raising it when full. They are now from three to six inches long, fat and chubby."

In general appearance *Amia* suggests somewhat the catfish. It is heavy bodied with a large and somewhat depressed head, and a well-rounded snout. In its movements it gives one a suggestion of its great strength. When observed cautiously it appears slow and deliberate, with the air of a creature which dreads no enemy; when startled, however, it pushes through the water quickly but clumsily. In shallows it often breaks the surface of the water and leaves a wake behind. In point of size the male and female differ notably. The female sometimes measures four feet in length, and weighs perhaps thirty pounds; the male is smaller and relatively of less weight. The sexes also differ in their coloration: at breeding time the male presents quite a brilliant appearance. Its color is chrome green, fading away into orange-yellow and

DOG-FISH, MUD-FISH, BOW-FIN OR GRINDLE. (AMIA CALVA.)
Upper figure Female. Lower figure Male.

creamy white below. At the side of its tail there is a conspicuous spot, with a ring of orange about it, and flecks of scarlet are sometimes seen, as in the specimen figured, on the sides of the body. The female, on the other hand, is somber in hue and scarcely shows the spot at the base of the tail. In the latter regard, however, the females show considerable variation: in some cases hardly a trace of this caudal spot can be seen. The accompanying colored plate represents the fish, male and female, in the colors they assume during the height of the breeding season. The drawings from which these figures were taken were colored from living specimens by the late Dr. Arnold Graf.

The dogfish has been described by some as diurnal, by others as nocturnal in its habits. In the daytime during the season of breeding the fish can readily be seen in shallow waters, and, when not actually on its nest, can sometimes be made to take a bait. At night, however, judging from my own experience with set lines, the fish is not often taken. And the result of my later observations is not favorable to the view that the dogfish is distinctly nocturnal in habit. With a view of determining how active the fish were at night, I have kept them in captivity and I have also watched them at different hours on their spawning grounds, when light was no more than sufficient to enable their outlines to be seen. My conclusions indicate that the dogfish is rather to be regarded as most active at twilight. It takes the hook best shortly after sundown and during the early morning, and at these times I have seen it exceedingly active under natural conditions. In a general way the fish can hardly be described as shy. As far as taking an alarm is concerned, it behaves very much as a catfish: it is certainly less apt to notice one's approach than, for example, many common teleosts.

The general habitat of the fish varies greatly at different seasons of the year. In summer it frequents deeper water; in spring it comes into the marshy shallows and makes its way through reedy places where the water is scarcely deep enough to cover its dorsal fin. In general it affects muddy water.

In the matter of feeding, the rapacious nature of the dogfish has already been noted. Its common articles of diet, as Fülleborn, for example, has noted, are small fishes and crayfish. The latter are especially common in the stomach contents. Among the specimens examined by the present writer was noted one, a female, measuring twenty-eight inches, which had eaten, among other things, a pickerel twelve inches in length. Another, a female measuring thirty-one inches, contained the columns of eleven fishes, cyprinoids, each about three inches in length. Another, taken at twilight near the margin of a rubbish heap, had eaten scraps of meat and a lump of a raw potato, the latter having been taken from the stomach altogether undigested. Among the local fishermen of the Wisconsin lakes, salt pork is well known as a "killing" bait. I have found no evidence that the dogfish eats fish, or more accurately *some* fishes, after they are dead. Dead perch and sunfish remain untouched, even in regions where *Amia* is very abundant.

II. Spawning.

The dogfish deposits its eggs in more or less definitely prepared nests.* These often occur very abundantly in the reedy shallows in the margins of the lakes. A particular region of the shore will often be given marked preference: in one case observed by the writer eleven nests occurred within a radius of fifty feet, and seven of these within a radius of fifteen feet. The spawning season, like that of all fishes, varies somewhat from year to year. In Wisconsin, where the fish have been most accurately observed, the height of the spawning occurs about the middle of May. It, however, varies in this locality from the first day of April until the early part of June. There is usually a maximum period of spawning, as in the case of other fishes.

The actual nesting habits of the fish have not as yet been examined in sufficient detail. There is good evidence to believe that the fishes divide into spawning parties, as in the case of the garpike, *Lepidosteus*, each party consisting of a female and several males. In a single instance the writer has seen three fishes on a nest after spawning had commenced. Whitman, on the other hand, maintains, also from a single observation, that but a single male is present. The eggs are scattered over the nests thickly, in number varying from a few hundreds to possibly a hundred thousand. A single male tends the nest, keeps away intruders, and by vigorous breathing produces a current of water which probably retards the growth of fish fungus. The fish stands guard, sometimes for hours motionless, save for its movements in balancing and breathing; at other times it appears restive, turning about in the nest, making short detours, and returning by the "runway" which it provides. A favorite position is for the fish to lie in the "runway" with its head projecting over the nest. It usually remains in the shaded side of the nest, but appears occasionally in bright sunlight, so that it can be seen quite a distance away. Such a fish, for example, has been photographed and is shown in the two cuts on the following page. These pictures clearly demonstrate that *Amia* does not hesitate to show itself in the sunlight, as Fülleborn early maintained. The outline of the nest in this case was clearly seen from the surface, and all of the "supernatant" rushes must have been brushed aside, or even removed by the fish, since the nest was photographed as it first appeared.

* The writer has obtained good evidence that inconvenient rushes are *bitten off* when the fish prepares the nest. This is also noted by Reighard.

FIGURE I.

FIGURE II.

FIGURE III.

FIGURE IV.

NESTS OF THE DOGFISH (*AMIA CALVA*).

MALE AMIA GUARDING NEST.

The eggs hatch out in the course of about a week, the length of time varying notably with the temperature of the water. The larvæ pass their first few days deep in the nest, where they attach themselves to *débris* by means of curious sucking disks developed on the under side of their snouts. In the course of another week or so, the young are probably herded together by the male fish, who leads his flock of young to various points in the neighborhood in search of food. This peculiar "nursing habit" of the male is known to continue until the young fish attain a length of several inches. During the later spring it becomes a common sight to see the male fish accompanied by a dense swarm of young, the latter appearing dark in color, and at first sight tadpole-like.

The foregoing description of the nesting of *Amia* may perhaps best be understood by reference to the accompanying figures, 1 and 2. In the first of these, in Figure 1, is shown a typical nest. This is located among very dense rushes, and the water in which the eggs lie is scarcely eight inches in depth. The rushes are flattened down to form the bottom of the nest and they are covered by thickly deposited eggs. The present photograph is taken from a nest which was quite open to the sunlight. In Figure 2 is pictured a nest which occurred in deeper water than the preceding. This too is shown in an altogether natural condition. Its depth is over two feet and its diameter over a yard. The bottom has been largely freed from rushes, these having been actually bitten off by the fish. Fresh cuts were apparent on the bases of rush stalks that were taken from this nest. In Figure 3 a surface view of another nest is shown, in which, again, the surface has not been disturbed. A clear space enables the sunlight to enter the nest. The nest, shown in Figure 4, has evidently been carefully prepared; its circular outline was of almost mathematical accuracy.

MALE AMIA GUARDING NEST.

A few rushes which were found floating on the surface were removed before the present photograph was taken. It was a nest of this kind which the writer sketched in an earlier paper on the subject. The present figure shows also the concave nature of the bottom of the nest, and it even indicates the delicate rootlets of the rushes projecting inward. It cannot be stated that the nest of the dogfish is *always* as elaborately constructed an affair as the present figure indicates.* In the writer's experience, however, he has found that a definitely prepared spawning place occurs in as large a proportion of instances as eight or nine out of ten. Occasionally, when the fish selects its spawning place in deeper water—four feet or more in depth,—the bottom and its adjacent hummocks may be of such a character that the fish can utilize the natural conditions with a minimum of effort. An instance of this kind is shown in Figure 5, where a natural outline for a nest is formed by clumps of rushes. The water is here slightly over a yard in depth. In the case of this nest there were no "supernatant" rushes present. The eggs were exposed to the sunlight and the fish itself was largely exposed. Even at this depth the eggs can be seen clearly a couple of yards away; there seems to be a peculiar brilliancy to the eggs which causes them to stand out in bold relief against the dull colored background. Perhaps the most characteristic nest shown in the present figures is that of Figure 6. It was photographed just as the boat approached it, and the guardian fish could still be clearly seen. It will be noted that the water surface is encumbered by but few rushes. The open space serves to let the light into the nest, and is, I believe, of direct value in hastening the development of the eggs. It is in this clear space, by the way, that the fish rises to the surface, from time to time, for respiration. Another very typical nest is that shown in Figure 7. This, too, was photographed at the first approach of the boat, the fish having just been driven away. Here again the central portion of the nest is entirely open; the "supernatant" reeds are practically absent and it is only the slight overbending of the marginal rushes which makes the nest appear at the surface smaller than it really is. To give an idea of the general character of the bottom of such a nest, the writer caused it to be removed. The rootlets which attached it below were clipped away, and a towel was passed beneath it. The bottom of the nest was now lifted out but little injured. It was then placed in a bucket of water and photographed (Figure 8). The present illustration is accordingly of interest as showing the exact character of the bottom of a nest. One observes the dense masses of eggs scattered upon it, and the mossy and matted rootlets which smoothly line it, which suggests the lining of the nest of a bird. Before concluding this section of the present paper the writer may be permitted to quote several para-

* The fish, as Fülleborn notes, is "particular" in selecting the site of its spawning place. And favorable nesting places are probably occupied from year to year.

graphs from one of his earlier papers; these add several details to the history and habits of the newly hatched fish:

"After hatching, the young fish remains inactive for several days, during both day and night, at all events under the living conditions offered in an aquarium. There is a marked tendency for the larva to attach itself by its sucking disk, but, rather curiously, it does not seem to become attached to the surrounding stems and leaves of the water weeds; it sinks to the bottom, and there, lying on its side, rests attached to whatever may have been touched. In case no solid object comes in contact, the sucking disk functions, nevertheless, and becomes covered with sediment.

"The larvæ of the second, third and fourth day exhibit considerable advances; they depend less upon their sucking disk, and occasionally exhibit a spasmodic activity; when touched, they wiggle about rapidly for a short distance, and then sink motionless, resting on their sides. As in the younger stage, there is a tendency to swim head downward.

"The larvæ of the fifth, sixth and seventh day have become notably active in their movements, are restless, and can with difficulty be kept, even for a few minutes, in a single spot. When not swimming they rest on their yolk-sac, in a normal position; but even then their large pectoral fins are kept in constant movement, as if serving as balancers. They disliked to be turned on their sides. They breathe with quick movement, the mouth and gill covers opening and shutting widely.

"The larvæ of the second week begin to attain the characteristic movements of the adult fish; they balance themselves with inconspicuous movements of the fins, pectorals and dorsals. Their firm movements in swimming are now in contrast to the wiggling motions of the younger stages. The caudal fin has become the main organ of propulsion. It is at this period that the young fish have been seen near the surface attended by the male, in dense swarms often of several thousand. As previously noted by the writer, the habits of the young fish under these conditions may be readily observed; the attendant male may be closely approached, and its movements followed. In a slow and cautious way he circles about, now over and now under his swarming charges, watchful apparently that the stragglers shall be kept up to the rest; and in their turn, the young fish seem to fully realize that it is their duty to keep as close as possible to the guardian It was found by the writer by no means easy to approach the male fish without attracting his notice; he appears to be constantly watchful, and when alarmed exhibits the greatest solicitude for his charges. Sometimes he backs quietly into some reed-screened pool, hiding below in the shadow of floating weeds, his presence betrayed only by the black mass of larvæ about him; at other times he will skulk cautiously away, drawing the swarm after him as rapidly as possible. His duty is clearly to care for his charges, and in the majority of cases, when he finds it impossible to carry them off with him, he will remain quietly and face the enemy. In one instance he was actually pushed away. There can be no question, the writer believes, that the feeling of alarm of the guardian may be transmitted to the young; for in case of need the swarm can be moved more rapidly, the young, excited in their movements, appearing to draw more closely together; under all circumstances they appear to be careful not to disperse. When the male has been driven away, the swarm sometimes becomes so dense that it may be taken almost to a fish by a single dip of the scap-net; if not interfered with, it will gradually move away and take refuge among the floating weeds, often so perfectly that no traces of it can be noticed. Exactly to what period the larval *Amia* remains in company with the male fish has not been determined. The smallest which in any case the writer observed measured five eighths of an inch, the largest one inch; and as these notes have been made from a large series of swarms, during a period of about two weeks, there is ground for believing that the time of the guardian's care of the movements of the young extends from, at least, the stage in which the yolk supply is exhausted, to that in which the caudal fin and scales have attained the adult outlines—a time certainly not less than four weeks.*

"The rate of growth of larvæ of the same swarm has been observed to be approximately uniform, the individual differences depending rather upon size than upon actual developmental advances; larvæ of apparently the same stage of development vary in length as much as three eighths of an inch. In some cases, however, the range in development seems, as nearly as could be determined, to have been equivalent to a difference of two or three days.

"Upon the dispersal of the swarm, the larvæ appear to make their way to the well-weeded shallows of the neighborhood; here they remain during the first summer, occasionally taken along adjacent shore reaches in the drawing of the minnow nets. Mr. Henry G. Meyer, to whom the writer has hitherto referred for his kindness during collecting trips, has stated that during the first summer many of the fishes will be taken in and near the mouths of the small streams that feed the lake chain of Pewaukee. It may, at all events, be surmised that the habits of the late larvæ of *Amia* do not differ widely from those of the prevailing forms of the local teleosts."

III. Means Suggested for Reducing the Numbers of the Dogfish.

The foregoing notes upon the spawning and habits of the dogfish provide the fish culturist, I am convinced, with data which should enable him, and with relatively little trouble, to materially reduce their numbers in localities where they abound. He learns, for example, that these fish will repair to a more or less definite locality at the time of spawning, and that here in the shallows their nests can be readily found and destroyed. He concludes, furthermore, that without extraordinary effort he can secure the male fish which guards the nest and young. This he can take either by snare or by spear. As the first step in reducing the numbers of dogfish, he finds it of course necessary to determine accurately the time of spawning; in this he is helped, since the general limits of the season have been already indicated. The exact time of spawning may usually be determined with but little difficulty, for the splashing of the fish during the early days of spring may be looked upon as an indication that spawning has either begun or is about to begin. An occasional rise in the shallows is thus found to mark the preparation for spawning; a continuous and noisy splashing, one which can be

* "The writer has recently learned from his friend Mr. F. B. Sumner, that the period of the attendance of the male is much longer than at first supposed. In Minnesota, Mr. Sumner records the taking of a swarm of *Amia* larvæ in which the individuals measured three to four inches in length, and must have been about four months old. A remarkable fact in connection with them was that all of these young fishes (females, therefore, as well as males, although no dissections were made to determine sex) had acquired the characteristic coloration of the male, with the prominent orange and black spot on the caudal fin."

FIGURE V.

FIGURE VI.

FIGURE VII.

FIGURE VIII.

NESTS OF THE DOGFISH (*AMIA CALVA*).

noted at a distance of a hundred yards or more, is, in the experience of the present writer, a most useful sign that the fish are actually spawning. At this time, perhaps, the greatest difficulty will be experienced in approaching the fish closely enough to capture one or more of them. A slight movement is sometimes enough to give the alarm. And a further difficulty in capturing them at this time is the muddiness of the water, caused by the energetic movements of spawning. In some localities, no doubt, nests are more easily found than in others, but in a general way the writer believes that there are few fishes in our fresh-water lakes whose eggs and young can be secured with less difficulty than those of the dogfish. Should the novice in collecting fail to find at once one of their nests, the rush and splash of the escaping guardian fish will often give a sufficiently obvious hint as to the location of a nest. I may note, furthermore, that the dogfish does not prove itself skillful in throwing a human enemy off the scent; one rarely finds that a fish will move away quietly from the nest and then make a noisy escape in order to divert the collector. The fish, on the other hand, is far more likely to remain on the nest till the boat is actually upon it, when with a sudden plunge it reveals the exact position of the nest. So fearlessly does it stand its ground that in several cases noted by the writer, the fish was not discovered until the stern of the boat had passed over it. There may indeed be cases where, although almost touched by the bottom of the boat, the fish has been actually overlooked; but as the writer has noted, the shape of the nest is so often shown at the surface of the water, that one can frequently detect it before any sign of the fish is visible.

Furthermore, the habit of the dogfish in accompanying its young for a number of weeks after hatching gives the fish culturist another valuable hint. With little difficulty many schools of young dogfish can be found and destroyed. The very fact that the young when alarmed draw together into a more and more compact mass puts them readily into the hands of the collector—although on the other hand, this habit has doubtless proved of great value as a means of preserving them from rapacious fishes; for should the young scatter at the first alarm, they could obviously be less perfectly protected by the parent fish.

In conclusion, accordingly, I think it is fair to assume that whenever it becomes necessary, dogfish can be readily destroyed. The fish themselves can be speared when they appear at the season of spawning; their nests can be found and destroyed; and young fish can later be taken, and in large numbers, when in company with the male fish. I am led to believe that a single collector, operating in a lake several miles in length, could in one season reduce the supply of dogfish in a very effective way.

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TEMPTATION.

Schedule of Prosecutions for Violations of Fish, Game and Forest Laws for the Fiscal Year Ending Sept. 30, 1898.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. Albert E. Jones,	Steuben,	John L. Ackley,	$65 00
" Edward Hammond,	Schuyler,	"	15 00
" Charles F. Beebe,	Yates,	"	11 00
" Henry Conklin,	"	"	11 70
" William Townsend,	"	"	11 70
" James Conklin,	"	"	11 00
" F. J. Carr,	"	"	Sentence susp.
" Charles Dart,	"	"	11 00
		Total,	$136 40
People vs. Sidney Trombler,	Franklin,	W. J. Alfred,	$75 00
People vs. Cash. Lamy,	Essex,	F. S. Beede,	Acquitted
" Albert Winch,	"	"	$15 00
" Elmer Grinshaw,	"	"	25 00
" James Kennedy, }	"	"	60 days in jail
" Andrew Burgess, }			
" John Mohler, }	"	"	30 00
" H. M. Stevenson, }			
" George Reniger,	"	"	30 days in jail
" George Hotaling,	"	"	80 60
" Andrew Sheldon,	"	"	50 00
		Total,	$200 60
People vs. George Baxter,	Monroe,	E. I. Brooks,	H'ld for Gr. J'ry
" Frederick Josh,	"	"	"
" John Cline, }	"	"	Sentence susp.
" Henry Seager, }			
" Manley B. Thurston,	"	"	H'ld for Gr. J'ry
" Henry Stein, }	"	"	Pd. court costs
" Jacob Stein, }			
" Jacob Schlaefer,	"	"	Acquitted
" Jacob Wagman, }	"	"	$52 00
" George Martin, }			
" Burt Bence, }	"	"	55 00
" James Hallings, }			
" Charles Biesiegel, }	"	"	Acquitted
" Louis Lockwood, }			

SCHEDULE OF PROSECUTIONS.—CONTINUED.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. Alfred Chambers, . .	Monroe, .	E. I. Brooks, . .	Acquitted
" Frank Chapman, . .	" .	" . .	$10 00
" Charles Childs, . .	" .	" . .	15 00
" Hiram Greene et al., .	" .	" . .	Acquitted
		Total,	$132 00
People vs. A. Mennesising, . .	Wayne, .	George Carver, . .	$10 00
" William A. Myers, . .	" .	" . .	250 00
		Total,	$260 00
People vs. James H. Thompson, .	Wyoming, .	T. H. Donnelly, . .	$25 00
" William Crocker, . .	Allegany, .	" . .	3 months in jail
" Charles Newton, . .	" .	" . .	30 days in jail
" Frank Gorton, . .	" .	" . .	50 00
" Harris F. Wells, . .	" .	" . .	50 00
		Total,	$125 00
People vs. Donald Shafer, . .	Schoharie, .	L. S. Emmons, . .	$10 50
" G. J. Vanderwerker, .	Otsego, .	" . .	Acquitted
" David B. Scott, . .	Sullivan, .	" . .	75 00
" A. Basso, . . .	Orange, .	" . .	100 00
" Charles M. Stubbs, .	Sullivan, .	" . .	100 00
" W. A. Robinson, . .	Chenango, .	" . .	Acquitted
" F. L. Strain, . . } " Murray Bostwick, . }	Otsego, .	" . .	"
" A. D. Ward, . . .	Delaware, .	" . .	20 45
" William Osterhout, . .	Otsego, .	" . .	26 50
" Robert Clark, . .	Sullivan, .	" . .	16 00
" Stephen Terpening et al.,	Otsego, .	" . .	100 00
" Cyrus Crounse, . .	Albany, .	" . .	20 00
" George W. Thomas, .	Otsego, .	" . .	10 00
" W. Neir et al., . .	Delaware, .	" . .	100 00
		Total,	$578 45
People vs. William Darling, . } " William Collier, . }	Suffolk, .	John Ferguson, . .	Pd. court costs
" George W. Hulse, . .	" .	" . .	$50 00
		Total,	$50 00

SCHEDULE OF PROSECUTIONS.—Continued.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. E. F. Steinberg,	Oswego,	Spencer Hawn,	$30 00
" John Belknap,	"	"	Acquitted
" Earl Degolia et al.,	Onondaga,	"	50 00
" Dwight Wager,	Oswego,	"	22 75
		Total,	$102 75
People vs. John S. Lucas et al.,	Richmond,	Edgar Hicks,	$190 00
" D. Haly & Co.,	New York,	"	50 00
" Bernard Cone,	"	"	176 00
" S. L. Storer & Co.,	"	"	118 00
" N. Y. Fish Co.,	"	"	116 00
		Total,	$650 00
People vs. Ira Fiske,	St. Lawrence	E. A. Hazen,	$10 00
" W. & J. Holliday,	"	"	12 25
" John Bateman,	"	"	5 00
" Jos. Barley,	"	"	6 50
" Wesley Cline,	"	"	17 00
" Charles Dart,	"	"	15 00
" Bert A. Petrie,	"	"	100 00
		Total,	$165 75
People vs. E. B. Barton,	Broome,	James Holmes,	$10 70
" James C. Sargent,	Tioga,	"	25 70
" Benjamin Ritz,	Broome,	"	13 50
" Charles Johnson,	"	"	13 50
" A. & F. Hyde,	Tioga,	"	Acquitted
" C. O. & J. Smith,	"	"	"
" E. M. Goodspeed,	"	"	25 00
" George Severson,	"	"	12 00
" Judson Courtright,	"	"	25 00
" E. Hallenbeck, Jr.,	"	"	15 00
" William H. Jackson,	"	"	15 00
" Josh. Nowland,	"	"	Pd. court costs
		Total,	$155 40
People vs. Freeland Jones,	Hamilton,	Carlos Hutchins,	$25 00
" Isiah Perkins,	"	"	100 00
" Robert Shaw,	"	"	357 17
		Total,	$482 17

SCHEDULE OF PROSECUTIONS.—Continued.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. Lewis Titch,	Ulster,	Robert S. Jones,	Acquitted
" George C. Eckert,	"	"	$5 00
" Joseph Deitz,	Sullivan,	"	Acquitted
" James Conley,	Orange,	"	25 00
		Total,	$30 00
People vs. William F. Quackenbush,	Orange,	Willett Kidd,	$25 00
" D. W. Wynkoop,	Ulster,	"	25 00
" Jos. Morgan et al.,	Orange,	"	Sentence susp.
" Stephen Garrison, } " M. L. Morehouse, }	"	"	100 days in jail
" Peter Conklin,	Tompkins,	"	Jury disagreed
		Total,	$50 00
People vs. Henry Coonrad, } " John Steves, }	Onondaga,	James H. Lamphere,	$60 00
" Earl Babcock,	Cayuga,	"	30 00
		Total,	$90 00
People vs. Lewis Gerhardt, } " John Bellanger, }	Fulton,	John E. Leavitt,	$26 00
" M. N. Mayhew,	Oneida,	"	200 60
" John S. Dater,	Saratoga,	"	12 50
" John McClelland,	Herkimer,	"	25 00
" William H. Brown,	Rensselaer,	"	25 62
" Theodore R. Fallis,	Fulton,	"	Acquitted
" Frank Moore, } " James N. James, }	"	"	49 00
" S. B. Leavenworth,	"	"	Judgment 111 31
		Total,	$450 03
People vs. Rudolph Magnus,	Franklin,	James W. Littlejohn,	$55 00
" Elijah E. Miller,	"	"	176 25
" S. W. Roarke,	"	"	150 00
" A. S. Abbott,	"	"	26 31
" M. D. Lyon,	"	"	16 30
" Albert McCann,	"	"	51 50
" C. A. McArthur,	"	"	30 00
		Total,	$505 35

SCHEDULE OF PROSECUTIONS.—CONTINUED.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. George Adams,	Fulton,	E. J. Lobdell,	$25 00
" Oliver Whitman,	Hamilton,	"	30 days in jail
" Adelbert Carpenter,	"	"	15 00
" Robert Peck,	"	"	Acquitted
" Oliver Whitman,	"	"	75 days in jail
" Benjamin Sweet,	"	"	15 00
" Albert T. Peck,	"	"	170 00
" William Green,	Albany,	"	25 00
" Jesse Honeywell,	Hamilton,	"	300 50
" Nathan Lamphere,	"	"	40 days in jail
" Henry Page,	"	"	" "
" John Burton,	"	"	10 00
" George N. Barrows,	"	"	10 00
" Melvin Parker,	"	"	25 days in jail
" James McGilfrey,	Rensselaer,	"	25 00
" A. A. Webster,	Hamilton,	"	15 25
" Charles Parquette,	"	"	15 00
" Wilfred Colombe,	"	"	100 00
" Hannah Nolan,	Saratoga,	"	25 00
" Antonie Colombe,	Hamilton,	"	150 00
" John Davison,	"	"	35 00
" John Rogers,	"	"	15 00
" Arch Braham,	Fulton,	"	20 00
" Hiram Scribner,	Hamilton,	"	20 00
" William Edget,	Herkimer,	"	11 00
" Frederick Lyon,	"	"	11 00
" E. E. Ash,	"	"	10 25
		Total,	$1,023 00
People vs. E. H. Hanson,	Delaware,	D. H. McKinnon,	$15 00
People vs. Frank Davis,	St. Lawrence	B. H. McCollum,	Acquitted
" Bert Clark, / " Ralph Pelky,	"	"	Case withdrawn
" Augustus Richie, / " Elizar King, / " James Safford,	"	"	$60 00
" William Hall,	"	"	50 00
" Thomas Sharrow et al.,	"	"	30 00
" Henry Coffee,	"	"	Acquitted

SCHEDULE OF PROSECUTIONS.—Continued.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. William J. Horton,	St. Lawrence	B. H. McCollum,	$30 00
" J. S. Graves,	"	"	35 00
		Total,	$205 00
People vs. Sanford McCue,	Jefferson,	Joseph Northup,	$11 50
" Stephen Martin, } " John Gladd, }	"	"	20 00
" William Otis,	"	"	12 00
" Elmer Snell,	"	"	36 00
" Orie Tucker,	"	"	12 00
" George Parrigo et al.,	"	"	40 00
		Total,	$131 50
People vs. George West, } " Matthew Armer, }	Saratoga,	J. W. Pond,	$850 00
People vs. William Van Dyck,	Niagara,	D. N. Pomeroy,	$33 50
" James O'Horo et al.,	Erie,	"	47 00
" William Gersbach et al.,	"	"	Acquitted
" Henry Haverick et al.,	"	"	50 00
" S. & W. Noble,	"	"	Case withdrawn
" Edw. Martin,	"	"	"
		Total,	$130 50
People vs. A. H. Swingle,	Chautauqua	F. M. Potter,	$12 50
" J. Ō. Freed,	"	"	17 50
" Frederick Sindberg,	"	"	10 00
" Warren Towne,	"	"	25 00
" Newton Smith,	"	"	13 00
" L. A. Sprague,	"	"	17 00
" C. F. Herrick,	"	"	17 00
		Total,	$111 00
People vs. Joseph Esta,	Oneida,	Samuel Piersall,	$50 00
People vs. Patrick Logan,	Ontario,	W. L. Reed,	$25 00
" James Camp, } " Frederick Robin, }	"	"	10 00
" Robert H. Wiley,	"	"	63 30
" James Barber,	"	"	Acquitted

SCHEDULE OF PROSECUTIONS.—CONTINUED.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. Fred. Cratsley,	Ontario,	W. L. Reed,	$2 50
" William H. Leach,	Yates,	"	Acquitted
" George Collier,	Ontario,	"	"
" Jonathan Colgrave,	Livingston,	"	"
		Total,	$100 80
People vs. George Johnson et al.,	Madison,	R. M. Rush,	$115 00
" Chester Vaughn,	Oneida,	"	75 days in jail
		Total,	$115 00
People vs. Harvey Elkins,	Cattaraugus,	B. Salisbury,	$15 00
" William Walsh,	"	"	217 17
" James Hutchinson,	Chautauqua,	"	160 00
" Rodner G. Bailey,	Cattaraugus,	"	25 00
		Total,	$417 17
People vs. Matthew Armer,	Saratoga,	Nicholas Shaul,	$300 00
People vs. Henry Voran,	Clinton,	James F. Shedden,	$10 00
" Halsey Mitchell,	"	"	200 00
" Eli Cameron, } " Henry Duprey, }	"	"	23 50
" Peter Beshaw,	"	"	15 00
		Total,	$248 50
People vs. J. M. Welsh,	Schuyler,	George B. Smith,	$100 00
" William Revault et al.,	Steuben,	"	50 00
" Casper Volkes,	"	"	26 00
" C. & A. Ross et al.,	"	"	Sentence susp.
" Herdick Parker,	Ontario,	"	"
" Perter Knoblock et. al.,	Steuben,	"	69 40
" T. G. Stewart,	"	"	85 00
" William Hamilton et al.,	"	"	Pd. court costs
" Adam Vose et al.,	"	"	"
" William Eggleston,	"	"	Case withdrawn
" Benjamin Bunnell et al.,	Chemung,	"	59 75
" P. H. Shovalier,	Tompkins,	"	50 days in jail
" Eli A. Bishop,	"	"	25 "
" Lewis Bloom,	"	"	17 00
		Total,	$407 15

SCHEDULE OF PROSECUTIONS.—Concluded.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. James Mosher,	Lewis,	H. L. Wait,	$25 00
People vs. Albert Belknap,	Oswego,	Albert Warren,	$66 00
" Eben Tallman,	Oneida,	"	12 00
" James F. Griffing,	"	"	40 00
" Edwin Radford,	"	"	40 days in jail
" W. M. Vandenburgh,	"	"	35 00
		Total,	$153 00
People vs. James Palmer et al.,	Washington,	Alvin Winslow,	$75 00
" John MacDonald, Jr.,	Saratoga,	"	50 00
" Arthur Lyle, } " William Everts, }	Warren,	"	50 00
" Charles Smith,	"	"	15 00
" Royal Steves, } " Norman McMore, }	Washington,	"	8 00
" Samuel Stiles,	"	"	40 00
" O. W. Sheldon,	"	"	270 00
		Total,	$508 00
People vs. G. Christopher,	Kings,	A. A. Wyckhoff,	Sentence susp.
" Theo. Kraus,	Queens,	"	$30 00
		Total,	$30 00
People vs. O. M. Bennett,	Genesee,	M. C. Worts,	$25 00
" P. M. Freeman,	Franklin,	"	10 00
" F. S. Vaughn,	Genesee,	"	50 00
" William Johnson,	"	"	25 00
		Total,	$110 00

Schedule of Prosecutions for Violations of Fish, Game and Forest Laws for the Fiscal Year Ending Sept. 30, 1898.

BY SPECIAL PROTECTORS.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. M. M. Gatling,	Warren,	William H. Burnett,	$10 00
" Ira Cole,	"	"	10 00
		Total,	$20 00
People vs. Charles Wolf,	Cattaraugus,	George H. Bush,	$15 00
" Carl Zimmerman,	"	"	15 00
" F. A. Sherwood,	"	"	Pd. court costs
" John Blanchard,	"	"	Acquitted
		Total,	$30 00
People vs. R. C. Hatch et al.,	Westchester,	Jos. Canepi, Jr.,	$100 00
" Toney Costello et al.,	"	"	186 00
" Charles Rondienane,	"	"	25 days in jail
" Michael Rondienane,	"	"	35 00
		Total,	$321 00
People vs. Harvey L. Jones,	Saratoga,	Moses S. Capen,	$50 00
People vs. James Lynch,	Dutchess,	George A. Case,	$25 00
" Charles L. Miller,	"	"	15 00
" Austin Griffith,	"	"	Sentence susp.
		Total,	$40 00
People vs. James Moore,	Onondaga,	William Everson,	$193 32
" Fred. Myers, " George Simpson,	"	"	20 00
" Otto Sutser, " Matthew Menton,	"	"	15 00
" John Waldo,	"	"	Sentence susp.
" Frederick Barnes,	"	"	25 00
" Otto Wasmand,	"	"	25 00
" Ed. Joy,	"	"	Sentence susp.
		Total,	$278 32
People vs. George Miller et al.,	Cayuga,	George Geraghty,	$20 00

SCHEDULE OF PROSECUTIONS.—Continued.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. Myron Bridges,	Monroe,	C. S. Gifford,	Acquitted
People vs. Henry J. Gardner,	Suffolk,	M. M. Jackson,	$14 50
" William H. Warner,	"	"	Acquitted
		Total,	$14 50
People vs. Nelson Davis,	Dutchess,	Charles Knox,	$35 00
" Sherman Denton,	"	"	15 00
" Stephen O. Davis,	"	"	15 00
		Total,	$65 00
People vs. James Harmon, / " Thomas Murphy,	Dutchess,	Ed. Lasher,	$20 00
" A. D. Conklin,	Columbia,	"	10 00
" Roscoe Coons et al.,	"	"	30 00
		Total,	$60 00
People vs. August Rambask,	Richmond,	John W. Lisk,	$267 50
" Charles Webber,	"	"	10 00
		Total,	$277 50
People vs. John Rigney,	Monroe.	Simon Marshall,	$58 25
" William Nash,	"	"	Waived Exam'n
" Charles Corbitt,	"	"	50 00
" Sidney Church,	"	"	Acquitted
		Total,	$108 25
People vs. William K. Holmes,	Wyoming,	Charles M. Munger,	$15 00
People vs. Ezra Zeliff,	Allegany,	J. F. Oline,	$15 00
People vs. Lyman Dart et al.,	St. Lawrence	Jos. Sterling,	$10 00
People vs. Josh. Geannotte,	Westchester,	George W. Van Buren,	$20 25
" Apostoh Tomaso,	"	" "	30 00
" David Smith,	"	" "	25 00
" August Weiland,	"	" "	20 00
" William Kramer,	"	" "	21 00

SCHEDULE OF PROSECUTIONS.—Concluded.

TITLE OF CASE	COUNTY	PROTECTOR	RECOVERY
People vs. C. W. Tompkins, . .	Westchester,	George W. Van Buren,	Acquitted
" Henry Hurguth, . .	"	" "	$41 40
		Total,	$157 65
People vs. Harmon Simmons, . .	Dutchess, .	Charles Van Steenburg,	$15 00
People vs. Diefendorf et al., . .	Oswego, .	Charles Vogelsang, .	$53 10
" W. S. Tafft et al., . .	" .	" . .	29 30
		Total,	$82 40
People vs. J. W. Watts, . . .	Franklin, .	Isaiah Vosburg, . .	$63 55
" Charles Stevens, . .	" .	" . .	62 30
" Frederick Reynolds, .	" .	" . .	Acquitted
		Total,	$125 85
People vs. Leland Sanders, . .	Chenango, .	Garret R. Wheeler, .	Acquitted
" A. B. Haight, . .	Oneida, .	" .	$25 00
		Total,	$25 00
People vs. John Tanner, . . .	Saratoga, .	William Wolf, . .	$12 50
People vs. Conrad Fox, . . .	Ontario, .	Dennis P. Wood, . .	$15 00

Record of Illegal Devices Seized and Destroyed during the Fiscal Year Ending September 30, 1898.

BY THE REGULAR PROTECTORS.

John L. Ackley.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
October,	1897, .	..	..	5	..	..	..	6	..	$31 00
November,	" .	1	..	8	..	..	..	2	..	43 00
April,	1898, .	..	..	1	..	..	..	4	..	9 00
May,	" .	..	..	1	..	1	..	5	..	70 00
June,	" .	..	..	27	..	1	..	7	..	181 50
July,	" .	..	..	32	..	..	..	5	..	97 50
August,	" .	..	..	41	..	..	..	2	..	284 50
September,	" .	..	..	22	..	..	..	..	..	195 00
	Total,	1	..	137	..	2	..	31	..	$911 50

E. I. Brooks.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
October,	1897, .	15	..	4	..	..	..	..	..	$275 00
November,	" .	8	..	1	..	..	..	..	..	121 00
December,	" .	9	..	4	31	..	..	..	..	398 00
January,	1898, .	3	..	1	..	..	..	..	..	38 00
February,	" .	3	..	1	2	..	..	..	..	70 00
March,	" .	16	..	5	..	..	..	1	..	259 50
April,	" .	20	..	3	..	..	..	1	..	304 50
May,	" .	29	..	18	13	..	..	1	..	658 00
June,	" .	25	..	8	48	1	..	1	..	1,082 50
July,	" .	3	..	10	..	..	..	..	..	213 00
August,	" .	..	..	2	..	..	..	..	..	55 00
September,	" .	1	..	3	..	..	..	..	..	57 00
	Total,	132	..	60	94	1	..	4	..	$3,531 50

Thomas Carter.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
December,	1897, .	..	..	..	..	1	..	..	..	$60 00
March,	1898, .	..	..	..	5	1	..	..	..	73 00
April,	" .	1	1	..	14	2	..	..	..	221 00
May,	" .	2	..	..	13	2	..	..	..	163 00
June,	" .	4	..	..	8	..	..	..	..	102 00
July,	" .	9	12	..	7	2	..	..	..	619 00
August,	" .	29	2	..	32	..	..	..	..	409 00
September,	" .	20	2	1	15	2	..	..	..	599 00
	Total,	65	17	1	94	10	..	..	..	$2,246 00

GEORGE CARVER.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
December,	1897, .	1	..	..	..	..	..	..	..	$20 00
March,	1898, .	12	..	8	..	..	..	..	..	260 00
April,	" .	3	..	4	..	..	..	1	..	117 00
May,	" .	14	..	..	..	..	..	7	..	246 00
June,	" .	8	..	17	..	7	..	..	..	1,075 00
July,	" .	5	..	9	..	..	..	..	..	235 00
August,	" .	6	..	19	..	1	..	..	..	580 00
September,	" .	8	..	10	..	1	..	..	..	415 00
	Total,	57	..	67	..	9	..	8	..	$2,948 00

THOMAS H. DONNELLY.

May,	1898, .	..	..	..	..	..	..	2	..	$3 00
June,	" .	..	..	1	..	..	..	..	..	10 00
	Total,	..	..	1	..	..	..	2	..	$13 00

LESTER S. EMMONS.

August,	1898, .	..	..	..	..	1	..	..	..	$15 00

SPENCER HAWN.

October,	1897, .	..	8	..	..	1	..	..	..	$250 00
November,	" .	..	13	..	..	..	..	..	..	367 50
December,	" .	..	6	..	..	..	..	..	..	145 00
March,	1898, .	1	16	..	..	..	..	..	..	326 00
April,	" .	1	18	..	..	..	..	..	..	409 00
May,	" .	4	22	1	..	1	..	..	..	525 00
June,	" .	..	13	..	..	..	..	..	..	325 00
July,	" .	..	5	..	..	..	..	..	..	130 00
August,	" .	..	10	..	..	..	..	..	..	282 00
September,	" .	..	8	..	..	..	..	..	..	200 00
	Total,	6	119	1	..	2	..	..	..	$2,959 50

JAMES HOLMES.

May,	1898, .	..	..	..	..	..	..	2	..	$5 50
June,	" .	..	..	..	..	..	..	1	..	2 00
	Total,	..	..	..	..	..	..	3	..	$7 50

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Tip-ups	Value
Carlos Hutchins.										
May,	1898, .	..	..	..	..	..	..	2	..	$4 50
E. A. Hazen.										
October,	1897, .	1	..	4	..	..	..	8	..	$143 00
November,	" .	2	..	3	..	..	..	7	..	119 00
December,	" .	..	1	3	..	..	..	5	11	81 00
January,	1898, .	..	..	..	..	1	..	32	..	21 00
February,	" .	..	..	..	..	..	..	166	..	16 60
March,	" .	1	..	2	..	..	..	..	..	29 50
April,	" .	1	2	4	..	..	..	..	..	136 00
May,	" .	1	3	3	..	..	..	..	..	84 00
June,	" .	2	..	..	..	..	..	..	..	30 00
July,	" .	..	2	..	..	..	..	3	..	106 00
August,	" .	1	..	12	..	..	..	5	..	41 00
September,	" .	..	7	4	..	1	..	..	..	425 00
	Total,	9	15	35	..	2	..	226	11	$1,232 10
Willett Kidd.										
May,	1898, .	..	..	..	..	1	..	..	..	$50 00
June,	" .	4	..	..	..	..	..	..	..	30 00
July,	" .	..	..	..	..	..	..	1	..	3 00
	Total,	4	..	..	..	1	..	1	..	$83 00
James H. Lamphere.										
October,	1897, .	12	..	3	..	1	..	3	..	$180 00
November,	" .	11	1	..	..	..	..	1	..	102 00
December,	" .	1	..	..	..	..	..	..	..	25 00
January,	1898, .	1	..	..	..	..	..	..	..	10 00
March,	" .	31	..	..	..	..	..	..	..	340 00
April,	" .	19	..	..	..	..	..	..	..	190 00
May,	" .	32	2	1	..	..	..	..	..	395 00
June,	" .	9	..	..	..	..	..	..	..	90 00
July,	" .	18	..	..	..	..	..	..	..	180 00
August,	" .	1	..	..	..	..	..	..	..	10 00
September,	" .	9	..	..	..	..	..	..	..	90 00
	Total,	144	3	4	..	1	..	4	..	$1,612 00

John E. Leavitt.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Tip-ups	Set Lines	Spears	Value
June,	1898, .	..	..	..	..	1	..	..	..	$15 00
July,	" .	..	2	..	..	..	..	..	..	100 00
	Total,	..	2	..	..	1	..	..	..	$115 00

E. J. Lobdell.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Tip-ups	Set Lines	Spears	Value
May,	1898, .	5	..	..	..	..	..	..	..	$42 00
June,	" .	1	..	..	..	1	..	..	..	20 00
August,	" .	..	..	..	..	..	..	2	..	2 50
	Total,	6	..	..	..	1	..	2	..	$64 50

Josh. Northup.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Tip-ups	Set Lines	Spears	Value
October,	1897, .	..	..	5	..	..	..	7	..	$107 00
November,	" .	1	1	4	..	..	..	..	1	133 00
December,	" .	3	1	6	..	..	..	3	..	198 00
January,	1898, .	3	..	..	..	..	12	..	..	63 00
February,	" .	1	..	1	..	..	27	..	..	34 00
March,	" .	5	..	1	..	..	15	..	1	90 00
April,	" .	9	..	..	..	..	..	4	..	188 00
May,	" .	3	..	1	..	..	..	4	..	77 00
June,	" .	3	..	2	..	..	..	3	..	75 00
July,	" .	..	..	..	..	..	..	5	..	16 00
August,	" .	1	..	..	..	..	..	2	..	40 00
September,	" .	..	..	..	..	..	..	4	..	18 00
	Total,	29	2	20	..	..	54	32	2	$1,039 00

F. M. Potter.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Tip-ups	Set Lines	Spears	Value
March,	1898, .	..	..	..	..	..	..	4	..	$6 00
June,	" .	..	..	1	..	..	..	..	..	10 00
	Total,	..	..	1	..	..	..	4	..	$16 00

D. N. Pomeroy.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Tip-ups	Set Lines	Spears	Value
October,	1897, .	4	..	..	..	..	..	..	..	$40 00
November,	" .	2	..	..	1	..	..	..	..	16 00
January,	1898, .	5	..	..	..	..	..	..	..	50 00
	Total,	11	..	..	1	..	..	..	..	$106 00

W. L. Reed.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Minnow Nets	Set Lines	Spears	Value
October,	1897, .	2	..	..	..	..	..	..	..	$30 00
November,	" .	..	..	1	..	..	..	2	..	18 00
December,	" .	..	..	..	..	..	..	2	..	6 00
February,	1898, .	..	..	1	..	..	..	..	..	8 00
March,	" .	3	..	3	3	1	..	..	..	89 00
April,	" .	..	..	1	..	..	..	..	4	35 00
May,	" .	..	..	1	..	..	..	..	2	18 00
June,	" .	..	..	2	..	..	..	..	1	65 00
July,	" .	..	..	1	..	..	..	..	..	10 00
August,	" .	..	..	..	..	..	..	2	..	5 00
	Total,	5	..	10	3	1	..	6	7	$284 00

R. M. Rush.

October,	1897, .	..	..	..	..	1	..	..	..	$30 00

Newton A. Scott.

July,	1898, .	..	..	2	..	..	..	12	..	$24 00
August,	" .	..	..	1	..	..	..	19	..	38 50
September,	" .	..	..	..	..	..	..	5	..	7 50
	Total,	..	..	3	..	..	..	36	..	$70 00

George B. Smith.

October,	1897, .	4	..	..	..	..	..	2	..	$24 00
November,	" .	..	..	3	..	..	..	..	..	37 00
April,	1898, .	..	..	1	..	..	..	1	..	25 00
May,	" .	..	..	5	..	..	..	2	..	46 50
June,	" .	..	..	..	..	1	..	..	..	10 00
August,	" .	..	..	3	..	..	1	10	..	33 00
September,	" .	4	..	..	..	..	..	..	..	18 00
	Total,	8	..	12	..	1	1	15	..	$193 50

JAMES F. SHEDDEN.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
October,	1897, .	..	..	2	..	..	..	..	..	$10 00
December,	" .	2	..	..	..	..	..	..	..	30 00
March,	1898, .	..	..	10	..	..	..	..	..	50 00
April,	" .	5	..	..	..	..	..	..	..	75 00
June,	" .	..	..	2	..	..	..	1	..	17 00
July,	" .	..	..	..	..	2	..	..	..	60 00
August,	" .	..	..	2	..	..	..	..	..	10 00
September,	" .	..	..	1	..	..	..	..	..	7 00
	Total,	7	..	17	..	2	..	1	..	$259 00

STANTON J. TEFFT.

October,	1897, .	8	..	..	..	..	..	..	..	$55 00
March,	1898, .	3	..	..	..	..	..	..	..	12 00
April,	" .	3	..	..	..	..	..	..	..	30 00
June,	" .	..	..	..	..	..	..	1	..	1 50
July,	" .	..	..	..	..	..	..	1	..	1 50
	Total,	14	..	..	..	..	..	2	..	$100 00

ALBERT WARREN.

October,	1897, .	..	4	5	..	..	..	..	..	$190 00
November,	" .	..	13	..	..	..	..	..	..	367 50
December,	" .	..	5	..	..	..	..	..	..	125 00
March,	1898, .	..	16	..	..	..	..	..	..	320 00
April,	" .	1	18	1	..	..	..	..	..	409 00
May,	" .	4	11	..	..	..	..	..	..	625 00
June,	" .	..	13	..	..	..	..	..	..	325 00
July,	" .	..	5	..	..	..	..	..	..	125 00
August,	" .	..	9	..	..	..	..	..	..	253 00
September,	" .	..	8	..	..	..	..	..	..	200 00
	Total,	5	102	6	..	..	..	..	..	$2,939 50

Alvin Winslow.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Dip Nets	Set Lines	Spears	Value
October,	1897, .	9	..	..	..	..	..	..	..	$55 00
April,	1898, .	19	..	..	..	..	..	1	..	192 00
May,	" .	1	..	..	..	..	..	1	..	6 00
June,	" .	..	..	..	..	..	..	2	..	3 00
	Total,	29	..	..	..	..	..	4	..	$256 00

M. C. Worts.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Dip Nets	Set Lines	Spears	Value
October,	1897, .	4	2	..	..	..	..	..	..	$33 00
November,	" .	2	1	24	..	..	..	29	..	385 00
February,	1898, .	..	..	..	1	..	..	..	..	3 00
March,	" .	1	..	..	1	..	..	..	..	32 00
April,	" .	5	..	..	..	1	..	..	..	54 50
May,	" .	4	3	6	..	..	..	9	..	265 00
June,	" .	1	..	4	..	..	..	..	..	90 00
July,	" .	5	..	18	..	..	..	..	..	160 00
August,	" .	..	..	10	..	..	..	..	..	115 00
September,	" .	1	..	..	..	..	..	5	..	28 00
	Total,	23	6	62	2	1	..	43	..	$1,165 50

George W. Harmany.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Dip Nets	Set Lines	Spears	Value
March,	1898, .	5	..	..	..	1	..	..	..	$100 00
April,	" .	3	..	..	..	..	..	..	..	30 00
May,	" .	7	..	..	..	..	..	..	..	45 00
June,	" .	7	..	1	6	..	..	..	..	125 00
July,	" .	40	..	1	..	1	8	..	..	318 00
August,	" .	53	..	..	..	1	..	..	..	504 00
September,	" .	46	2	..	..	..	..	..	..	390 00
	Total,	161	2	2	6	3	8	..	..	$1,512 00

Samuel Piersall.

Month		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Dip Nets	Set Lines	Spears	Value
April,	1898, .	..	3	..	..	..	..	..	..	$60 00
May,	" .	..	3	..	..	1	..	..	..	205 00
June,	" .	..	4	..	..	..	..	..	..	200 00
July,	" .	..	5	..	..	..	..	..	..	100 00
August,	" .	..	2	..	..	..	..	..	..	45 00
September,	" .	..	8	..	..	..	..	..	..	200 00
	Total,	..	25	..	..	1	..	..	..	$810 00

Record of Illegal Devices Seized and Destroyed during the Fiscal Year Ending September 30, 1898.

BY THE SPECIAL PROTECTORS.

WILLIAM EVERSON.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
October,	1897, .	1	..	2	..	1	..	..	..	$58 00
November,	" .	19	16	2	..	..	..	1	..	467 00
March,	1898, .	2	1	7	..	..	..	..	..	83 00
April,	" .	4	1	..	3	1	..	2	2	67 00
May,	" .	2	..	4	2	..	..	..	..	42 00
June,	" .	2	1	2	2	1	..	..	..	78 00
July,	" .	..	..	3	2	1	..	..	..	40 00
August,	" .	..	1	6	..	..	..	..	..	66 00
September,	" .	4	2	3	..	..	..	..	..	80 00
	Total,	34	22	29	9	4	..	3	2	$981 00

JAMES H. GERAGHTY.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
October,	1897, .	11	..	2	..	..	..	..	..	$62 00
November,	" .	..	..	4	..	..	..	..	..	14 00
	Total,	11	..	6	..	..	..	..	..	$76 00

WILLIAM HARRIS.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
October,	1897, .	9	..	..	..	..	..	1	..	$82 00
November,	" .	20	..	..	..	..	..	..	..	156 30
December,	" .	11	..	..	..	..	..	..	..	88 00
January,	1898, .	5	..	11	..	..	..	..	..	100 00
February,	" .	3	..	..	..	..	..	4	..	50 00
March,	" .	19	..	1	..	..	..	2	..	194 00
April,	" .	9	..	..	..	..	..	..	..	82 00
May,	" .	2	..	..	..	..	..	..	1	22 00
June,	" .	4	..	..	..	..	..	..	..	32 00
July,	" .	10	..	..	..	..	..	..	..	48 00
August,	" .	8	..	..	..	..	..	..	..	40 00
September,	" .	2	..	..	..	..	..	..	..	16 00
	Total,	102	..	12	..	..	..	7	1	$910 30

RICHARD HAMPTON.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Spears	Value
July,	1898, .	4	..	..	..	..	..	..	..	$28 00

H. H. Kelsey.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Dip Nets	Value
March,	1898, .	4	..	2	..	..	..	..	..	$60 00
June,	" .	..	..	1	..	..	..	1	..	8 00
	Total,	4	..	3	..	..	..	1	..	$68 00

Clarence W. Lane.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Dip Nets	Value
March,	1898, .	2	..	..	..	..	..	..	..	$30 00
April,	" .	9	..	4	..	..	..	..	..	140 00
May,	" .	2	..	6	..	..	..	..	..	60 50
June,	" .	22	..	..	..	..	..	2	..	230 00
July,	" .	14	..	22	..	..	..	..	..	250 00
	Total,	49	..	32	..	..	..	2	..	$710 50

Simon Marshall.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Dip Nets	Value
October,	1897, .	1	..	3	..	..	..	..	..	$70 00
November,	" .	4	..	1	..	..	..	..	..	130 00
December,	" .	9	..	..	..	..	..	..	..	105 00
January,	1898, .	..	..	..	..	..	..	..	11	25 00
February,	" .	..	..	..	..	..	..	..	3	5 50
March,	" .	6	..	2	..	..	..	..	2	119 00
April,	" .	18	..	..	..	..	..	..	..	90 00
May,	" .	4	..	4	..	..	..	2	..	188 00
June,	" .	1	..	6	..	..	..	..	..	110 00
July,	" .	..	..	4	..	..	..	..	..	45 00
August,	" .	5	..	2	1	..	..	1	..	85 00
September,	" .	..	1	4	..	..	..	4	..	49 00
	Total,	48	1	26	1	..	..	7	16	$1,021 50

Bentley S. Morrill.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Seines	Pound Nets	Set Lines	Dip Nets	Value
November,	1897, .	2	..	1	..	2	..	..	..	$90 00
December,	" .	10	..	1	..	3	..	..	..	157 00
January,	1898, .	1	..	..	..	..	..	..	..	10 00
February,	" .	4	..	..	..	..	..	..	..	27 00
March,	" .	3	..	1	..	..	1	..	..	57 00
April,	" .	4	..	3	..	1	1	..	..	131 00
May,	" .	..	..	3	..	3	..	..	..	69 00
June,	" .	3	..	2	..	..	..	..	..	37 50
July,	" .	10	..	2	..	..	..	..	..	75 00
August,	" .	..	..	..	..	1	..	..	..	20 00
September,	" .	2	..	1	..	1	..	..	..	32 00
	Total,	39	..	14	..	11	2	..	..	$705 50

CHARLES M. MUNGER.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Set Lines	Spears	Scap Nets	Eel Weir	Value
March,	1898, .	. .	. .	. .	. .	. .	1	. .	. .	$2 50

H. W. SCHUMANN.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Set Lines	Spears	Scap Nets	Eel Weir	Value
June,	1898, .	1	. .	. .	. .	5	. .	. .	. .	$21 00

WARREN J. SLATER.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Set Lines	Spears	Scap Nets	Eel Weir	Value
October,	1897, .	. .	. .	1	. .	. .	. .	. .	. .	$10 00
November,	" .	. .	. .	3	. .	. .	. .	. .	. .	30 00
June,	1898, .	. .	. .	. .	. .	. .	. .	. .	1	8 00
July,	" .	. .	. .	1	. .	. .	. .	. .	. .	12 00
	Total,	. .	. .	5	. .	. .	. .	. .	1	$60 00

JOSEPH STERLING.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Set Lines	Spears	Scap Nets	Eel Weir	Value
October,	1897, .	. .	1	7	. .	. .	. .	. .	. .	$102 00
April,	1898, .	. .	2	7	. .	1	. .	. .	. .	165 00
May,	" .	. .	. .	8	. .	. .	. .	. .	. .	80 00
June,	" .	1	1	. .	. .	. .	. .	. .	. .	45 00
	Total,	1	4	22	. .	1	. .	. .	. .	$392 00

HENRY THURLOW.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Set Lines	Spears	Scap Nets	Eel Weir	Value
October,	1897, .	1	. .	1	. .	. .	. .	. .	. .	$18 00

CHARLES VOGELSANG.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Set Lines	Spears	Scap Nets	Eel Weir	Value
May,	1898, .	. .	. .	. .	. .	1	. .	. .	. .	$3 00

DENNIS P. WOOD.

MONTH		Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Set Lines	Spears	Scap Nets	Eel Weir	Value
June,	1898, .	1	. .	. .	3	. .	. .	. .	. .	$35 00
July,	" .	. .	. .	. .	. .	3	. .	1	. .	20 00
	Total,	1	. .	. .	3	3	. .	1	. .	$55 00

SUMMARY OF ILLEGAL DEVICES DESTROYED DURING THE FISCAL YEAR ENDING SEPTEMBER 30, 1898.

1897 and 1898	Fyke Nets	Trap Nets	Gill Nets	Squat Nets	Set Lines	Seines	Spears	Tip-ups	Minnow Nets	Value
Ackley, John L., .	1	...	137	...	31	2	...	...	...	$911 50
Brooks, E. I., .	132	...	60	94	4	1	...	...	...	3,531 50
Carter, Thomas, .	65	17	1	94	...	10	...	...	...	2,246 00
Carver, George, .	57	...	67	...	8	9	...	...	...	2,948 00
Donnelly, T. H., .	...	...	1	...	2	...	...	...	...	13 00
Emmons, L. S., .	...	...	...	...	...	1	...	...	...	15 00
Hawn, Spencer, .	6	119	1	...	...	2	...	...	...	2,959 50
Holmes, James, .	...	...	...	...	3	...	...	...	...	7 50
Hutchins, Carlos, .	...	...	...	...	2	...	...	...	...	4 50
Hazen, E. A., .	9	15	35	...	226	2	...	11	...	1,232 10
Kidd, Willett, .	4	...	...	...	1	1	...	...	...	83 00
Lamphere, J. H., .	144	3	4	...	4	1	...	...	...	1,612 00
Leavitt, John E., .	...	2	...	...	...	1	...	...	...	115 00
Lobdell, E. J., .	6	...	...	...	2	1	...	...	...	64 50
Northup, Jos., .	29	2	20	...	32	...	2	54	...	1,039 00
Potter, F. M., .	...	...	1	...	4	...	...	...	...	16 00
Pomeroy, D. N., .	11	...	...	1	...	...	...	...	...	106 00
Reed, W. L., .	5	...	10	3	6	1	7	...	...	284 00
Rush, R. M., .	...	...	...	...	...	1	...	...	...	30 00
Scott, N. A., .	...	...	3	...	36	...	...	...	...	70 00
Smith, George B., .	8	...	12	...	15	1	...	...	1	193 50
Shedden, James F., .	7	...	17	...	1	2	...	...	...	259 00
Tefft, S. J., .	14	...	...	...	2	...	...	...	...	100 00
Warren, Albert, .	5	102	6	...	...	...	...	...	...	2,939 50
Winslow, Alvin, .	29	...	...	...	4	...	...	...	...	256 00
Worts, M. C., .	23	6	62	2	43	1	...	...	...	1,165 50
Harmany, G. W., .	161	2	2	14	...	3	...	...	...	1,512 00
Piersall, Samuel, .	...	25	...	...	...	1	...	...	...	810 00
Total,	716	293	439	208	426	41	9	65	1	$24,523 60

Illegal devices destroyed by Regular Protectors	2,198.	Value, $24,523 60
Illegal devices destroyed by Special Protectors	509.	Value, 4,992 30
Total.........	2,707.	Value, $29,515 90

The Common Eel.

THE EEL SPEARERS.

MUCH has been written about the eel that is to-day absolutely valueless in the light of scientific research into the natural history of this fish, prosecuted by scientists chiefly in Europe; and when I was asked by Dr. John D. Quackenbos, of Columbia University, to "tell us something about eels," I gathered together bits of information from various sources regarding the common eel and sent the result to *Forest and Stream*, and that paper has given its consent to the re-publication of my article in this report, and I give it herewith as originally written in my Angling Notes in that journal.

Angling Notes.

EELS.

Dr. Quackenbos, who received the following letter, sent it to me with some comments of his own, and I copy both. The letter is dated Rahway, New Jersey, and reads as follows:

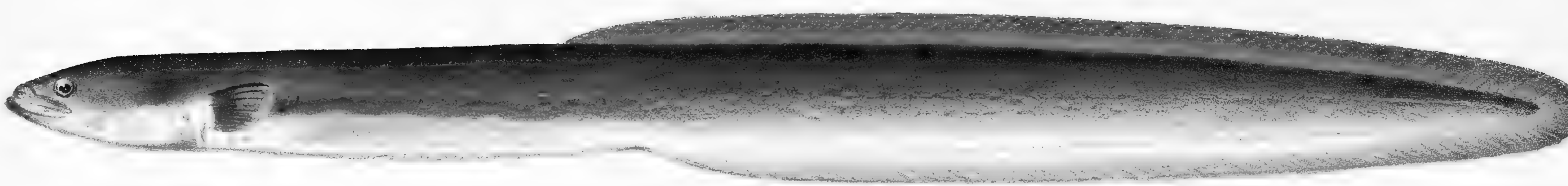
"The papers you sent me make me think of the time when we were boys fishing on the Rahway River on River street, shaded by large willows, water beeches, oaks and grapevines, with plenty of fish and clear sparkling water. I was skating last week from Gibbs' Island up to Bondley's on River street, and had lots of fun, but the water is so black from the dye factories above that we could not drink it, and all the fish die off, and the willows and other large shade trees are gone. Do you know anything about eels? I was told by a friend that there is a man on Staten Island who raises eels for market and does well with them, as he will not dress and sell them until two pounds in weight, and he sells only when there is a demand for them and they command a high price. This is the way he came to raise eels: There is a salt-water creek on his farm, and he thought he could rear ducks at a profit, and hatched out a large number and kept them on and in the creek, and fed them cracker dust and oatmeal, which he threw on the water at feeding time. After a time he noticed that eels came to the surface of the water to eat the food thrown for the ducks, and he assumed that they must have run up from the river below. He disposed of his ducks and made a screen across the creek at the bottom of his land, arranging an opening by which the eels could enter but could not return. In the winter he covers the creek with flooring so that the water will not freeze, and now at feeding time when the eels hear his footsteps they will come to the surface of the water in the creek for their meals. I could make an eel pond if I knew how long it takes to grow them to two pounds weight; so if you know please tell me, for this is no fish story, but an eel story that is true."

COMMENTS.

My friend commenting on this letter says: "The writer of the inclosed letter lives in Jersey and describes the decadence of my earliest hunting and stamping ground. I began with him as a small boy with pin hook and for 'sunnies,' and a bow-gun for blackbirds, and rose through the successive stages of penny hook and eighteen-cent pistol, dollar jointed pole and three-dollar sixteen-bore, purchased at a junk-shop with carefully saved dimes, to Leonard 5-oz., and Scott hammerless. Alas! the pellucid stream that heads in the Orange Mountains and used to yield the speckled starred! (Oh, how I remember a half-pound *fontinalis* we kept for more than a year in the well!) That stream now runs black dye stuffs to the kills. But the memory of those days will never die—and the boy who fished and hunted with me seems to love me still—loves me because I loved Nature with him. He may be poor, he may be unlearned, but, as Emerson says, we have something in common.

"He has within himself a god (as Pasteur calls it), a high ideal. His life is gentle. He cultivates Marie Louise violets for a living. Give us something about eels in *Forest and Stream*—eels, rapid growers, prolific to a fault. Centuries ago they got a lot of money out of them at Comacchio lagoons near Venice. Your friend Theodatus of patronymic says they are well suited to culture.

"And would you believe it, old Rondeletius (I have a printed copy, Lyons, 1554) says every eel is born in fresh water—*Anguilla omnis nascitur in aqua dulci*—and adds they go to sea or salt-water lagoons. His chapter on crustacean fish food is a marvel. I don't know whether Pinchon, who raised fish artificially in the century of Columbus, tried eels on. I am sure the Romans did, for Pliny tells how Pollio, the ass who cut his arteries when his fortune was reduced to five hundred thousand dollars, to save himself from starvation, used to pitch live negroes to his eels to give them a fine flavor. So tell us something about eels."



COMMON EEL.
(ANGUILLA ROSTRATA)

DOM PINCHON.

Before saying anything about eels, a word about Dom Pinchon, the French monk that my friend the doctor refers to. It has been claimed that he hatched fish artificially in 1420, but it is believed from the best evidence obtainable that he simply gathered and transplanted fish ova naturally fertilized, and that he knew nothing about artificial fish propagation as practiced to-day. Vrasski, the Russian fish culturist, who discovered the dry method of impregnating fish eggs, did try to cultivate the eel artificially, but how he succeeded history does not tell us; but we can guess pretty accurately from what we now know about eels.

The doctor says, "tell us something about eels in *Forest and Stream*"; but the last time I told about eels at any length, it was under oath as a witness in the Supreme Court in Brooklyn, and other witnesses had been testifying about fresh-water eels, and salt-water eels, and silver eels, and when an attorney asked me how many species of eels we had, and I said one, the presiding justice turned to the witness box and said, "What's that?" in such a surprised tone of voice that I did not know but we had other species that I did not know about; and if I write much about the eel in this column, I expect some *Forest and Stream* reader may ask, "What's that?"

EELS HAVE SCALES.

"True eels are characterized by their scaly skin in association with a conical head and a general resemblance to the congers."—*Jordan and Evermann.* It is true that the scales are imbedded, but the eel has them, and we have but one species, called American eel, or fresh-water eel, though when taken in salt water it is called salt-water eel or silver eel; but I have known species of trout to be called silver trout when they have been in salt water, or for a season on white sand in fresh water, which gives a silvery coating both to the brook and lake trout; but that is not the reason that eels have a silvery appearance. It may be as well to say here that the literature of the eel would fill several issues of *Forest and Stream*, as there has been much speculation about this fish, its habits, reproduction, and even its origin; and the scientists of the Old World have written elaborate papers on the subject of the eel within the past one hundred or more years to show what they did or did not know about it; but I shall be as brief as possible and boil down what is now known into as small space as possible.

BELIEFS AS TO ORIGIN OF THE EELS.

It is not necessary to dwell upon the early beliefs that the eel was generated from horsehairs, from dew, from slime, from the females of another fish; that the eel produced its young alive; that both turf and mud produced them, and that they were hermaphrodites, for to-day men may be found having just as strange ideas concerning the generation of the eel. It was not, however, until 1850 that Rathke definitely discovered the ovary of a female, and not until 1873 that Dr. Syrski discovered the male organs, and Dr. Jacoby completed the discovery in all its details in 1877; but even this discovery left a big gap in the life history of the eel. Adult eels leave the fresh water and go down to the sea, and elvers, three to five inches long, return in vast numbers from the sea to fresh water, the migration being called eel-fairs, from the Saxon term *fare*, to travel; but where they were hatched and how old they were and what became of the parent eels was unknown until 1894, when Prof. Grassi and Prof. Calandruccio, of Rome, cleared up some of these points by discovering the larvæ of the eel in the Mediterranean. To put the matter briefly, it is now maintained, in the light of the discoveries mentioned, that female eels only go into fresh water, while the male eels remain in the sea. Some females do not go to salt water to breed, because they are barren, and they remain permanently, it is assumed, in fresh-water ponds or lakes. What becomes of the adult eels after spawning is not positively known, but the females do not return to fresh water, and it is believed that they die, and possibly both sexes die.

SILVER EELS.

Of the silver eels Prof. Grassi says: "As a result of the observations of Peterson, we know now that the common eel develops a bridal coloration or 'mating habit,' which is chiefly characterized by the silver pigment without trace of yellow, and by the more or less black color of the pectoral fin, and finally by the large eyes."

Peterson's inference that this was bridal coloration was derived from the largely developed state of the reproductive organs and by their ceasing to take nourishment. Dr. Bean records five eels from Great South Bay, which are described as having "large eyes, short snout, and long pectoral fins as compared with the common form, silvery gray above with a clear satiny white abdomen, separated from the color above by the lateral line." They were found "to be males with the generative glands so well developed as to leave no doubt concerning the sex."

DR. GRASSI SUMS UP.

Dr. Grassi says further: "To sum up, *Anguilla vulgaris*, the common eel," [Dr. Meek, Bulletin United States Fish Commission, 1883, after a careful comparison of American (*Anguilla chrysypa*) and European eels, concludes, 'in American specimens the dorsal fin is proportionately further from the end of snout, making the distance between front of dorsal and front of anal a little shorter than in European specimens; otherwise no permanent difference seems to exist. We should not, therefore, in my opinion, consider the two as distinct species, but rather as geographical varieties of the same species'] "matures in the depths of the sea, where it acquires larger eyes than are ever observed in individuals which have not yet migrated to deep water. * * * The abysses of the sea are the spawning places of the common eel. * * * Its eggs float in the sea water. In developing from the egg it undergoes a metamorphosis—that is, it passes through a larval form. What length of time this development requires is very difficult to establish. So far we have only the following data:

"First, *A. vulgaris* migrates to the sea from the month of October to the month of January; second, the currents, such as those of the Messena, throw up from the abysses of the sea specimens which, from the commencement of November to the end of July, are observed to be more advanced in development than at other times, but not yet arrived at total maturity; third, eggs which, according to every probability, belong to the common eel, are found in the sea from the month of August to that of January, inclusive; fourth, the *Septocephalus brevirostris*" (the specific name of the larval form) "abounds from February to September—as to the other months, we are in some uncertainty; fifth, I am inclined to believe that the elvers ascending our rivers are already one year old."

ELVERS.

The tales that are told about young eels running up rivers from the sea are nothing short of marvelous; but the fact that a single eel produces nine million eggs will help us accept the number of elvers that go up a single stream in a body. Not that the number is to be given here in figures, but rather in a blanket statement, for the only estimate I have seen in figures is eighteen hundred passing a given point in one minute; but the proximity of the point to the sea is not given, nor the width of the school. For years I have been gathering all sorts of information, and misinformation, about the common eel, chiefly because I think the eel works greater injury to our trout, both lake and brook, by eating the fry and spawn, than can be estimated or than we realize, and I have clipped everything my eyes have rested upon regarding the eel. I do not propose to give one hundredth part of it here. One clipping, which from the type I judge to be from the New York *Sun*, with the date line Milford, Pa., says: "Here is a story told me by William Wallace, a man of unquestioned veracity. Last spring he was informed by his wife, who had gone to the Big Bushkill for a pail of water, that there was a mass of eels ascending the creek. Mr. Wallace went to the creek and for a while watched a procession such as he had never seen before, although he had lived his lifetime in the same house on the bank of this stream. The eels were small, averaging possibly four inches in length, and were formed in a dense column about two and one half to three feet wide, and were rapidly making their way up stream. Mr. Wallace went about his work, but returned to the creek nearly an hour afterward and found the school still in line and still going. How long these eels had been running neither he nor any one else knew, and it was impossible to estimate the numbers, which must have been enormous. All who saw this procession said they fully believed that eels were largely responsible for the decrease of the trout in our streams." The *Christian World* makes this contribution on the subject of elvers: "The eels which descend to the sea never return, but young eels or elvers come up from the sea in the spring, millions at a time. The elvers have been seen to travel along the bank of a river in a continuous band, or eel rope, which has been known to glide upward for fifteen days together."

Next to the *Christian World* clipping I find one alleged to be a reprint from a scientific paper, giving what Grassi discovered, only it does not give what Grassi said. I mention this simply to show that clippings are not always reliable.

It is scarcely necessary to say more about the elvers running up streams. The sight is not unfamiliar to many anglers and others, and what I have quoted describes the ascent as accurately as needs be, when there are no obstructions in the water to overcome. When they come to falls or dams they pass above them or around them if there is the least moisture, although thousands, perhaps millions, perish in the attempt.

EELS ON LAND.

Günther says of elvers ascending streams: "In the course of the summer young individuals ascend rivers in incredible numbers, overcoming all obstacles, ascending vertical walls and floodgates, entering every large and swollen tributary, and making their way even over *terra firma* to waters shut off from all communication with rivers." An unknown German writer says: "The small size of the gill opening makes it possible for the eel to live a long time out of the water, and it is possible that in their wanderings over moist meadows they may find places in which there are snails and other desirable food."

From time to time the newspapers publish items concerning the finding of eels in the grass a considerable distance from water, and I have called attention to some of these in this column. In May I was leaving New York for Albany on the fast mail, and going into the smoking compartment found Col. W. C. Sanger, of Sangerfield, in this State, who said he had a friend with him whom he would like me to meet. The friend (Mr. Georges A. Glaenzer, a French artist) and I talked fish over our cigars until he said: "I will tell you something which I never tell until I know that the person I am to tell it to understands much about fish, their habits and peculiarities, for it really seems improbable on the face of it." What he told me was that on his family estate, near Paris, was a pond containing fish for the family table. As the city of

Paris began to take up streams and ponds in the vicinity for a city water supply, this pond was drawn down until it was decided to let out all the water and cement the bottom and sides. When this was done and the pond filled, it was again stocked with fish—"carp, pike to keep the carp active and from getting too fat, and some thousands of young eels."

When it was believed that the eels were large enough for the table, none could be found, and the pond was drawn, and not an eel was left in it. This was strange enough, for no one had fished or netted the pond, which for years before it was cemented had contained eels, and another large supply of young eels was turned in, only to disappear as mysteriously as the first lot, and a third attempt was made to stock the pond with the elusive fish. One morning after a heavy rain the gardener appeared at the house with a basket of eels, which he had found in the wet grass, all headed in the direction of the nearest stream which led to the sea, and then it was discovered that the eels had left the pond in a body.

A gunner in England was attracted to the nest of a polecat by the action of his dog, and in it was found a fresh eel with its head bitten off. The keeper explained that the polecat had caught it "as the eel was taking an evening stroll amongst the grass."

In "Natural History of Worcester" Dr. Hastings relates: "A relative of the late Mr. Perrott was out in his park with his keeper, near a large piece of water on a beautiful evening, when the keeper drew his attention to a fine eel ascending the bank of the pool, and with an undulating motion making its way through the long grass; on further observation he perceived a considerable number of eels quietly proceeding in the same manner to a range of stews nearly a quarter of a mile distant from the large piece of water whence they started. The stews were supplied by a rapid brook, and in all probability the instinct of the fish led them in that direction as a means of finding their way to some large river, where their ultimate destination, the sea, might be obtained." This circumstance took place in Sandford Park, near Enstone.

Pennell says: "The mode in which eels effect their escape from a basin or other similar place of confinement is peculiar. They commence tail, instead of head, first, throwing the former over the edge of the vessel, and by this means gradually lifting themselves out." He also says eels mature in three years, but does not explain how he knows this to be so. No other writer, so far as I can find, pretends to state with accuracy how long it takes for the eel to mature or arrive at breeding stage. From the same authority, and the last "exhibit" on the subject of eels on land: "If eels are kept in confinement and not closely covered up or shut in with smooth, steep sides, they will almost certainly make their escape, generally in the night-time, and travel overland to any water which may be in their neighborhood. The same thing occurs on a stream or pond being dried up in summer, when the eels will quit it and wind through the wet grass in search of water."

BARREN EELS.

A writer in *Land and Water* gave an account in 1893 of a quantity of eels found in a pond with no outlet. The eels were all of large size and all barren; but he did not say how he knew they were barren. Another writer in the same journal doubted that all eels found in fresh water were barren. Mr. Thomas Southwell replied to him, and I quote from his reply in part as follows: "Far be it from me to attempt to prove a negative; but this much I can say: No statement of a gravid eel having been detected in a pond of fresh water has, so far as I can learn, hitherto borne investigation. Many times I have been told by the eel catchers that they frequently met with gravid eels, but the oft-renewed offer of a sovereign for one in such a condition has hitherto been fruitless, and of the many examples from such localities which I have dissected, not one has indicated an approach to breeding. The only eels showing even a partial development of the ova which I have obtained were from a tidal water, where they were on their way to the sea. I do not think Dr. Grassi attempted to account for the continued presence of eels in apparently isolated ponds; that was beyond the scope of his inquiry; but it seems likely that in such cases the reproductive instinct is arrested; but if eventually developed it would probably lead them to attempt to escape, and the marvelous situations in which full-grown eels have been found lead one to infer that they frequently do so. The ascending elvers, whose instinct leads them to go on and on, irrespective of barriers, I can believe would penetrate almost anywhere, and there are few ponds so isolated as to have no outlet or overflow whatever; and their numbers are so immense that a very large proportion might perish without being missed. I see no insuperable difficulty in their gaining access even to localities which appear to be cut off from all access to river or stream."

EELS AND POLLUTION.

Interesting evidence was given in an English court when the Hematite Iron and Steel Company was summoned, at the instance of the West Cumberland Fishery Board, for allowing a certain substance to flow into the River Eheu and its tributaries to such an extent as to kill trout and salmon. The evidence was conclusive that the defendant company, for sanitary reasons, did let off the sediment from a pond and the sediment did flow into the stream, and large quantities of trout and salmon were destroyed.

The water bailiff, one Sanderson, testified that eels from the polluted stream were "found in hundreds making their way overland to holes and to any place they could get to escape the pollution, and it seemed a pity that the trout could not have done likewise." An English writer, commenting on the case, said: "Although eels bear the reputation of being dirty feeders and are fond of being buried in the mud, my experience of them is that they are terribly susceptible to pollution of actually a poisonous character, and their testimony bears out my opinion. A river I know abounding with eels has, since pollution has nearly ruined it, ceased almost to hold an eel at all; at any rate they are so few that they are not worth fishing for."

ABUNDANCE OF EELS.

Nearly every year some mills on a stream within fifty miles from where I live are obliged to shut down and kill eels. The eels get into the mill wheels and block their motion, and so interfere with the machinery that a shut-down and eel-killing is in order. As to the number of eels that cause this trouble, no one can estimate it. Mr. Pinkerton, an English writer, says: "It is about this time of year that the annual migration commences, the eels moving in the night, and always choosing a dark night for the purpose. A change of wind, a clap of thunder, a cloudy night becoming clear and starry, will at once stop the movement. I have frequently visited the great eel fishery at Toome, on the lower Bann, where from fifty to sixty tons of eels are annually caught in the migrating season. As many as seventy thousand eels have been taken at this place in one night."

The town of Ely, in England, is said to be named from the rents having been formerly paid in eels, the lords of the manor being entitled to upward of one hundred thousand eels annually.

In one lake that I am very familiar with, when the lake trout gather on the spawning beds in the autumn, the eels also gather, and the sight under a flaming torch at night is one to vex the soul of the trout fisherman. There are usually a far greater number of eels on the shoals than trout, and the lake is full of trout and well stocked annually, and they scarcely wait for the trout to deposit their eggs before they devour them; and the law will not permit the taking of eels from this lake in eel pots because there are trout in it. Eels are rarely taken in this lake with hook and line, but they grow fat on the trout spawning beds and would make good eating if eel pots were permitted to take them out, and save the trout eggs in a degree. The New York *Sun* had this news item in 1897: "The Fisheries, Game and Forest Commission of this State was the first to recognize the destructive qualities of eels, and in its report for 1896 says: 'Fish of all kinds are spawn eaters to a greater or less extent, but the eel is more destructive of spawn than any other fish, as it does not spawn in fresh water and is ready to prey upon both the fall and spring spawning fishes. * * * We would ask that the Commission have power to use or authorize the use of eel pots in all waters, whether inhabited by trout or not, for it is in trout waters particularly that eels are proving destructive of young fish.'"

The Commissions made the same recommendation in their report for 1895, but the law has not been changed to give them the discretion in the matter which they should have, for it is in waters inhabited by trout that eels are doing the greatest damage. Eel pots would not take trout in any event, and so far as possible the eels should be removed from trout waters.

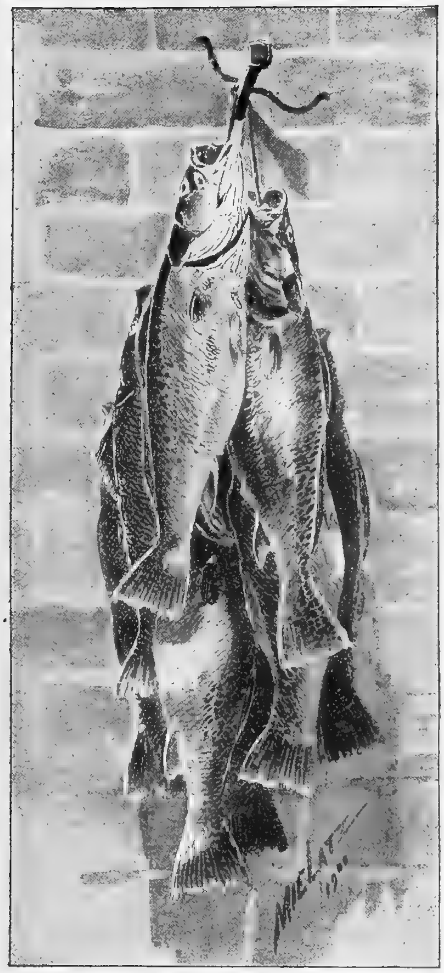
THE EEL COMMERCIALLY.

It is a most difficult matter to obtain complete statistics in regard to the number, weight, and value of fish taken in internal waters. From men engaged in commercial fisheries it is possible to secure figures upon which to base the value of the catch; but of the thousands of individual fishermen who fish only for home consumption, their catch never finds its way, either in pounds or dollars and cents, into a statistical report of State fisheries. One has only to look along the banks of our rivers and canals to see that a great number of men are daily engaged fishing for eels, not for market, but for the home pot. While visiting the shad nets in the upper Hudson I one day counted twenty-three men and boys on the docks fishing for eels, and every dock had its quota of eel fishermen. Only a few days ago I counted seven men on one pier of the railroad bridge at Albany as I crossed on a railroad train. Their lines showed that they were fishing on the bottom, and for eels. Statistics gathered by the United States Fish Commission of fisheries of the interior lakes of New York show that seventeen thousand pounds of eels were taken in each of the two years during which the investigation was conducted, and that part of Lake Ontario touched by counties of New York furnished sixty-six thousand pounds in addition. It is scarcely necessary to tabulate returns from the Hudson or waters adjacent to the sea to show that many eels are taken in the waters of the State annually, and I think it is not pretended that the most accurate statistics on the subject of the eel fisheries show anything like the number caught. Here is a fish considered an excellent food fish that does not breed in fresh water, but simply comes into fresh water for development and returns to the sea, probably to perish after spawning. While in fresh water it is a notorious spawn-eater, and it has no fasting season, like fishes that spawn in our lakes, ponds, and streams; and all that can be caught add to the food supply; so why is it not best to use every legitimate means to catch eels while in our fresh waters, and thereby rescue the spawn of what many consider better fishes?

A. N. CHENEY,
State Fish Culturist.

TOMCOD OR FROST-FISH.
(GADUS TOMCOD.)

Figures of Fishes in Colors.



A GOOD STRING.

THE first report of the Fisheries, Game and Forest Commission—namely, for the year ending September 30, 1895,—contained figures of some of the fishes of the State in colors, reproduced from drawings of the fishes themselves by Sherman F. Denton, an artist eminent in this particular field. The fishes selected to be presented in the first volume were the brook trout, a breeding male; the Atlantic salmon, the whitefish, the small-mouth black bass, the large-mouth black bass, the pike-perch, the mascalonge, the pike, the pickerel, two figures showing different marking; the shad, the rainbow trout, the brown trout, and the smelt. In the next report, the Commission decided to continue the colored illustrations of fishes, as an educative feature of the printed book, as the demand for the first volume far exceeded the supply, although the Legislature had ordered an extra number of the books. This demand was traceable, in great part, to the colored plates, and it was decided by the Commission to include all the fishes hatched by the State, and others of the more common fishes from both fresh and salt water. In the printed report for the year ending September 30, 1896, it was found necessary to reproduce the male brook trout and the pike-perch, as the specific requests for the pictures of these particular fishes had been most numerous, and in addition the female brook trout, the male Sunapee trout, the female Sunapee trout, the male landlocked salmon, the female landlocked salmon, the lake trout and the Adirondack frostfish were added. The first report had the colored figures of but one game-bird, and others were added in the second report, and it was decided to include a number of figures of the better-known game-birds in each volume. In the report for the year ending September 30, 1897, the figures of fishes included the cisco from Hemlock Lake, the white bass, the fall fish or silver club, the red-throat or black-spotted trout, the steelhead or salmon trout, the golden shiner, the alewife or branch herring, and the common or lake whitefish, male and female, from two of the interior lakes of the State. The whitefishes were presented in consequence of the fact that it had been discovered by Dr. Bean that the so-called Labrador whitefish was the common whitefish.

In the present volume, the report for the year ending September 30, 1898, it was found necessary to reproduce the shad because of the demand for it by those who had been unable to secure copies of the earlier report containing it.

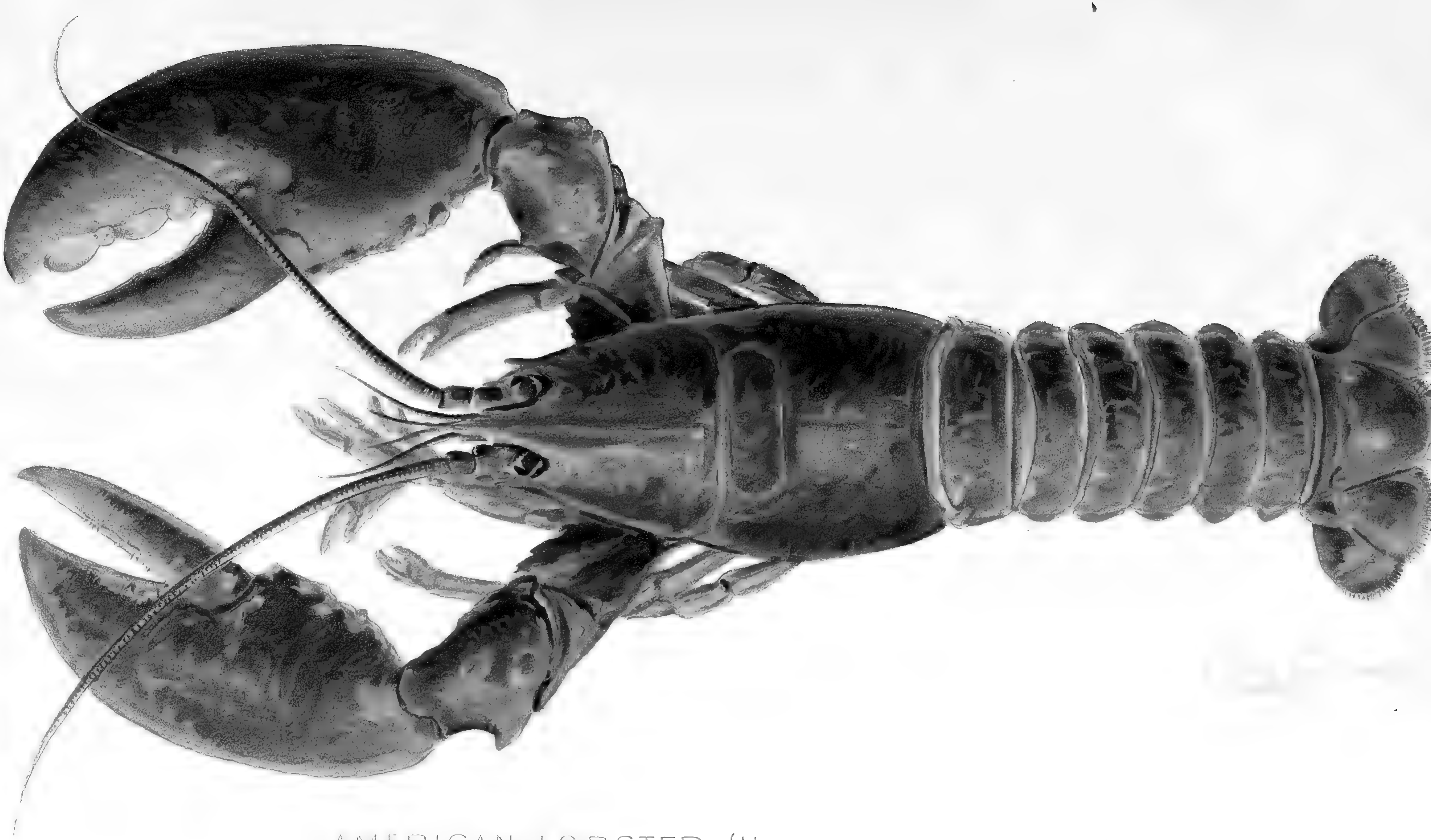
With the figures of the dogfish is an exhaustive article by Dr. Bashford Dean, and the eel is mentioned in a separate article. It was the intention of the Commission to have the artist prepare a figure of the "silver eel," so-called, which is simply the name of the common eel of the illustration when it puts on nuptial coloring and descends to the sea, where it is called salt-water eel; but specimens could not be obtained at the time from which to make the drawing.

The Lobster.

The State hatches annually a number of millions of lobsters at the Cold Spring Harbor hatchery on Long Island. The eggs are obtained from the lobsters in the lobster pots of the professional lobster fishermen and would be lost if not rescued by the hatchery employees and hatched in the jars at the hatchery. The figures presented are those of a male lobster, upper side, and the under side of a female or "berried" lobster, showing the manner of carrying the eggs. Authorities differ as to the spawning habits of the American lobster. It was announced a few years ago that the same lobster spawned once in two years, and facts and figures were given to prove the statement. More recently, Professor Prince, of Canada, declared that the lobster spawned annually, and when scientists disagree it is unwise for the layman to say anything on the subject. The following, taken from "A Manual of Fish Culture," published by the United States Fish Commission, treats of the reproduction of the lobster:

"The principal spawning season for lobsters on the United States coast is summer, especially July and August, when probably three fourths of the lobsters deposit their eggs. The remaining egg-producing lobsters lay during the fall and winter. A given lobster does not spawn oftener than every second year, as has been shown by recent studies conducted by the Commission.

"The eggs are fertilized outside the body of the female. The spermatic fluid is deposited in a receptacle at the base of the third pair of walking legs, and retains its vitality for a long time. When the eggs are being extruded the female lobster lies on



AMERICAN LOBSTER. (HOMARUS AMERICANUS)
Male upper side.

her back and folds the tail so as to form a kind of chamber to retain the eggs. After their discharge from the body the eggs become coated with a cement substance secreted by glands in the swimmerets; this substance hardens after being in contact with the water and firmly unites the eggs to the hair-like filaments on the swimmerets. The exact method by which the fertilizing principle is conveyed to the eggs from the pouch in which it is contained is not known.

"The incubative period is much prolonged. After the eggs are extruded and become attached externally, they are carried ten or eleven months before hatching ensues; during this time they are carefully protected, and are perfectly aerated by the active motion of the swimmerets. On the United States coast most of the lobsters emerge from the eggs in June, although some of the hatching is completed in May and some in July, or even later. A few eggs are now known to hatch in winter. All of the embryos do not come from the eggs at the same time, the hatching occupying a week or more. The young receive no attention from the adults, but lead an independent existence immediately after escaping from the egg.

"The lobster egg is about one fifteenth of an inch in diameter. When newly laid it is usually of a dark-green color, but is sometimes light grayish or yellowish green.

"The known maximum number of eggs produced at one time by a lobster is 97,440; the average from lobsters taken for market is 10,000 or 12,000. The number depends largely on the size of the lobster, apparently in conformity to the following rule: The numbers of eggs laid by given lobsters vary in a geometric scale, while the lengths of the lobsters vary in an arithmetic scale.

"The following table illustrates, with approximate accuracy, the egg-producing capacities of lobsters of the lengths indicated under normal conditions:

LENGTH OF LOBSTER.	NUMBER OF EGGS LAID.
8 inches,	5,000
10 inches,	10,000
12 inches,	20,000
14 inches,	40,000
16 inches,	80,000

"MOULTING AND GROWTH.

"The act of shedding the shell, or moulting, is important and critical. It is only after shedding that growth takes place; during the early stages

A SPECIAL PERFORMANCE.

of the lobster's existence this function is often exercised in a comparatively short time, while later it occurs only at long intervals. Moulting in the lobster consists in throwing off the entire external skeleton, together with the lining of the digestive tract.

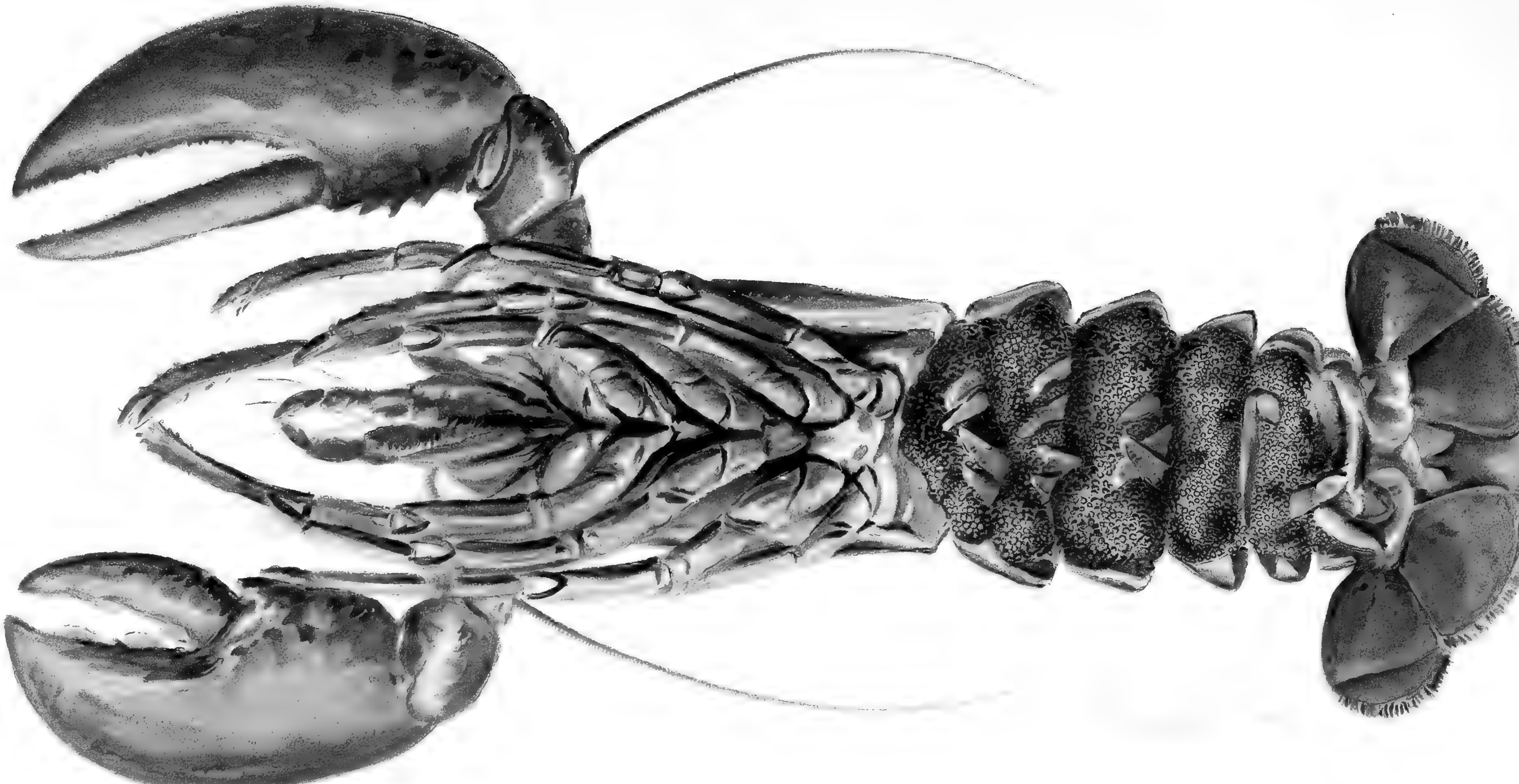
"The first moult takes place about the time the young emerges from the egg, when it is about a third of an inch long, and many lobsters do not survive this. During this first stage the larval lobster swims at or near the surface. A second moult eusues in from one to five days, and the lobster enters on its second stage, its average length being about two fifths of an inch and its habits similar to the first stage. In two to five days another moult takes place, and the length of the larva increases to about half an inch. This is followed in two to eight days by another moult, and the lobster enters on the fourth stage, when its length becomes slightly greater. From ten to twenty days later the fifth moult ushers in the fifth stage, after which the surface-swimming habit is discarded and the larva goes to the bottom and begins to assume the characteristics of the adult. This stage lasts eleven to eighteen days, and in it the young lobster has attained a length of about three fifths of an inch. From this time on the moults are at longer intervals, until the fully mature condition is reached, when shedding takes place only once in one or two years.

"The food of lobsters during the larval stages consists chiefly of small crustaceans. A very pugnacious instinct then characterizes them, and active cannibalism prevents their artificial rearing for lack of abundant natural food.

"Larval lobsters are very susceptible to the influence of the sun (heliotropic) while in the first three stages, being attracted by bright rays to the surface of the ocean or to the side of a vessel. This peculiarity is lost during the fourth stage.

"During the first year the young lobster, which since the fourth stage has become more and more like the adult in form and habits with each moult, attains a length of about two or three inches. At the end of the second year the length is five to seven inches. By the end of four and a half or five years a length of about ten inches is reached. The rate of growth, however, depends greatly on the environment, the abundance of food being a very important factor.

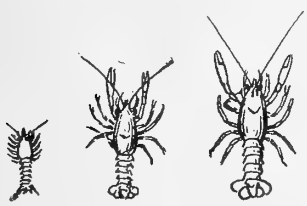
"The adult lobster usually moults in summer, and in the case of the female, shortly after the hatching of the eggs. As several months are required for the new shell to acquire the hardness of the old; as newly laid eggs are rarely found on a soft-shell lobster; as moulting does not ensue while the eggs are on the swimmerets; and, furthermore, as dissection has shown that the ovaries of a lobster whose eggs have recently hatched are in an immature condition, and will not yield eggs until the succeeding year, it follows that the mature lobster deposits eggs not oftener than once in two years, with an alternating moult.



"SIZE AND WEIGHT.

"The average size of lobsters caught for market is now much less than it was in the earlier days of the fishery, and their average weight is probably not over two pounds. A lobster nine inches long weighs, on an average, one and one sixth pounds; a ten-and-one-half-inch lobster, one and three quarter pounds; a twelve-inch lobster, three pounds, and a fifteen-inch lobster, four to five pounds; while a lobster twenty inches long weighs twenty pounds or more. Lobsters weighing as much as fifteen or twenty pounds are uncommon, and those weighing over twenty pounds are very rare. Up to a recent date, the largest lobster of authenticated weight was about twenty-five pounds. In 1897, however, three lobsters, each weighing over thirty pounds, were taken off Sandy Hook, N. J., the weight of the largest being thirty-three pounds."

At the Cold Spring Harbor station of this Commission lobster eggs are secured from the lobster pots by scraping the naturally impregnated eggs from the swimmerets of the berried lobsters, and are placed in McDonald hatching jars and hatched precisely as shad and smelt and whitefish and tomcod eggs are hatched. The eggs may hatch in two days or two weeks, for naturally the eggs of some females may be more advanced than others at the time of capture, and when hatched the young lobsters begin almost at once to eat one another. They grow rapidly, and illustrations are here given of their exact size at two, five, and sixteen days of age. Within a few days after hatching, the young lobsters are planted in the harbors of Long Island, and thereafter they must fight their own battles for existence.



The Yellow Perch.

The yellow perch is one of the most common of pan-fishes found in fresh water and one of the best for the table when taken from pure cold water. It is a sweet-meated, firm-fleshed fish comparatively free of bones, and though it ordinarily grows only to a few ounces in weight, specimens from favored waters have been taken weighing from two and one half to four pounds. Not only is the yellow perch an excellent pan-fish for mankind, but it furnishes food for other and larger fishes. Although the perch is not protected

YELLOW PERCH.

by a close season during its breeding period, it does not seem to diminish in any waters where it is found naturally. At intervals, in some waters, even the best and purest, an epidemic visits the perch tribe, and vast numbers are found dead in the water and on the shores; but this does not appear to decrease the supply of healthy fish in the water. The following description of the fish is taken from the "Manual of Fish Culture," already mentioned:

"The eggs of the yellow perch are among the most remarkable that have been artificially hatched. The spawn is in one piece, a much elongated ribbon-like structure, of a semi-transparent, light-grayish color. One end of the large egg mass, corresponding to the anterior part of the roe, is larger than the other, and is bluntly forked. The string is very long, but may be much compressed lengthwise by virtue of its arrangement in regular transverse folds like the sides of a bellows or accordeon. When deposited the eggs are in a loose globular form, and after being fertilized and becoming "water-hard" their mass rapidly becomes many times larger than the fish which laid them. The length of the strings is from two to more than seven feet, depending on the size of the fish. One fish in an aquarium at Washington deposited a string of eggs eighty-eight inches long, four inches wide at one end and two at the other, whose weight after fertilization was forty-one ounces avoirdupois, while the weight of the fish before the escape of the eggs was only twenty-four ounces.

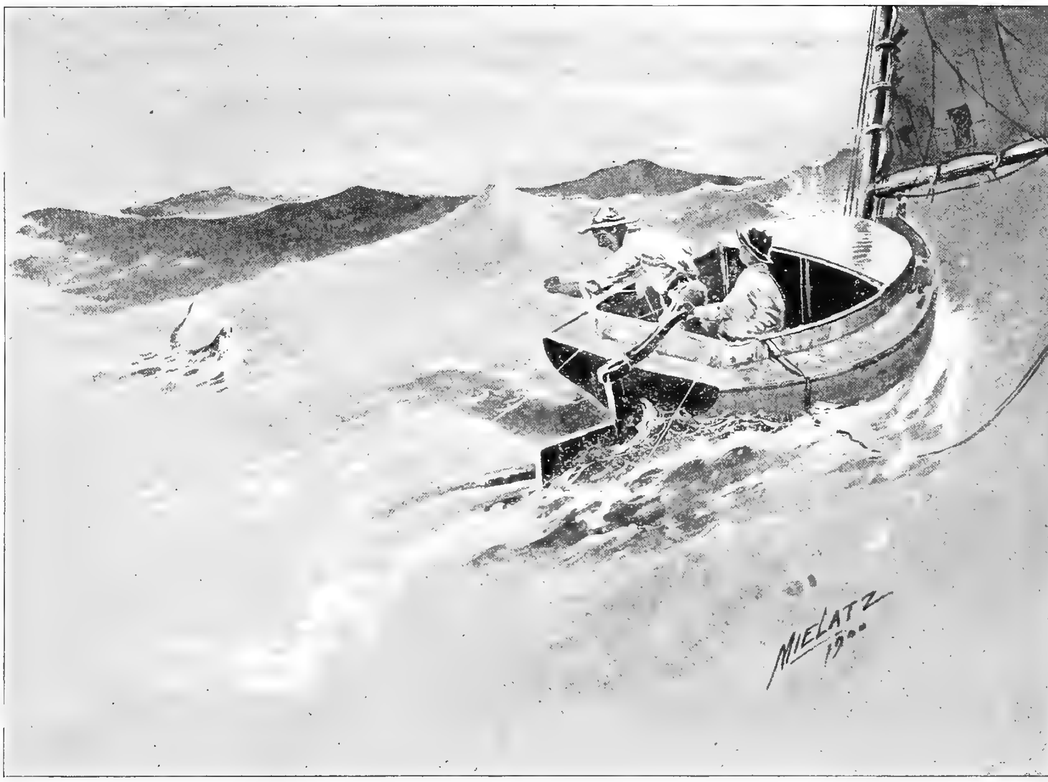
"A cavity extends the whole length of the egg mass, its walls being formed by the delicate membrane in which the eggs are imbedded. The cavity is almost closed, small apertures occurring irregularly, which have the appearance of being accidental, but may be natural, in order to permit the circulation of water on the inside of the mass.

"The egg string is quite light and resilient or stringy, the least agitation of the water causing a quivering motion of the whole mass.

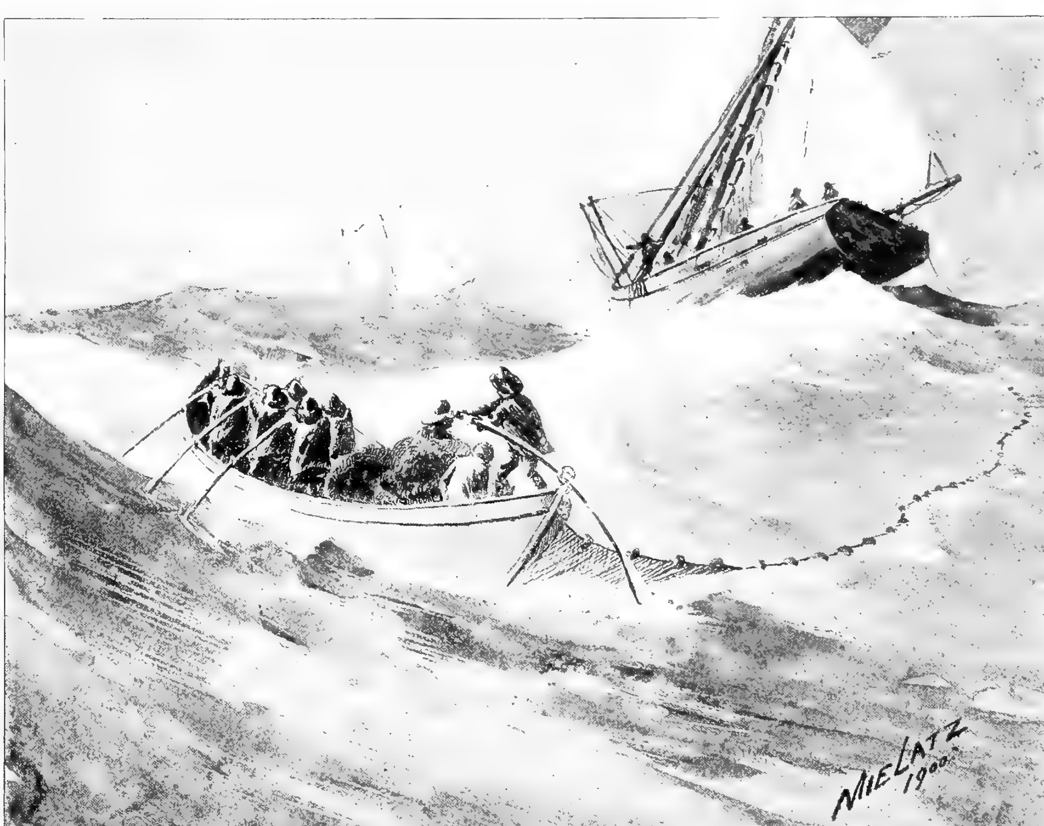
"The diameter of the egg is one thirteenth of an inch. The quantity cannot be easily measured, but the number is approximately twenty-eight thousand to a quart.

"The best method of securing the spawn is to place mature fish of both sexes in suitable tanks with running water. The females selected should be those whose external appearance indicates that the eggs are still undeposited. Spawning takes place at night, and the eggs are naturally fertilized. Under proper conditions, it is the exception to find unfertilized eggs. In the morning the eggs are transferred to the hatching apparatus.

"The eggs of this fish have been hatched at different stations of the Commission. One season, at Central Station, Washington, D. C., one hundred and thirty ripening females and about an equal number of males taken from the Potomac were placed in aquarium tanks supplied with water from the city water-works. Spawning began



FISHING FOR WEAKFISH.



ROUNDING A SCHOOL.

March 10th and continued till April 3d, and ninety-eight strings, containing nearly one million eggs, were deposited.

"The eggs are hatched in the automatic shad jar, provided with a cap of fine-meshed wire netting; the usual inflow tube is retained, but the siphon tube is withdrawn, the water escaping over the top of the jar. The amount of water circulation is not great enough to force the mass of eggs to the upper side of the jar, or to give much motion to them. They are lighter than shad or whitefish eggs, and when put in rapid motion to dislodge adhering sediment they would clog the outlet tube if the ordinary method of manipulating this jar were employed.

"The eggs from several fish may be placed in one jar. They perhaps need as little care as any eggs handled by fish culturists. When one string of eggs or one lobe of a string dies it may be removed with a small net, or the entire contents of the jar may be turned into a pan.

"The period of hatching varies from two to four weeks, according to the temperature. As the fry hatch, they pass over into tanks provided with screened overflows, where they are held till planted. The fry are very hardy, and may be readily retained in aquaria for several weeks. The percentage of eggs hatched is very large. From one lot of 955,000, 754,000 fry, or seventy-nine per cent., were produced."

The Tomcod.

The tomcod or frostfish is a toothsome little fish, and adds materially to the food supply, as it may be caught from almost every dock and pier-head of Greater New York. The State in some years hatches over forty million of little tomcods. They spawn in December and average twenty-five thousand eggs to a fish, though one fish of one pound weight furnished 43,740 eggs. With the water at forty degrees Fahrenheit, the eggs hatch in thirty-five days, and it requires four days to absorb the sac with which they are born.

The Mackerel.

The common mackerel, so-called. that it may be distinguished from the Spanish mackerel and related genera, seems, like the codfish, to be one of the fishes indispensable to that portion of the human family who are fish eaters. It is a comparatively small fish, averaging about twelve inches in length and three quarters to one pound in weight; but fish weighing from three to four pounds are occasionally taken. The mackerel has been propagated artificially, more successfully by the dry process as practiced with brook trout and other eggs, than by the wet process. The fish average about forty thousand eggs, but 546,000 eggs have been taken from a mackerel of one and one quarter pounds, and the largest fish may yield a million eggs. The period of incubation with water temperature of fifty-eight degrees is five days. Seventy-five per cent. of some eggs have produced fry, but less than one per cent. of most of the eggs hatch, and they are taken from commercial fish, and are not received in good order.—From "Manual of Fish Culture."

The Weakfish.

The weakfish is a prominent food fish commercially, as well as hook-and-line fish. Its average size is under five pounds, but it grows to thirty pounds. It has been hatched artificially by the United States Fish Commission, the eggs being very small, and they hatch in two days with the water at sixty degrees. The "sea trout" is also a weakfish, called spotted squeteague, and is smaller than the fish figured in the illustration, the maximum weight being about ten pounds.

A. N. CHENEY,
State Fish Culturist.

YELLOW OR BARRED PERCH.
(PERCA AMERICANA)

Report of the Superintendent of State Forests.

To the Commissioners of Fisheries, Game and Forests:

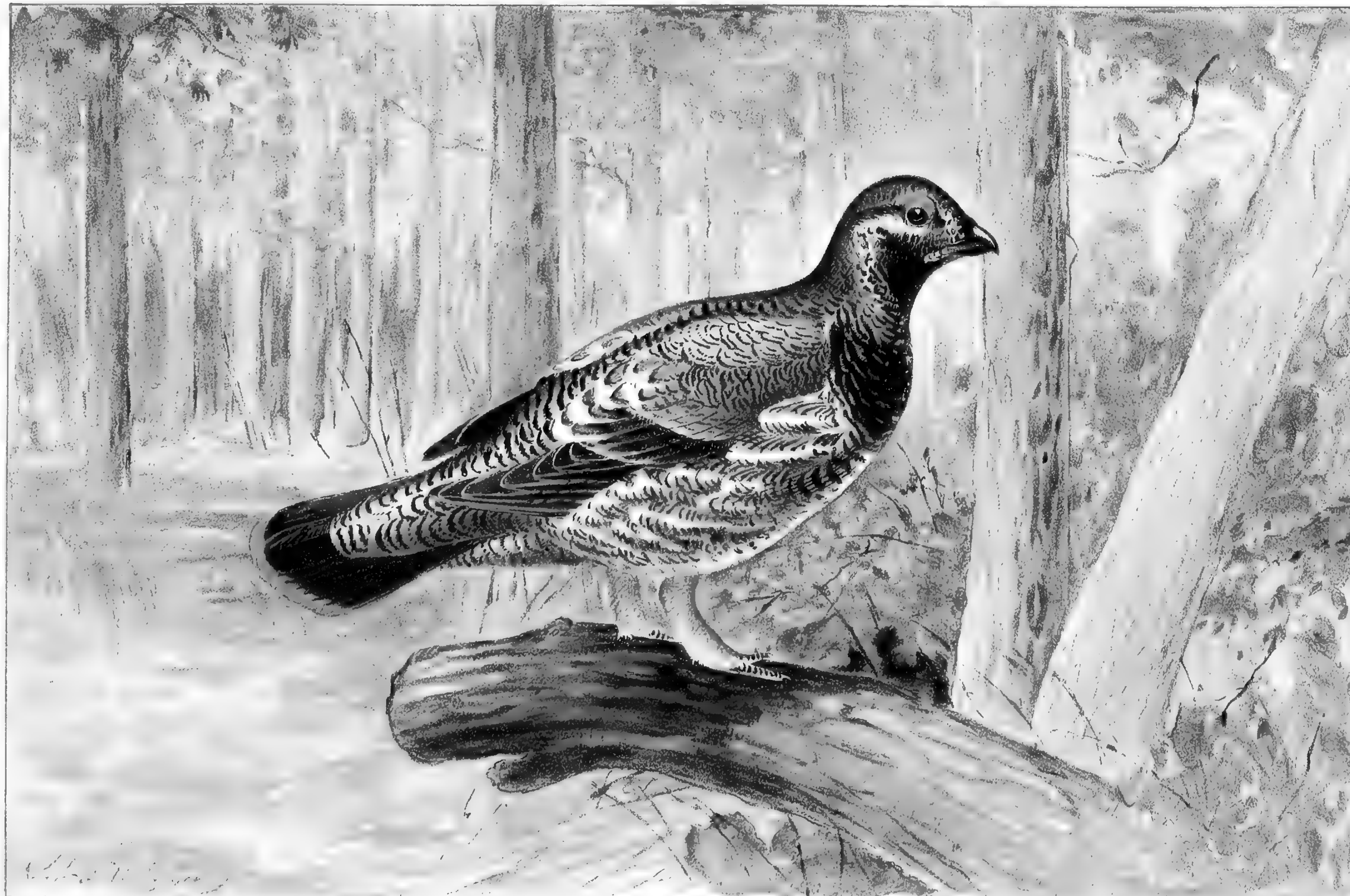
GENTLEMEN:—The forestry work of this Department has been carried on during the past year with satisfactory results. Forest fires have been of rare occurrence—the damage from this source being merely nominal as compared with the destruction and devastation wrought in former years. The burnings this season were few in number and small in area. It is a matter of congratulation that none occurred on the Forest Preserve. With one exception, these fires started near the outskirts of the main forest, or along the highways where, for the most part, they originated in brush fires started by farmers for clearing land, from which the flames, driven by wind or through lack of proper watching, escaped into the adjoining forest. The exception referred to was a fire that occurred in the interior of the wilderness, and which was started from an abandoned camp-fire of some fishermen. In nearly every instance, incipient fires were promptly extinguished through the activity and efficiency of the local firewardens, of whom there are 281 in the woodland towns. The reports of the firewardens include also some cases where small tracts of waste or brush land were burned over—these fires originating from locomotives, or from incendiarism on the part of huckleberry pickers with a view to increasing the next year's crop. The damage from this class of fires is slight so far as regards present conditions; but it involves a loss, in this, that it prevents the future reforesting of these waste tracts. This class of fires, which at one time were a regular occurrence each season, have been so far minimized that we have reason to believe they will soon be prevented altogether.

The activity and efficiency of the foresters throughout the Adirondack and Catskill regions is well attested by the fact that there has been no timber cutting or trespassing on State land during the past year, aside from cases in which the title to the land was in dispute, or where there was a misunderstanding as to the location of boundary lines. Even in such instances the cutting was promptly stopped before it had proceeded to any serious extent. The penalty in each case was promptly enforced. Occasional reports were received of petty depredations, based on the thieving instincts of individuals, which are as difficult to suppress in a forest community as in the inhabitants of a city.

The lumber and wood-pulp industries of our State continue to make a heavy drain upon the resources of our Adirondack forests. The demand is increasing; the supply is rapidly diminishing. With such conditions, the result is easily foreseen. In the past year 450,995,416 feet of timber was cut and removed from the great forest of northern New York. This means that over 105,000 acres of forest land was stripped of its merchantable timber. It does not imply that this area was denuded or left without forest cover, but it means that our State is that much nearer the end of its timber supply, and that it is a serious menace to our economic conditions. A still more serious feature of this timber cutting is that, with the exception of a few localities, no provision whatever is made for the future growth. These unfavorable conditions can be remedied only by thoughtful, judicious legislation. A forestry policy providing for such future supply need not antagonize the great industries now dependent upon our forests for their raw material. Such policy aims to protect the source of supply, and in so doing best protects and fosters the industry itself. The State of New York leads all others in the manufacture of wood-pulp. Many millions of capital are invested in the various plants. Thousands of workmen derive a profitable living from this industry. The same can be said of our great lumber industries and woodworking manufactories, all of which are dependent upon our forests for their raw material. If left to individuals and individual interests, no provision will be made for the future supply. The protection of these industries, and their continuance is dependent solely on an intelligent forest policy, directed and controlled by the State.

Owing to the restrictions of the forestry clause in the State Constitution, this Department is unable to undertake any work of a scientific character or forest improvement which might involve the cutting of any timber, either for market or in the way of pruning, thinning or removal of diseased and dead trees. At the same time, the Department is contemplating the inauguration of some improvement, in the way of reforesting the barren, burned or denuded tracts, of which there are several areas, large and small, in the Forest Preserve. Such action would not involve any cutting or removal of timber for many years—at least, not within the period in which the present constitutional clause will be operative. Unless some such work is undertaken, these waste and denuded lands will remain as open barrens, or, if they reforest themselves naturally, will be very apt to produce a growth of inferior or unmerchantable timber. As the Department would like to inaugurate some work other than that of mere police duty, to which it is now confined, it would gladly undertake the task of reforesting these waste areas. The details would be placed under the charge of skilled, professional foresters, whose experience in the technical management of such lands would insure success.

In connection with this proposed work of reforesting, meteorological stations could be established at points where observations could be made and recorded by these pro-



SPRUCE GROUSE
(DENDRAGAPUS CANADENSIS)

fessional foresters. The observations thus proposed belong to a class intimately connected with forestry work, and would furnish certain scientific data absolutely necessary to a correct understanding of the subject and proper forest management. The question as to the influence of forests on rainfall, their connection with moisture and other atmospheric conditions, and their influence on climate, will all be better understood and can be better acted upon when this knowledge is obtained—information which can only be secured through the establishment of stations at proper points for making the scientific and meteorological observations necessary to a long and accurate record of the facts.

In order to carry out the proposed plan for reforesting our denuded lands, and the establishment of stations for observing temperature and rainfall, no legislation is necessary, as such work would come properly within the scope and province of this Department. Some special appropriation, however, might be needed for the inauguration and maintenance of such work; but the amount need not be large, as the work for several years would be experimental in character, and limited, on the start, to comparatively small areas. Sooner or later this work must be done. There is no better time for its commencement than now.

Under our present law the territory constituting the Adirondack Park is defined by naming the various towns within which it is located, the outside boundaries of these towns thereby forming the boundary of the park. But many of these towns are not all under forest cover, and contain large areas of farming land. It is highly desirable that the boundary of the Adirondack Park should conform, as nearly as practicable, to the outer line of the forest. As now defined by law, the park contains over 400,000 acres of open farm land under cultivation. This is an absurdity which should be remedied by proper legislation at the first opportunity. The "blue line" on the Adirondack map published by this Department is not the boundary of the Adirondack Park as many suppose, but represents merely a proposed line. The Forest Preserve Board in all its purchases has been governed by this proposed line, and no land has been bought outside of it. As the blue line referred to lies entirely within the park as defined by law, no exception could be taken to the policy of the Forest Preserve Board in this respect; especially as nearly all the land outside the blue line is composed of cultivated farms which could not be purchased under the terms of the act appropriating money for the purchase of forest land. In case any bill is presented to the Legislature for the purpose of adjusting the park line to the boundaries of the Adirondack forest, it is hoped that the measure will receive favorable consideration. No preliminary survey or expense is necessary in establishing this boundary, as it can be made to follow the well-known and plainly marked lines that define the limits of the various tracts and townships—lines which are near enough to the edge of the forest to subserve this arrangement.

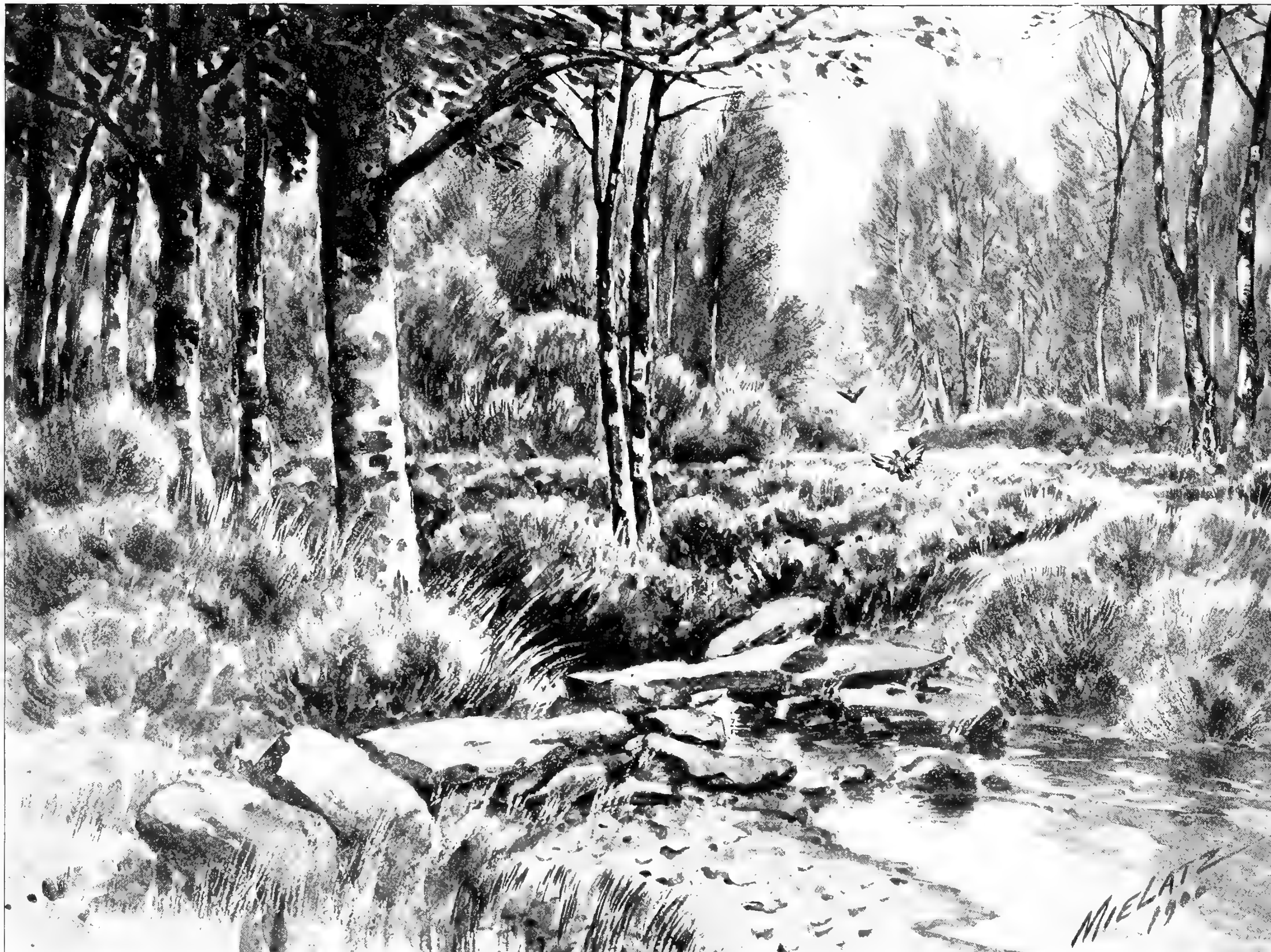
The present law providing for the taxation of State property in the Forest Preserve restricts the payment of taxes by the State to wild and forest land; but, within the Preserve there are many parcels of farming land on which there are houses and barns, which, under the provision of the law, are necessarily assessed to the occupants. The continued payment of taxes by these occupants is liable to result in a cloud on the State's title; especially, as the State titles are obtained through taxes, in which too often there are irregularities in the assessment, and which give the occupants an opportunity for litigation in a question of ownership. In view of these facts, and other reasons which we do not deem prudent to discuss here, it is advisable that the law should be amended so that all the land in the Forest Preserve, together with whatever buildings or improvements may be there, should be assessed to the State. If, in case of a litigation, only the cleared land and farm buildings were at stake, a cancellation of the State title would not cause any serious loss; but in every case a cancellation would involve not only the small area of cleared land on some farm, but the entire tract, varying from 160 to 1,000 acres, nearly all of which, in every instance, is forest land. There have already been cases where, through irregularity in the assessment prior to the tax sale by which the State acquired title, a quarter of a township, containing 6,000 acres or more, has been lost through litigation growing out of the occupancy of some little clearing not over ten square rods in extent. This recommendation is based upon fourteen years' practical experience by the Department in these matters.

The Forestry Department publishes, from time to time, a schedule of the many lots or parcels of land, several thousand or more, constituting the Forest Preserve, this list of lands forming the basis on which rest all the work and business of the Department. It is highly necessary that it should be correct as to every lot or parcel. No lands should be borne upon this list that the State does not fairly and honestly own. And yet, we are unable to say that such is the case. Three fourths of the land in the Forest Preserve was acquired at tax sales, the greater part of these lots having passed into the possession of the State from the sale of 1877, over twenty-two years ago. At that time, through the carelessness and illiteracy of some of the Adirondack assessors, many lots were sold without proper warrant. Very often, through clerical errors, lands were sold on which all the taxes had been paid, and for which the owners held, and still hold, receipts for the payment of every tax that was levied. The question may be asked, Why does not the State return the land to the owners? In reply, we have to admit that our tax laws will not permit such a course of procedure. By a decision of the Court of Appeals it is held that a cancellation of a tax sale cannot be obtained except upon the application of the person who was the purchaser at the sale. Now, as the purchaser can have no object in having the sale set aside, the title always stands. The original owner of the land is forced to apply to the courts for redress, thereby involving an expense which, too often, the value of these wild lands will not warrant. In view of the number of lots appearing on the land list of the Forest Preserve in which the State's title is of doubtful character, some legislation is necessary to amend and correct the schedule. But the work of selecting these lots and determining the facts as to whether the State's title to a lot is a valid one, would require the services of persons thoroughly familiar with the character of tax titles, the nature of a legal occupancy, and the general history of each case. The State Comptroller, Hon. James A. Roberts, in his last report, dated January 11, 1899, says, in relation to these complications:

"It has been reported to this office that a number of parcels of land in the Forest Preserve are occupied by people claiming to be the fee-owners thereof. These lands, it is alleged, have been assessed both as resident and non-resident lands, and the taxes levied on the resident assessments duly paid. In such cases the State's title seems likely to remain in dispute and doubt until an investigation shall disclose the exact condition. If it is deemed advisable to have this important matter investigated, a small appropriation to defray the expenses of the persons appointed therefor should be made, and a reference of the matter made to some department with power to act."

I would respectfully ask that the recommendation of the Comptroller in this matter receive thoughtful consideration, and that the necessary legislation be granted. It would seem advisable to enact some law authorizing the proper department to report a Bill of Relief, under which legislative authority shall be granted to erase from the schedule of lands in the Forest Preserve any lots or parcels that may not properly belong there, such lots being specified distinctly in the act. The preparation of the list of lands to be thus released might be intrusted to the Comptroller's office; or, the work might be done through the services of experts, of whom one might be detailed from the Comptroller's office, one from the office of the Fisheries, Game and Forest Commission, and one from the office of the State Engineer and Surveyor, these officials to receive proper compensation for the additional work thus required of them. The assistance of the Attorney-General's office might be needed, also, in furnishing opinions on questions arising from the discussion of disputed titles.

Although, in the management of the Forest Preserve the last year, the forest fires have been less in number and in area than at any like period since the establishment of the Forestry Department, we believe that the damage from this source can, under proper arrangement, be still further minimized, and, perhaps, entirely prevented. To this end a more compact and systematic organization of the corps of firewardens is necessary. The various duties of the Superintendent of Forests will not permit him to give the attention to this branch of the service which he would like, and which the safety of the forest demands. I would suggest the appointment of an assistant, who shall be designated as the Supervisor of Firewardens, or Chief Firewarden, and whose time and services shall be devoted exclusively to the proper organization, supervision and direction of the firewardens, of whom there are 281 in the forest towns, not including district wardens. This official in the course of his duties would have the opportunity of visiting the place where each fire occurred, and making a proper examination as to its cause, extent and damage, and to institute whatever prosecution might be necessary for a violation of the fire law. He should see that in each case the warden fills out his blank report, and that it states all the facts connected with the case. He should scrutinize the bill of each warden for the services of the posse ordered out at the fire, and see that the number of men charged for and other items are correct. He should have supervision of the bills rendered by the various towns against the State in reimbursement for half of the expenses paid by them for the extinction of forest fires, as now provided by law. By careful attention to the latter requirements, a competent official would save to the State a sum greater than his salary. Furthermore, in fulfillment of the requirements of the law, he should see that whenever a vacancy occurs in the list of firewardens that the place should be promptly filled, by recommending some person who has not only had experience in fighting fire, but, also, one who will command the respect and obedience of a posse of fellow citizens when it is necessary to order them out to fight fire. In further compliance with the requirements of the fire law, he should see that every forest town is properly divided into small districts, and a district firewarden, properly located, appointed in each. During his spare time, while at the Albany office, he should prepare maps of each town showing the subdivisions into fire districts, on which should be noted the residence of the district firewarden. He should also attend to the distribution, among the firewardens, of the printed notices containing the rules and regulations of the Forestry Department in relation to the prevention and extinction of forest fires, and should see that these notices are thoroughly and properly posted throughout the woodland districts of the Adirondack and Catskills. The Forestry Law, furthermore, provides that this Department shall "have charge of the public interests of the State with regard to forestry, and *especially with reference to forest fires in every part of the State.*" As the latter clause is mandatory in its character, it should be the duty of the supervisor of firewardens to obtain annually the list of the supervisors of every town in the State outside the counties mentioned in the Forest Preserve Act, and furnish each with printed instructions regarding his duties as a firewarden, *ex-officio*, as prescribed in the forestry law. He should, furthermore, require and obtain of each supervisor annually a statement as to whether or not any forest fires have occurred in his town, and, if there has been one, a report of the same properly filled out on the blank forms furnished by this Commission for that purpose. As the law governing this Depart-



PARTRIDGE COVER.

ment does not provide for the appointment of such an official, and as our annual appropriation makes no provision for such an expenditure, some legislation seems necessary if this recommendation meets with your approval.

The Commission has noted with dissatisfaction and regret the failure of many of the firewardens to send in their reports promptly after a fire has occurred. Most of them wait until the end of the year, when it is too late to make the necessary inquiries into the cause of the fire and institute proceedings for a violation of the law. To provide against this persistent negligence of many firewardens, the law relating to forest fires should be amended so that no firewarden shall receive pay from a town board until he has first sent his report and bill to this Commission, in order to have it properly audited and stamped before it is presented by him to the town board for payment. The Commission is justified in making this requirement, because the State is obliged to refund to each Adirondack and Catskill town one half of the total amount paid to a firewarden for the expenses and services of himself and assistants in fighting fire.

I would embrace this opportunity to commend to the favorable consideration of the Board the valuable and meritorious work which has been done in the Adirondacks during the past few years, and is still being carried on, by the United States Geological Survey. The United States officials connected with this work are men of the highest attainments in their profession, and the people of our State are to be congratulated on thus receiving the benefit of their services. The work of this survey is topographical, as well as geographical in its character. The greater part of the Adirondack region has been surveyed and mapped by them, and the entire work will be completed within a comparatively short time. These maps, which are on file in this Department, and also in the office of the State Engineer and Surveyor, are open to inspection by the members of the Commission, and I trust that in the course of your duties you will give them a careful examination. The maps are on a large scale, showing accurately the location of every mountain, river, and smallest stream. The situation of each lake, pond, and tiny sheet of water is also shown. Every marsh, swamp, and piece of meadow land appears, depicted in the conventional characters used by skilful draughtsmen. Every road and trail is carefully laid down, the location of every house and barn properly noted, as well as that of every village, hamlet and hotel. The site of each bridge and dam along the streams is also shown. But the greatest value of this survey is found in the accurate delineation of the mountain topography. From the slightest elevation to the highest mountain the steepness of the land is shown in lines of twenty-foot contours, while on the summits of all the large hills and mountains, as shown on the map, figures are inserted indicating the altitude of these peaks above the sea level. The surveyors in their work noted, as they went along, the location of the blazed lines that mark the township, town, and county boundaries; and, so, by means of the relative topography any forester, hunter, or tourist can, by the aid of these maps and a pocket compass, go directly to any point within the Great Forest of Northern New York, whether it be on the top of the highest mountain, the lowest valley, or within the most remote recesses of the pathless forest. These sheets are unsurpassed as specimens of cartography. They are to be combined in one large map, on which the Adirondack region will stand revealed to the eye as plainly as the area of a farming district in a county atlas. Although the cost of this work hitherto has been largely defrayed by the general Government, through a recent arrangement the State of New York has agreed to pay one half of the survey, the agreement being that the United States will expend on this survey of the Adirondack region any amount necessary to the completion of the work, provided the State of New York will appropriate annually a similar sum, the entire amount to be expended under the direction of United States Geological Survey. This map is so necessary in the proper management of the Forest Preserve, and is of such great assistance to our officials in their travels and the prosecution of their work, as well, also, to all guides, hunters and tourists, that it is earnestly hoped that the Legislature will grant a liberal appropriation to enable the State to fully co-operate in the prosecution of this most valuable work, and avail itself of the offer made by the general Government.

A map of the forest counties in the Catskill region has been prepared under the direction and instructions of the superintendent. It is on a large scale, two miles to an inch—the same as that of our Adirondack map—and includes the counties of Ulster, Greene, Delaware and Sullivan, in which are situated 55,092 acres of the Forest Preserve. The entire landed allotment of this territory is shown on the map. Each tract or patent, with all its many subdivisions into small lots, is clearly and accurately outlined. The names of all the patents and surveys are neatly lettered, and the number of each lot is inserted in its place. All the town and county boundaries, villages, and railroads are laid down, while its value as a geographical map is enhanced by the many wagon roads which are also accurately shown. This map will be highly serviceable in our work, as it will enable the foresters and other officials to locate each parcel of State land in the Catskill Preserve and to care for it accordingly. I submit herewith as a part of this report the original draft of this Catskill map, and respectfully ask that when the report is sent to the State printer the map be sent also, with instructions to engrave and print 2,000 copies in style similar to our Adirondack map.

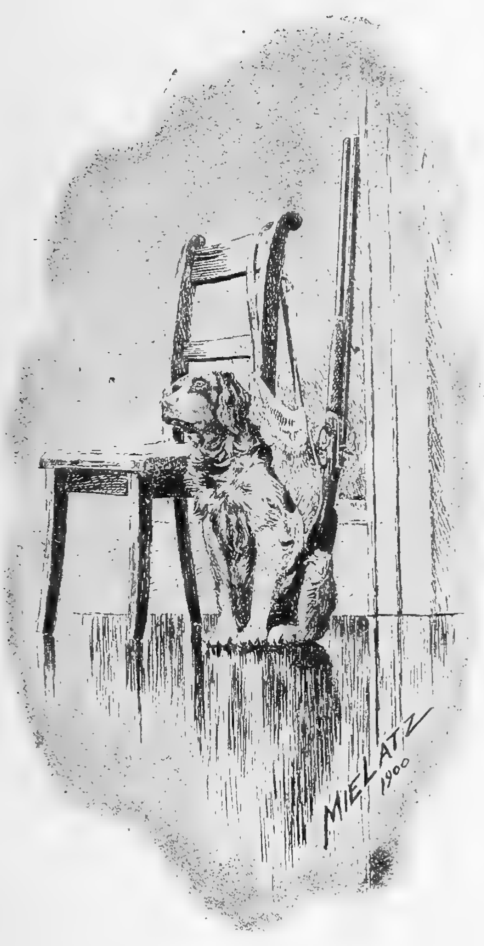
Respectfully submitted,

WILLIAM F. FOX,

Superintendent of State Forests.

Annual Timber Product of Northern New York.

By WILLIAM F. FOX, Supt. State Forests.



ALL READY.

THE amount of timber cut in the Adirondack forests in 1898 exceeds that of any other year since the time when the first tree fell under the axe of the pioneer lumberman. The production has increased steadily in recent years, and, under the stimulus of the present high prices for lumber and pulpwood, the annual output of our forests will probably be increased still further.

The amount of timber (log measure) cut in 1898 was as follows:

Spruce (saw mills), .	216,920,594	feet.
" (pulp mills), .	229,581,918	"
Hemlock, . . .	46,611,412	"
Pine, ...	33,236,410	"
Hardwood, . .	17,883,873	"
Total, . .	544,234,207	feet.

This is an increase of 93,238,791 feet, or twenty per cent., over the production of the previous year. The additional cutting is almost entirely in the spruce. The amount used for pulpwood is 63,494,046 feet more than was consumed in 1897, an increase of thirty-eight per cent. in one year.

It appears that the saw mills and pulp mills together consumed 446,502,512 feet of spruce. To people unfamiliar with forestry matters these figures will probably convey little meaning. Their significance will be better understood when it is stated that our Adirondack forests, on an average, contain about 3,800 feet of spruce to the acre, including the small pulp timber; and that, consequently, the lumbermen and pulpwood men during the last year removed the spruce trees, large and small, from 111,000 acres, or from an area of 173 square miles.

If the total product of the Adirondack forests last year—spruce, hemlock, pine and hardwoods—lumber and pulpwood—were shipped by rail, it would require over forty thousand cars to transport it, and it would make a railway train 225 miles long. There can be no error as to these quantities. They are not mere estimates, made to support some theory. The figures in the following tables showing the amount of timber consumed at each mill are the ones taken from the office books of the respective firms or individuals, and forwarded to us in writing by the manufacturers themselves.

Over two thirds of the Great Forest of Northern New York has now been "lumbered"; that is, the merchantable softwoods, the spruce, pine and hemlock, have been culled out, leaving a hardwood forest. There remains about 1,200,000 acres from which the spruce has not been removed, or which, having been partly lumbered several years ago, contain a partial crop of conifers, mostly small trees. But a part of these spruce lands belongs to the Forest Preserve, on which no lumbering at present is permitted, owing to the restrictions in the forestry clause of the new State constitution, and which narrows down the available supply of spruce to a much smaller area. It seems now that, if the present rate of cutting continues, most of our saw mills and pulp mills will be closed within thirteen years for a lack of timber, or be obliged to bring their supply from Canada. Before that time, however, the State may be ready to sell timber, so far as it can be done without detriment to the public forests. But there is no forestry plan, however liberal, which would permit an annual cutting equal to the present consumption of timber, or anything like it; and, if the Canadian government places the expected export duty on saw logs and pulpwood, little relief can be obtained in that quarter. The rapidity with which the Adirondack land owners are cutting over their woodlands recalls to mind the old fable of the goose that laid the golden egg, and its untimely fate at the hands of the enterprising owner.

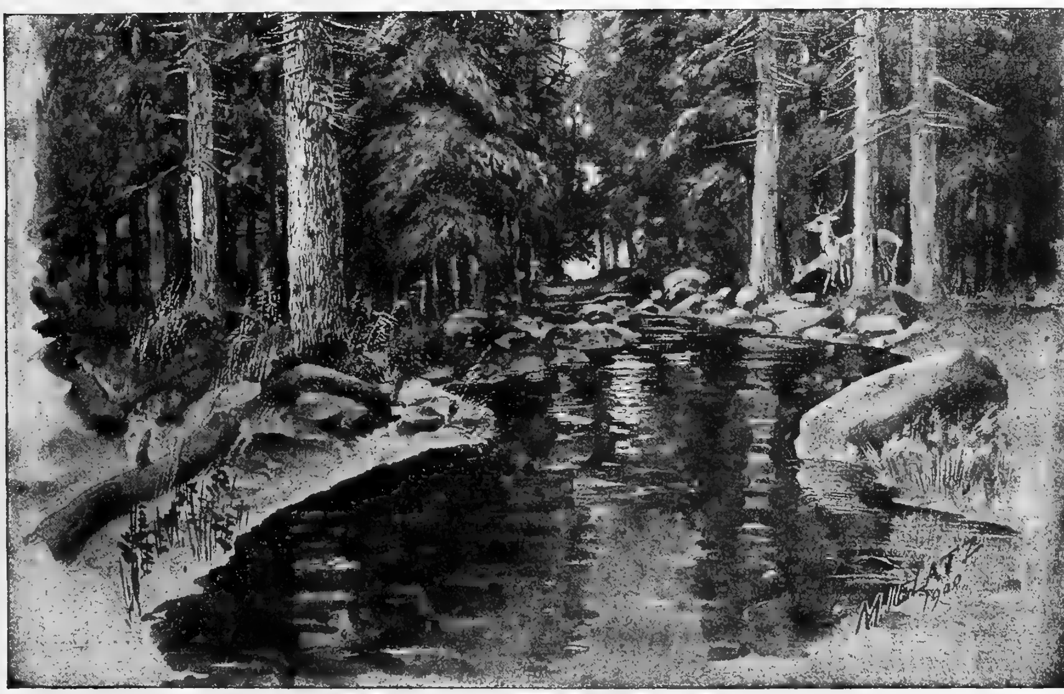
The condition of affairs in our Northern forest, as regards the rapid diminution in timber supply, shows clearly the wisdom of the State policy, which seeks to make some provision for a future permanent timber supply and the continuance of the great industries dependent on it.

It should be stated here, as it has been done before, that the operations of our lumbermen do not seriously impair the protective capacity of our forests. The culling out of the comparatively small percentage of merchantable species does not prevent the forest from exercising its natural and beneficent functions. There still remains a covering of trees, sufficient in number and density to protect the various watersheds, conserve moisture, exert favorable climatic influences, and form a desirable retreat for

IN QUIET COVER.

those who seek a woodland home or natural sanitarium. The Adirondack and Catskill regions contain to-day hundreds of thousands of acres that have been lumbered, but which are covered with dense forests that to an unpracticed eye reveal no trace of timber cutting, and which preserve their grand scenery unimpaired.

Could our woodlands be lumbered under some more conservative methods, could the annual cutting be restricted in quantity to that of the annual growth, as is now proposed for the State forests, then there would always be a constant supply. The



IN THE FOREST.

yield would be much smaller, but it would be perpetual; and the mills dependent on this product would have a permanent, solid basis on which to conduct their business.

It hardly seems necessary at this late day to argue in favor of harvesting the forest crop, instead of leaving the matured timber to fall from decay, blight or storms. Under a definite forestry system, with its approved and successful methods, our forests can be maintained perpetually and at the same time be made to furnish a constant revenue to the State. To neglect the permanent income available from the Forest Preserve is to ignore one of the great factors of our political economy.

GREAT FOREST OF NORTHERN NEW YORK.

LOCATION OF MILL		NAME OF MANUFACTURER	SPRUCE
Altona,	N. Y.	Allen & Cunningham	400,000
Au Sable Forks,	"	J. & J. Rogers Company	....
Beaver River,	"	F. Ouderkirk	7,000,000
Benson Mines,	"	James L. Humes	8,000,000
Benson Mines,	"	Bench Lumber Company	800,000
Bleecker,	"	John M. Peters' Sons	150,000
Bleecker,	"	John M. Peters, Jr.	250,000
Bleecker,	"	George Schamberger	75,000
Bleecker,	"	H. Van Denburgh	700,000
Blue M'nt'n Lake,	"	Tyler M. Merwin	100,000
Blue Ridge,	"	Henry O'Neal	50,000
Bloomingdale,	"	E. M. White	255,000
Canton,	"	Canton Lumber Company	7,500,000
Canton,	"	James Spears*	6,000,000
Castorland,	"	Beaver River Lumber Company	12,000,000
Carthage,	"	Carthage Lumber Company	2,286,979
Carthage,	"	Balcom & Spicer	....
Clinton Mills,	"	Ladd & Smallman †	200,000
Conklingville,	"	A. A. Sumner	....
Champlain,	"	Robert McCrea	600,000
Corinth,	"	Getman & Co	....
Corinth,	"	Joel Townsend	10,000
Corinth,	"	Freegrace White	....
Cranberry Creek,	"	L. G. Gifford	35,000
Crary's Mills,	"	Oscar Runions	40,000
Day,	"	Van R. Rhodes	30,000
Dickinson Centre,	"	B. L. Orcutt	350,000

* Mills at Canton and Buck's Bridge.

† This firm has a mill at Malone reported separately.

LUMBER MANUFACTURED IN YEAR 1898.

HEMLOCK	PINE	HARDWOOD	TOTAL
....	....	142,000	542,000
....	217,238	....	217,238
2,000,000	4,000,000	....	13,000,000
....	....	100,000	8,100,000
....	....	300,000	1,100,000
125,000	....	165,000	440,000
40,000	....	60,000	350,000
15,000	....	100,000	190,000
100,000	....	....	800,000
5,000	1,000	1,000	107,000
100,000	25,000	25,000	200,000
50,000	20,000	25,000	350,000
500,000	40,000	....	8,040,000
4,000,000	500,000	....	10,500,000
4,000,000	1,000,000	....	17,000,000
1,523,774	692,057	11,182	4,513,992
....	....	1,000,000	1,000,000
175,000	....	50,000	425,000
....	....	1,000,000	1,000,000
100,000	10,000	10,000	720,000
150,000	200,000	50,000	400,000
25,000	100,000	30,000	165,000
250,000	75,000	....	325,000
100,000	30,000	*40,000	205,000
150,000	25,000	200,000	415,000
400,000	75,000	50,000	555,000
150,000	....	500,000	1,000,000

* Black Ash.

GREAT FOREST OF NORTHERN NEW YORK.

LOCATION OF MILL		NAME OF MANUFACTURER	SPRUCE
Duane,	N. Y	Charles Selkirk	275,000
Ellenburgh,	"	John L. Carter	500,000
Ellenburgh,	"	F. W. Sherlock	100,000
Ellenburgh Centre,	"	John Houghran	500,000
Elizabethtown,	"	Livingston Woodruff................	75,000
Euba Mills,	"	Orlando Beede	50,000
Fine,	"	Cardiff Brothers....................	77,162
Forestport,	"	Forestport Lumber Company.........	6,225,000
Forestport,	"	Edward Curran	500,000
Forestport,	"	Denton & Waterbury	4,000,000
Glens Falls,	"	Finch, Pruyn & Co..................	18,500,000
Glens Falls,	"	Morgan Lumber Company*	13,473,097
Glens Falls,	"	George H. Freeman	1,870,041
Gurnspring,	"	F. Van Wagner	....
Garnet,	"	John Grogan, Jr	90,000
Gloversville,	"	R. E. Holmes	300,000
Gloversville,	"	W. DeGolyer......................	175,000
Gloversville,	"	A. T. Peck	250,000
Gouverneur,	"	Aldrich, Dean & Aldrich†	7,400,000
Gray,	"	C. B. Gray	150,000
Gray,	"	William Bennett...................	250,000
Herman,	"	A. Negas	25,000
Harrisville,	"	C. R. Remington & Son Co..........	61,912
Herkimer,	"	C. R. Snell	....
Hope Falls,	"	William Lawton	75,000
Indian Lake,	"	J. W. Kerst	150,000
Inlet,	"	Peter J. Rohr	300,000

* Mill at South Glens Falls.

† Mill at Natural Dam.

LUMBER MANUFACTURED IN YEAR 1898.—*Continued.*

HEMLOCK	PINE	HARDWOOD	TOTAL
25,000	20,000	....	320,000
....	....	....	500,000
200,000	....	200,000	500,000
....	....	....	500,000
100,000	50,000	10,000	235,000
100,000	20,000	25,000	195,000
98,916	10,000	359,697	545,775
....	....	....	6,225,000
....	....	300,000	800,000
....	....	....	4,000,000
2,000,000	500,000	50,000	21,050,000
3,705,023	1,070,320	130,136	18,378,576
98,095	242,266	14,691	2,225,093
50,000	90,000	60,000	200,000
75,000	25,000	....	190,000
200,000	....	....	500,000
125,000	....	5,000	305,000
420,000	10,000	75,000	755,000
7,000,000	1,600,000	....	16,000,000
....	....	*400,000	550,000
10,000	....	15,000	275,000
150,000	10,000	150,000	335,000
576,966	115,209	78,120	832,207
150,000	....	250,000	400,000
125,000	....	60,000	260,000
50,000	5,000	10,000	215,000
200,000	50,000	....	550,000

* Beech.

GREAT FOREST OF NORTHERN NEW YORK.

LOCATION OF MILL	NAME OF MANUFACTURER	SPRUCE
Inman, N. Y.	M. E. Walker	3,000,000
Jayville, "	Post & Henderson	2,410,775
Keene Center, "	H. C. Nye	200,000
Keene Valley, "	F. S. Beede	450,000
Knowelhurst, "	Charles Smith	40,000
Lake Pleasant, "	Asa Aird	200,000
Lake Pleasant, "	M. B. Hosley	75,000
Lewis, "	A. A. Boynton	40,000
Long Lake, "	A. W. Shaw	142,000
Long Lake, "	Helms & Wilson	94,200
Long Lake "	M. C. Robinson & Bro	75,000
Luzerne, "	John Shaver	....
Luzerne, "	Frederick C. Hall	50,000
McKeever "	Moose River Lumber Company	9,000,000
Malone, "	Miles N. Dawson	275,000
Malone, "	Ladd & Smallman*	80,000
Middle Sprite, "	George Van Allen	40,000
Middle Sprite, "	George Shull	80,000
Middle Sprite, "	John C. Shulenberg	100,000
Milton Center, "	William W. Streever	....
Morrisonville, "	F. M. Purdy	4,500,000
Mountain View, "	E. R. Bryant	5,219,000
Natural Bridge, "	Calvin V. Graves	25,000
Natural Bridge, "	Yousey Brothers	325,000
New Bremen, "	M. W. Van Amber	600,000
Newcomb, "	John Anderson, Jr	400,000
Newman, "	Benjamin T. Brewster	400,000
Newton Falls, "	Newton Falls Paper Company	....

* This firm has a mill at Clinton Mills, reported separately.

LUMBER MANUFACTURED IN YEAR 1898.—*Continued.*

HEMLOCK	PINE	HARDWOOD	TOTAL
800,000	250,000	215,000	4,265,000
1,585,383	157,557	109,924	4,263,639
25,000	20,000	10,000	255,000
300,000	....	75,000	825,000
60,000	1,000	75,000	176,000
100,000	330,000	10,000	640,000
40,000	5,000	10,000	130,000
60,000	500,000	10,000	610,000
98,000	10,000	36,000	286,000
61,180	30,600	15,940	201,920
25,000	15,000	10,000	125,000
53,498	385,380	53,838	492,716
600,000	200,000	200,000	1,050,000
1,000,000	3,000,000	200,000	13,200,000
150,000	....	....	425,000
60,000	....	....	140,000
40,000	....	20,000	100,000
25,000	....	20,000	125,000
50,000	....	50,000	200,000
....	300,000	120,000	420,000
100,000	100,000	75,000	4,775,000
100,000	50,000	188,000	5,557,000
50,000	25,000	100,000	200,000
1,130,000	18,000	69,000	1,542,000
400,000	....	....	1,000,000
100,000	....	15,000	515,000
....	....	....	400,000
1,325,611	14,194	547,545	1,887,350

GREAT FOREST OF NORTHERN NEW YORK.

LOCATION OF MILL		NAME OF MANUFACTURER	SPRUCE
Newton Falls,	N. Y	North Woods Lumber Company	....
North Creek,	"	John Barton	25,000
North Elba,	"	B. R. Brewster	800,000
North Hudson,	"	William Sturtevant	15,000
Northville,	"	John A. Willard	10,000
Northville,	"	Sherman Tenant	183,000
Northwood,	"	Aug. Odet	50,000
Norwood,	"	Norwood Manufacturing Company	13,080,416
Old Forge,	"	George Linston	230,000
Onchiota,	"	Kinsley Lumber Company	4,000,000
Oswegatchie,	"	John Irwin	1,000,000
Oswegatchie,	"	J. R. Lafavre	....
Oswegatchie,	"	Andrew Collins	100,000
Owl's Head,	"	S. G. Boyce	2,200,000
Parishville,	"	Parishville Lumber Company	3,000,000
Parishville,	"	S. L. Clark & Son	2,000,000
Paul Smiths,	"	Paul Smith's Hotel Company	558,062
Philadelphia,	"	William Roberts	50,000
Pine Lake,	"	Henry T. Bona	300,000
Pine Lake,	"	Frank A. Hill	80,000
Potsdam,	"	A. Sherman Lumber Company*	6,757,977
Reynoldston,	"	Reynolds Brothers & Co	1,500,000
Rockwood,	"	Everett Young	400,000
Rockwood,	"	Levi Stahl & Son	50,000
Salisbury,	"	James Fuller	200,000
Salisbury Center,	"	J. F. McDougal	150,000
St. Regis Falls,	"	Santa Clara Lumber Company	1,500,000
Sandy Hill,	"	Kenyon Lumber Company	5,298,372

* This firm has a mill at Tupper Lake, reported separately.

LUMBER MANUFACTURED IN YEAR 1898.—*Continued.*

HEMLOCK	PINE	HARDWOOD	TOTAL
....	....	1,300,000	1,300,000
30,000	20,000	25,000	100,000
....	....	....	800,000
70,000	20,000	5,000	110,000
20,000	800,000	150,000	980,000
91,500	9,150	366,000	649,650
50,000	....	100,000	200,000
319,770	3,821,832	2,480	17,224,498
30,000	12,000	10,000	282,000
200,000	100,000	200,000	4,500,000
500,000	....	150,000	1,650,000
....	50,000	1,200,000	1,250,000
250,000	50,000	200,000	600,000
25,000	....	1,000,000	3,225,000
1,000,000	250,000	....	4,250,000
300,000	75,000	25,000	2,400,000
....	173,864	....	731,926
800,000	50,000	100,000	1,000,000
50,000	....	50,000	400,000
25,000	3,000	....	108,000
196,438	704,523	15,000	7,673,938
500,000	....	100,000	2,100,000
200,000	80,000	100,000	780,000
200,000	25,000	15,000	290,000
100,000	....	30,000	330,000
....	....	100,000	250,000
....	....	3,000,000	4,500,000
1,809,258	1,536,106	25,320	8,669,056

GREAT FOREST OF NORTHERN NEW YORK.

LOCATION OF MILL		NAME OF MANUFACTURER	SPRUCE
Saranac Inn,	N. Y.	Upper Saranac Association	600,000
Saranac Lake,	"	Stephen Merchant	300,000
South Greenfield,	"	E. H. Dunham	....
South Schroon,	"	F. N. Tyrrell	113,000
Stony Creek,	"	A. D. Scribner	20,000
Stony Creek,	"	Lee L. Hall	....
Stratford,	"	J. C. Livingston & Co	2,000,000
Stratford,	"	David Helterline	800,000
Stratford,	"	Wheeler Knapp*	400,000
Stratford,	"	C. P. Goodwin	70,000
Thomson,	"	Thomson, Douglas & Dix	400,000
Tupper Lake,	"	Tupper Lake Manufacturing Company	30,000,000
Tupper Lake,	"	A. Sherman Lumber Company †	7,308,601
Wadhams Mills,	"	D. F. Payne ‡	350,000
Warrensburgh,	"	A. C. Emerson & Co	200,000
West Stockholm,	"	George N. Gibson & Son	700,000
Wilmurt,	"	Richards Brothers	96,000
		Total	216,920,594

* Mills at Stratford and Dolgeville.

† This firm has a mill at Potsdam, reported separately.

‡ Mills at Wadhams Mills and Westport.

LUMBER MANUFACTURED IN YEAR 1898.—*Concluded.*

HEMLOCK	PINE	HARDWOOD	TOTAL
20,000	100,000	....	720,000
75,000	20,000	20,000	415,000
15,000	200,000	2,000	217,000
100,000	85,000	35,000	333,000
20,000	....	300,000	340,000
40,000	....	150,000	190,000
....	....	300,000	2,300,000
....	....	50,000	850,000
100,000	....	200,000	700,000
50,000	....	75,000	195,000
50,000	10,000	2,000	462,000
....	7,000,000	....	37,000,000
....	1,126,114	....	8,434,715
80,000	275,000	20,000	725,000
1,000,000	300,000	....	1,500,000
500,000	100,000	100,000	1,400,000
38,000	....	74,000	208,000
46,611,412	33,236,410	17,883,873	314,652,289

GREAT FOREST OF NORTHERN NEW YORK.

MANUFACTURE OF SHINGLES AND LATH FOR YEAR 1898.

LOCATION OF MILL		NAME OF MANUFACTURER	SHINGLES	LATH
Bleecker,	N. Y.	John M. Peters, Jr	....	100,000
Blue Ridge,	"	Henry O'Neal	1,500,000	....
Canton,	"	Canton Lumber Company	....	1,600,000
Clinton Mills,	"	Ladd & Smallman	796,000	235,000
Corinth,	"	Freegrace White	200,000	100,000
Day,	"	Van R. Rhodes	200,000	50,000
Diana,	"	W. G. Ingraham	500,000	....
Dickinson Centre,	"	B. L. Orcutt	500,000	....
Ellenburgh Centre,	"	John Haughran	300,000	....
Elizabethtown,	"	Livingston Woodruff	150,000	....
Euba Mills,	"	Orlando Beede	300,000	....
Forestport,	"	Forestport Lumber Company	....	4,766,000
Forestport,	"	Denton & Waterbury	....	3,500,000
Glens Falls,	"	Finch, Pruyn & Company	....	5,000,000
Glens Falls,	"	Morgan Lumber Company	....	2,537,400
Glens Falls,	"	George H. Freeman	....	735,700
Gloversville,	"	A. T. Peck	....	600,000
Gouverneur,	"	Aldrich, Dean & Aldrich	2,000,000	4,000,000
Harrisville,	"	C. R. Remington & Son Co	325,000	....
Hermon,	"	A. Negas	200,000	....
Indian Lake,	"	J. W. Kerst	....	70,000
Inlet,	"	Peter J. Rohr	400,000	....
Inman,	"	M. E. Walker	2,000,000	2,000,000
Jayville,	"	Post & Henderson	376,000	800,290
Keene Valley,	"	F. S. Beede	175,000	350,000
Lake Pleasant,	"	Asa Aird	....	70,000
Lewis,	"	A. A. Boynton	600,000	....

GREAT FOREST OF NORTHERN NEW YORK.

MANUFACTURE OF SHINGLES AND LATH FOR YEAR 1898.

(Continued.)

LOCATION OF MILL		NAME OF MANUFACTURER	SHINGLES	LATH
Long Lake,	N. Y.	O. B. Lapell	500,000	....
Long Lake,	"	A. W. Shaw	....	86,000
Long Lake,	"	Helms & Wilson	190,000	....
Luzerne,	"	John Shaver	250,000	....
McKeever,	"	Moose River Lumber Company	....	4,800,000
Milton Center,	"	William W. Strever	....	130,000
Mooers Forks,	"	H. H. Howard	740,000	....
Morrisonville,	"	F. M. Purdy	800,000	2,000,000
Mountain View,	"	E. R. Bryant	200,000	141,000
Natural Bridge,	"	Calvin V. Graves	150,000	....
Newcomb,	"	John Anderson, Jr	350,000	25,000
North Creek,	"	John Barton	100,000	75,000
Newman,	"	B. R. Brewster	50,000	100,000
North Hudson,	"	William Sturtevant	125,000	50,000
Northville,	"	Sherman Tenant	....	200,000
Norwood,	"	Norwood Manufacturing Company	....	1,200,000
Onchiota,	"	Kinsley Lumber Company	200,000	....
Owl's Head,	"	S. G. Boyce	300,000	400,000
Parishville,	"	Parishville Lumber Company	2,000,000	....
Parishville,	"	S. L. Clark & Son	1,167,000	....
Paul Smiths,	"	Paul Smith's Hotel Company	150,000	....
Philadelphia,	"	William Roberts	680,000	41,600
Pine Lake,	"	Henry T. Bona	....	300,000
Pine Lake,	"	Frank A. Hill	....	80,000
Potsdam,	"	A. Sherman Lumber Company	6,369,000	1,766,700
Reynoldston,	"	Reynolds Brothers & Co	500,000	100,000
Rockwood,	"	Everett Young	....	300,000

GREAT FOREST OF NORTHERN NEW YORK.

MANUFACTURE OF SHINGLES AND LATH FOR YEAR 1898.

(Concluded.)

LOCATION OF MILL		NAME OF MANUFACTURER	SHINGLES	LATH
Rockwood,	N. Y.	Levi Stahl & Son	50,000	175,000
Sandy Hill,	"	Kenyon Lumber Company	....	2,043,800
Saranac Lake,	"	Stephen Merchant	100,000	125,000
South Schroon,	"	F. N. Tyrrell	95,000	....
Stratford,	"	David Helterline	200,000	....
Stratford,	"	Wheeler Knapp	100,000	....
Tupper Lake,	"	A. Sherman Lumber Company	....	2,569,000
Wadhams Mills,	"	D. F. Payne	185,000	....
Warrensburgh,	"	A. C. Emerson & Co	450,000	461,300
West Stockholm,	"	George N. Gibson & Son	750,000	250,000
		Total	27,273,000	43,933,790

GREAT FOREST OF NORTHERN NEW YORK.

CONSUMPTION OF PULPWOOD FOR YEAR 1898.

LOCATION OF MILL	NAME OF MANUFACTURER	CORDS
Au Sable Forks, N. Y	J. & J. Rogers Company	33,659
Au Sable Chasm, "	Alice Falls Company................	5,000
Ballston Spa, "	Union Bag and Paper Company	500
Beaver Falls, "	Lewis, Slocum & LeFevre	15,000
Beaver Falls, "	The J. P. Lewis Company	1,182
Black River, "	H. Remington & Son P. & P. Co	2,400
Black River, "	The Jefferson Paper Company	1,482
Black River, "	Empire Wood Pulp Company	350
Black River, "	Black River Wood Pulp Company	1,000
Brownville, "	Brownville Paper Company	1,700
Brownville, "	Outterson Paper Company...........	1,500
Cadyville, "	International Paper Company*	35,000
Carthage, "	The Jefferson Power Company	9,650
Carthage, "	Carthage Sulphite Pulp Company †	2,625
Carthage, "	Island Paper Company..............	2,000
Carthage, "	West End Pulp and Casket Company ..	620
Carthage, "	A. E. Maxwell.....................	600
Chateaugay, "	Chateaugay Pulp Company	3,000
Chateaugay, "	High Falls Pulp Company	3,000
Colton, "	Raquette River Pulp Company	4,100
Dexter, "	Dexter Sulphite Pulp and Paper Co.‡ ..	8,612
Dexter, "	St. Lawrence Mills	800
Dexter, "	Jones & Hunter....................	500
Dexter, "	Frontenac Paper Company...........	320
Emeryville, "	The Gouverneur Wood Pulp Company .	4,800
Felts Mills, "	Taggarts Paper Company............	5,570

* Three Mills. † Mill started September 15, 1898.

‡ Not quite one-half of the quantity used. The balance was obtained principally from Canada.

GREAT FOREST OF NORTHERN NEW YORK.

CONSUMPTION OF PULPWOOD FOR YEAR 1898.

(Continued.)

LOCATION OF MILL		NAME OF MANUFACTURER	CORDS
Fine,	N. Y	Standard Pulp Company	2,341
Fort Ann,	"	Kane's Falls Pulp Company*	200
Fort Edward,	"	International Paper Company †	7,000
Fort Miller,	"	Fort Miller Pulp and Paper Company ..	480
Fullerville,	"	Keller Brothers	1,000
Fulton,	"	Oswego Falls Pulp and Paper Company	6,000
Fulton,	"	Fulton Paper Company	4,300
Glens Falls,	"	International Paper Company	18,000
Great Bend,	"	Taggarts Paper Company	1,730
Greig,	"	Moyer & Pratt	50
Hadley,	"	Sacandaga Pulp Mills ‡	835
Hinckley,	"	Hinckley Fibre Company	19,535
Lockport,	"	Traders Paper Company	1,000
Lockport,	"	United Indurated Fibre Company	800
Lockport,	"	Lockport Pulp Company §	60
Lyons Falls,	"	International Paper Company	8,000
Lyons Falls,	"	Gould Paper Company	9,000
Mechanicville,	"	The Duncan Company	17,973
Middle Falls,	"	Bennington Falls Pulp Company	700
Middle Falls,	"	Washington Pulp and Paper Mills	450
Newton Falls	"	Newton Falls Paper Company	15,500
Niagara Falls,	"	International Paper Company ‖	5,000
Norwood,	"	O. E. Martin	1,200
Palmer Falls,	"	International Paper Company ¶	5,000

* This company obtains the most of its wood from Vermont.

† This mill used 43,000 cords from Canada.

‡ Uses wood from other localities also.

§ This company gets the principal part of its wood from the West.

‖ This mill used 26,000 cords from Michigan.

¶ This mill used 47,000 cords from Canada.

GREAT FOREST OF NORTHERN NEW YORK.

CONSUMPTION OF PULPWOOD FOR YEAR 1898.

(Concluded.)

LOCATION OF MILL		NAME OF MANUFACTURER	CORDS
Piercefield,	N. Y.......	International Paper Company	28,500
Plattsburgh,	"	James H. Allen	2,486
Plattsburgh,	" . .	Freydenburgh Falls Pulp Company	16,000
Plattsburgh,	"	Treadwells Mills Pulp and Paper Co. ..	6,000
Port Leyden,	"	Johnston & Gebbie*	1,500
Potsdam,	"	Raquette River Paper Company	7,335
Pyrites,	"	High Falls Sulphite P. and M. Co.....	8,000
Rochester,	"	Genesee Paper Company	4,000
Sandy Hill,	"	Union Bag and Paper Company	3,665
Schuylerville,	"	American Board Company............	1,645
South Edwards,	"	South Edwards Pulp Company	1,000
Ticonderoga,	"	International Paper Company.........	13,000
Ticonderoga,	"	E. Richards & Son	2,150
Warrensburgh,	"	Schroon River Pulp Company	3,335
Watertown,	"	International Paper Company†	39,500
Watertown,	"	Knowlton Brothers	850
Willsboro,	"	New York and Pennsylvania Company.	8,092
		Total..................	418,182

* Used 700 cords also, from Tug Hill.

† Four mills at Watertown-Brownville.

GREAT FOREST OF NORTHERN NEW YORK.

Yearly Production of Lumber and Pulpwood from 1890 to 1898.

	Feet.	
1890—Lumber,	325,690,634	
Pulpwood—94,638 cords,	51,956,262	
		377,646,896
1891—Lumber,*	286,710,593	
Pulpwood—126,183 cords,	69,274,283	
		355,984,876
1892—Lumber,	406,954,200	
Pulpwood—147,392 cords,	80,918,537	
		487,872,737
1893—Lumber,	355,050,528	
Pulpwood—167,825 cords,	92,135,707	
		447,186,235
1894—Lumber,	288,700,269	
Pulpwood—204,182 cords,	112,095,918	
		400,796,187
1895—Lumber,	297,610,161	
Pulpwood—276,669 cords,	151,891,281	
		449,501,442
1896—Lumber,	270,215,372	
Pulpwood—291,246 cords,	159,894,054	
		430,109,426
1897—Lumber,	284,907,544	
Pulpwood—302,528 cords,	166,087,872	
		450,995,416
1898—Lumber,	314,652,289	
Pulpwood—418,182 cords,	229,581,918	
		544,234,207

PRODUCTION OF LUMBER BY DISTRICTS IN 1898.

Glens Falls District,	65,473,011	feet
Clinton and Franklin Counties,	55,968,164	"
St. Lawrence County,	115,829,915	"
Jefferson, Lewis and Oneida Counties,	37,113,199	"
Herkimer and Fulton Counties,	40,268,000	"
Total,	314,652,289	feet

* Dry season; part of the log drives failed to arrive at the mills. Hence the large amount sawed next year.

SUMMARY, 1898.

Spruce,	216,920,594 feet
Hemlock,	46,611,412 "
Pine,	33,236,410 "
Hardwood,	17,883,873 "
Total lumber,	314,652,289 feet
Pulpwood, 418,182 cords—equivalent B. M.,	229,581,918 feet
Total lumber and pulpwood,	544,234,207 feet
Shingles,	27,273,000
Lath,	43,933,790

In computing the equivalent log measure of the pulpwood, a cord was figured as equal to three standard or market logs. The market log—which is 13 feet long and 19 inches in diameter—contains 183 feet, Doyle rule. Hence, the number of cords multiplied by 549 (3 x 183 feet) gives the equivalent in log or board measure.

YEARLY PRODUCTION OF SHINGLES AND LATH FROM 1894 TO 1898.

	SHINGLES.	LATH.
1894,	18,683,000	32,453,000
1895,	18,267,000	34,295,000
1896,	16,256,000	21,050,000
1897,	35,623,750	47,661,150
1898,	27,273,000	43,933,790

The comparatively small amount of shingles and lath reported for the years 1894, '95 and '96, is due to incomplete returns rather than any decrease in production.

I desire here to acknowledge the valuable assistance of Mr. A. B. Strough, of the office force, whose familiarity with the subject enabled him to collect and tabulate the foregoing statistics in accordance with the methods first used by me in my earlier reports to the Department.

The comparatively small amount of pine cut in 1898, and also in recent years, is due to the fact that the forests of Northern New York were, for the most part, stripped of their best pine over forty years ago. Prior to 1860, or thereabouts, the lumbermen in that region cut nothing else. No spruce was taken, the small market demand for that species being supplied from the Maine woods. The hemlock was left standing because the logs would not float unless peeled; and as all the tanneries were situated near the border of the wilderness it was too far to haul the bark. So the logging was confined to the white pine, on which there was only a small profit at that time, although it was the best timber in the woods. The Norway pine was not cut, it being inferior to the white pine, smaller and harder to manufacture. In fact, there is not much Norway pine in our Northern forest. Although it is apt to be standing in groups it appears only at widely separated intervals.

The production of hemlock in Northern New York has decreased steadily in the last eight years from 94,145,695 feet in 1890, to 42,611,412 feet in 1898. The Adirondack hemlock is inferior in size and quality to that in Pennsylvania, and owing to the favorable freight rates of the latter our Northern hemlock could not be handled with profit, unless it stood near enough to the tanneries along the border to market the bark. The price of hemlock lumber is now advancing rapidly. The pulp mills are using a larger admixture of this wood, which may result also in an increased cutting. But a large proportion of the hemlock lands have passed into the possession of the State, these forests having been abandoned by their owners after the spruce and pine had been removed, and allowed to revert for unpaid taxes. Large areas have also been sold to the State at a low price, lands on which the hemlock timber is still standing.

The hardwood production has steadily increased during the last eight years, from 5,835,844 feet, in 1890, to 17,883,873 feet in 1898. Along the entire border of the Great Forest there are small mills at frequent intervals, which saw hardwood mostly—many of them nothing else. Some of these mills formerly cut only spruce, pine or hemlock. But when the accessible timber of these species was exhausted, the mill owners had to either abandon their plant or commence sawing hardwood. They soon found a market for the latter, and now some of these operators are sawing more lumber, and making more money, than when they were in the spruce and hemlock business.

The hardwood production is composed almost wholly of birch, maple and beech, these species comprising the principal hardwood growth of the Adirondack forests. Small quantities of black cherry, ash, and elm are cut in some of the mills. Basswood, which cannot properly be called a hardwood, is sawed in considerable amount; and in the foregoing tabulation of the annual forest output this species is included, for convenience, with the hardwoods. No oak, chestnut, or hickory is cut, for these species do not grow on the Adirondack plateau.

Of the hardwoods, more birch is sawed than any other species. It is the yellow or gray birch (*betula lutea*), although it is known generally among the lumbermen and woodsmen as "red birch," a term used on account of the reddish tinge of the wood. It is sometimes called black birch, owing to the darker shade of the wood found in some of the trees. But the red, or river birch of the botanists (*betula nigra*), and the real black birch (*betula lenta*) is not found in our Adirondack woods, although I have noticed a few specimens of the latter in the vicinity of Keene Valley. But the altitude where these trees were growing was much less than that of the average plateau, which would account also for some red oaks that may be seen there.

With the increased facilities for transportation afforded by the recently constructed railroads the cutting of the broad-leaved trees will increase. Plans are already under consideration for the erection of stave mills and acid factories. The latter use hardwood of all kinds and sizes, which, following the operations of the lumbermen and pulpwood choppers, results in a complete denudation of the land. This, again, would not be so hopelessly bad if some provision were made for reforesting the land; but there is nothing to indicate that any work of this kind will be attempted on private holdings.

So long as the operations of the log jobbers were confined to the removal of one or two species the protective character of the forest was not seriously impaired. But with the advent of these other industries, requiring more or all of the species growing there, it is evident that large areas of standing timber are threatened with extinction. It becomes more imperative each year that the State shall acquire the territory in order to prevent such results, and also to inaugurate some conservative forest policy whereby it can supply the people with this much-needed product without ruining the source of the supply. To accomplish this the State must first acquire the lands by purchasing them as fast as they are offered for sale; and this can be done gradually without interfering with industries already established. But money will be required to do it, and in large amounts. The Legislature will always vote the necessary appropriations whenever it is clear that its constituency demands it. While it is evident that the people of the State are heartily in favor of forest preservation and a further enlargement of the public preserve, there is need of a more outspoken sentiment on this subject, coupled with a plainly voiced demand for the necessary legislation.

Forest Fires in 1898.

By WILLIAM F. FOX, Supt. State Forests.

IN THE SPRING.

IN the care and management of woodlands one of the most important duties devolving on the foresters is the prevention or extinguishing of woodland fires. The skillfully made working plans, the harvesting of the product, the reforesting of burned areas, the technical work of sylviculture—all count as nothing if fire sweeps over the ground.

In a primeval, unoccupied forest, controlled and managed under one sole ownership, little danger is to be apprehended from this source. But where holdings are scattered, interspersed with tracts belonging to various owners, bounded here and there with agricultural lands, crossed by railroads or highways, strewn with the dry brush, dead tops, and other *débris* of lumbering operations, and traversed by careless parties of tourists, campers, fishermen and hunters—fires are very apt to ensue. Despite these unfavorable conditions, which exist almost everywhere throughout the Adirondack and Catskill forests, much has been accomplished in preventing the widespread fires which in former years were allowed to run unchecked and unattended to in our woodland districts.

Good results have been attained through the appointment of a firewarden in each forest town, and the thousands of warning notices, posted annually throughout the woods and neighboring settlements, which have done much to educate the people in a more careful use of fire and to awaken the attention of the thoughtless or indifferent.

Under the present law relating to forest fires the Commission is empowered to appoint a firewarden in each town within the sixteen counties containing the lands of the Forest Preserve. Many of our woodland towns are very large, having an area greater than that of some of our counties. Hence, the firewarden is authorized by law to divide his town into districts, in each of which he shall appoint a deputy or district firewarden who shall have the same authority to " warn " out a posse of men to fight fire. Neither the town firewardens nor district firewardens are paid any salary; but they are entitled to receive from the town $2.50 per day for their services while actually employed at a forest fire. The men who are ordered out, or who assist, at a fire are entitled to $2.00 per day for their services while at work.

In providing for the appointment of district firewardens the intention of the law was that the town should be so divided into districts that the smoke of a fire could be seen by the deputy as soon as it arose, and that no time need be lost in sending for the town firewarden. In extinguishing a forest fire much depends on promptness, and in attacking it before it can gain any headway. Hence, it is the duty of the district firewarden to go to a fire immediately with his men as soon as it is observed. Having done this he can send word to the town firewarden whenever he can spare a man for that purpose.

The duties of adjusting the amounts due the men for fighting fire, the settlement of these accounts with the town, and the proper posting of the district with printed placards containing the rules and regulations regarding the use of fire, devolve upon the town firewarden.

Under the law all expenses incurred in extinguishing a forest fire, for the services of the men or otherwise, are a town charge and must be paid by the town. Payment having been made, the town is entitled to a rebate from the State of one half the amount thus expended. This applies, however, only to the towns within the sixteen counties containing lands belonging to the Forest Preserve. Twelve of these counties, including the Adirondack region, are in Northern New York, namely: Clinton, Essex, Franklin, Fulton, Hamilton, Herkimer, Lewis, Oneida, Saratoga, St. Lawrence, Warren and Washington. The remaining four counties include the Catskill region, namely: Delaware, Greene, Sullivan and Ulster. Outside of these counties the supervisor of each town is authorized to act as firewarden *ex officio;* and in these towns there is no rebate from the State for expenses incurred in fighting fire.

The most frequent causes of woodland fires in our State are the small fires started by farmers for the purpose of burning brush, logs and stumps, in order to clear some piece of land. These are known locally as fallow fires, and the operation is generally alluded to as burning a "foller." This work as a rule is carelessly done, and as the farmer always selects a dry time in order to get a good burn, as he terms it, the fire escapes too frequently into the adjoining forest. Having piled the brush and logs into heaps for burning, the farmer seldom employs any extra help to guard against the escape of the fire, and so when a breeze springs up, as is very apt to be the case, he is unable to control the flames or prevent them from being driven into the adjoining woods. Too often he is known to set fire to his brush heaps and then go away to attend to other work, leaving the fire unwatched. Nearly all the burned areas in the Adirondack region are due to the carelessness of men employed in these petty agricultural operations. It is the farmer, not the lumberman, who has destroyed so many thousand acres of timber land. The lumberman takes only a few trees per acre of some merchantable species; the farmer in his operations destroys the entire forest.

The forest fires resulting from the clearing of land grew so numerous and destructive that legislation became necessary, in order to control or restrict this evil. The forest law was accordingly amended in 1897 by the insertion of a paragraph prohibiting the burning of fallows in certain specified towns between April 1st and June 10th, and between September 1st and November 10th, these being the periods during which the ground was covered with dry, dead leaves, and in which the conditions were most favorable for the spread of fire. At other times, when the trees are in full leaf, or when the ground is covered with snow, little danger is to be apprehended from the brush fires of the farmers. As a result of this amendment to the law there has been a noticeable decrease in the destruction of timber lands from this source. There yet remains, however, much to be done in the way of the enforcement of this law.

What is known as the firewarden system is a good one, and is well adapted to the prevention of woodland fires so far as any plan can be made effectual which does not involve the services of a regularly paid force. As our present forestry law makes no provision whatever for the patroling and proper care of our forests, we must depend solely on the firewardens for the protection of our forests from fire. The system could be made much more efficient were the firewardens and their deputies placed under the control and management of some one person. At present there is no head to the organization. There should be some official, provided by law, whose sole duty should consist in perfecting the organization of the firewardens, and in attending to the vigorous prosecution of all violations of the law regarding forest fires.

Among the firewardens there are too many who are inefficient or indifferent. It frequently happens, also, that vacancies occur, through a change of residence or death, which are not reported to the superintendent; and when a fire occurs in these towns there is consequently no one to look after it or order out the necessary force of men to extinguish it. These evils could be remedied largely by the appointment of a chief firewarden, who should travel continually from town to town in order to see that the force is completely and efficiently organized, and that every violation of the law is promptly prosecuted. There are over seven hundred firewardens, including the deputies, and it must be evident that a force of this size needs some special officer at its head

WOODLAND TROUT POOL.

in order to obtain a proper degree of efficiency. It is hoped and expected that the Legislature will soon make the necessary provision for some such appointment.*

The firewardens are required by law to send to the Commission a written report of each fire. Printed blanks are furnished them for this purpose, on which, in answer to the questions contained therein, the firewarden states all the facts connected with the fire—the date, duration, locality, area burned over, estimated damages, cause of the fire, means employed in extinguishing it, number of men employed, and the number of days' work, together with any further information of a specific or general character which might be worth mentioning.

Some of these reports are very readable, containing considerable information on the subject of forest fires in general. But many of the firewardens seem to be unable to make out an intelligent report, and confine themselves to the bare answers to the printed questions. They are also very apt to overestimate the burned area and to exaggerate the losses. Too often they neglect, or are unable, to furnish information as to the cause of the fire, their failure in this respect being largely due to an evident reluctance to furnish information against their neighbors. Of the ninety-four fires which occurred last year, thirty-six were reported as "Cause Unknown."

In accordance with the provision of the law requiring that the annual reports of the Commission shall contain a statement showing the date, location and extent of each fire, I submit herewith a tabulation by counties containing this information.

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* Since the above was written the law has been amended in accordance with the suggestions of the superintendent, and a chief firewarden has been appointed.

Report of Forest Fires in 1898.

ADIRONDACK COUNTIES.

Clinton County.

TOWN	DATE		ACRES	DAMAGE	CAUSE OF FIRE
Black Brook	April	7	700	$30 00	Clearing land
Black Brook	April	12	800	50 00	Clearing land
Black Brook	April	19	75	10 00	Unknown
Black Brook	April	22	50	10 00	Fishermen
Black Brook	April	27	20	5 00	Unknown

Essex County.

TOWN	DATE		ACRES	DAMAGE	CAUSE OF FIRE
Chesterfield	April	15	100	$35 00	Railroad locomotive
Chesterfield	August	5	90	35 00	Railroad locomotive
Chesterfield	November	1	80	30 00	Unknown
Elizabethtown	April	13	50	10 00	Clearing land
Elizabethtown	April	15	75	10 00	Unknown
Elizabethtown	July	10	60	10 00	Clearing land
Jay	April	11	15	......	Clearing land
Jay	April	12	100	90 00	Clearing land
Minerva	June	12	80	20 00	Unknown
Minerva	July	14	25	5 00	Smoking
St. Armand	April	13	20	10 00	Unknown
Ticonderoga	April	14	100	200 00	Clearing land
Ticonderoga	July	14	3	......	Campers
Westport	September	11	75	70 00	Unknown
Wilmington	April	9	100	50 00	Clearing land
Wilmington	April	13	60	10 00	Unknown
Wilmington	August	1	25	100 00	Unknown
Wilmington	October	15	5	......	Hunters

Franklin County.

TOWN	DATE		ACRES	DAMAGE	CAUSE OF FIRE
Altamont	September	18	2	......	Steamboat sparks
Franklin	April	10	15	$25 00	Incendiary
Franklin	April	13	25	5 00	Clearing land
Franklin	April	19	100	20 00	Railroad locomotive
Franklin	April	19	10	70 00	Railroad locomotive

Franklin County.—Continued.

TOWN	DATE		ACRES	DAMAGE	CAUSE OF FIRE
Franklin	May	6	5	$10 00	Railroad locomotive
Franklin	May	6	25	5 00	Railroad locomotive
Franklin	May	8	75	100 00	Clearing land
Franklin	May	9	100	50 00	Railroad locomotive
Franklin	July	15	15	10 00	Unknown
Franklin	July	18	40	25 00	Unknown
Franklin	April	16	25	40 00	Unknown
Malone	April	27	5	10 00	Clearing land
Santa Clara	May	2	200	100 00	Railroad men

Fulton County.

Johnstown	May	7	45	$50 00	Clearing land
Stratford	July	14	10	......	Fishermen
Stratford	July	16	40	10 00	Fishermen

Hamilton County.

Indian Lake	May	2	2	$50 00	Clearing land
Indian Lake	July	7	400	400 00	Fishermen
Long Lake	July	9	400	400 00	Fishermen

Herkimer County.

Russia	May	10	25	$10 00	Unknown
Webb	April	13	20	50 00	Railroad locomotive

Lewis County.

Croghan	April	13	5	......	Clearing land
Croghan	April	19	6	......	Unknown
Croghan	July	12	1	.....	Clearing land
Greig	April	12	600	$50 00	Clearing land
Lyonsdale	April	11	300	25 00	Unknown
Lyonsdale	April	13	150	50 00	Unknown
Lyonsdale	April	17	200	20 00	Unknown

Lewis County.—Continued.

TOWN	DATE		ACRES	DAMAGE	CAUSE OF FIRE
Lyonsdale	July	27	20	$5 00	Unknown
Watson	April	11	100	10 00	Clearing land
Watson	April	13	40	15 00	Clearing land
Watson	July	15	50	100 00	Hunters

Saratoga County.

Ballston	March	18	2	......	Incendiary
Corinth	April	2	6	......	Railroad locomotive
Corinth	April	8	80	$50 00	Railroad locomotive
Corinth	April	30	30	10 00	Unknown
Corinth	May	10	50	10 00	Unknown
Corinth	May	10	5	......	Railroad locomotive
Hadley	July	15	75	250 00	Unknown

Warren County.

Johnsburgh	April	9	10	......	Unknown
Johnsburgh	April	12	30	$60 00	Railroad locomotive
Johnsburgh	April	18	50	60 00	Railroad locomotive
Johnsburgh	July	6	7	40 00	Unknown
Johnsburgh	July	9	40	50 00	Unknown
Johnsburgh	July	16	75	25 00	Clearing land
Luzerne	July	16	30	15 00	Fishermen
Luzerne	November	8	150	25 00	Hunters
Queensbury	April	12	50	50 00	Unknown
Queensbury	April	12	100	500 00	Railroad locomotive
Queensbury	May	10	25	10 00	Unknown
Stony Creek	July	15	10	25 00	Clearing land
Thurman	April	30	75	75 00	Unknown
Thurman	November	3	30	25 00	Unknown
Warrensburgh	April	7	500	580 00	Unknown
Warrensburgh	April	30	15	......	Clearing land
Warrensburgh	July	17	1	10 00	Unknown

Washington County.

Dresden	July	13	200	$200 00	Unknown
Fort Ann	April	15	100	150 00	Clearing land
Fort Ann	July	12	150	300 00	Hunters

WASHINGTON COUNTY.—Continued.

TOWN	DATE		ACRES	DAMAGE	CAUSE OF FIRE
Fort Ann	July	15	8	$10 00	Incendiary
Hampton	April	13	40	150 00	Unknown
Whitehall	July	11	50	125 00	Unknown

CATSKILL COUNTIES.

DELAWARE COUNTY.

Hancock	April	14	150	$300 00	Railroad locomotive
Hancock	July	15	150	250 00	Unknown
Hancock	August	17	100	250 00	Clearing land
Tompkins	July	16	250	500 00	Clearing land

GREENE COUNTY.

Cairo	July	16	400	$200 00	Unknown

SULLIVAN COUNTY.

Forestburg	July	16	10	......	Railroad locomotive
Highland	April	14	100	$20 00	Unknown
Lumberland	April	13	200	200 00	Unknown

SUMMARY.

COUNTIES	ACRES	DAMAGE
Clinton,	1,645	$105 00
Essex,	1,063	685 00
Franklin,	642	470 00
Fulton,	95	60 00
Hamilton,	802	850 00
Herkimer,	45	60 00
Lewis,	1,472	275 00
Saratoga,	248	320 00
Warren,	1,198	1,550 00
Washington,	548	935 00
Delaware,	650	1,300 00
Greene,	400	200 00
Sullivan,	310	220 00
Total,	9,118	$7,030 00

Of this burned area only 669 acres, or about seven per cent., belonged to the State.

CAUSES OF FIRES.

Clearing land, burning brush, etc.,	24
Railroad locomotives,	16
Fishermen,	6
Hunters,	4
Incendiary or carelessness,	3
Camp fires,	1
Tobacco smoking,	1
Berry pickers,	1
Steamboat sparks,	1
Railroad men,	1
Unknown,	36
Total,	94

It is also interesting and instructive to note the time of year in which these fires occurred. Of the ninety-four cases reported, the distribution was as follows:

March,	1
April,	45
May,	11
June,	1
July,	27
August,	3
September,	2
October,	1
November,	3
Total,	94

It may be noticed that in many instances the estimate of damages is small in comparison with the burned area as reported; and that in some of the reports as tabulated, the figures for the estimated loss are merely nominal or omitted altogether. In explanation of this it should be said that many of our fires in Northern New York occur on lands that have been burned over repeatedly in previous years, with the result that no timber of any value is left standing. On the outskirts of the Great Forest there are many abandoned farms and old clearings that are overgrown with brush, brier bushes and ferns—lands which might probably be classed as barrens. Fires occur more frequently in these open places than in the woods; and at some places in the Catskill counties the farmers persist in setting fire on these barrens in order to increase the crop of berries which is apt to be growing there. As we are obliged to include within our annual statement all fires that occur in the sixteen counties previously mentioned, these burnings necessarily enter into the annual statement, and without some such explanation as here given the figures would probably be misleading. The amount of standing timber actually destroyed by fire during the past year was comparatively small; but owing to the meager information in some of the firewardens' reports it would be difficult to classify the timber fires separately.

On the other hand, mention should be made here of certain losses from forest fires which are not included in the damages as stated in the foregoing table. Reference is made to losses occasioned by the burning of buildings, fences, cord-wood, pulp-wood, and other property which are often destroyed, especially when they sweep over open ground or occur on farm-lands. But as these losses have little or no connection with destruction of trees and standing timber, it has not seemed necessary to make any detailed statement of them.

The means employed in controlling and extinguishing tnese nres varied according to the conditions which prevailed. In the case of a slow-running ground fire, which was burning in the dead fallen leaves or underbrush, the flames were usually extinguished by whipping them out with boughs, or throwing dirt upon them, or by the use of water where it could be had conveniently. Trenches were often dug to prevent the fires from burrowing laterally through the duff or humus, these trenches being dug below the vegetable mould until clay, earth, or rock was reached. In case of a top fire, which was running rapidly through the branches of the trees and upper foliage, back-firing was resorted to wherever a suitable opening could be obtained from which to start a new fire in the direction of the oncoming flames. This was also resorted to where a ground fire was traveling rapidly, the ground being swept clean of leaves and inflammable material for a wide space, the back-fire being kindled on the side of the space toward the main fire. On open, barren plains, where fires were sweeping through the dried ferns, grasses, or some low scrubby growth, furrows were sometimes plowed, exposing a belt of freshly turned earth which was relied upon to stop the progress of the flames, or from which to make a back-fire. The implements generally used were shovels, hoes, brush brooms, water pails, and plows.

I submit herewith some extracts from the reports of the firewardens during the past year, as these may give some better idea of the work they are called upon to perform, and the various methods employed.

Mr. Arza R. Turner, firewarden for the town of Dannemora, Clinton county, N. Y., reports:

June 5, 1898. This fire was started by a farmer to clear some land adjoining State property. It did not escape from the man's premises, and hence no damage was done. I gave a permit in this case, because it was a good time for him to burn his fallow. Everything is green now and a fire will not run if taken care of.

August 31, 1898. This fire, which was on Township 5, was started by sparks from a locomotive on the Chateaugay Railroad. It caught in a pile of old ties near the railroad track, on the Parsons lot, at the head of Chazy Lake. I extinguished the flames by shoveling sand on the fire. It was not necessary to order out any one to assist me.

Mr. William Hopkins, firewarden for the town of Black Brook, Clinton county, N. Y., reports:

April 7, 1898. This fire burned for two days, during which it ran over about seven hundred acres. I report no damage or loss to timber, because the fire was on denuded lands from which all the timber had been removed during the past two years. The small amount of wood which was destroyed was of such a scrubby growth that in my opinion it was worthless. I fought the fire so successfully that I was able to keep it out of the valuable standing timber. I do not know how the fire originated. In extinguishing it we plowed furrows and dug trenches. I was in attendance three days. I ordered out, in all, twenty-seven men to assist me. The total number of days' labor by the men called out amounted to seventy-nine.

Mr. E. A. Howes, firewarden for the town of Tompkins, Delaware county, N. Y., reports:

July 16, 1898. This fire escaped from the lands of Austin Wakeman, who started it in order to burn a fallow. He lighted his brush fires without my knowledge or consent, and as he lives in a remote part of the town I knew nothing about it until nearly all of the territory mentioned was burned over. I responded as soon as I was notified, and we stopped the fire from running and spreading; but it was necessary to keep a man on watch for four days, it being very dry. I inquired into the cause of this fire, as to where and by whom it was started. I conclude that it was set by Wakeman in some brush heaps near the woods. He went away and neglected to attend to it. I have no knowledge that he made any attempt to stop the fire. It burned over about 250 acres; part of it on Lots 153 and 162 of the Rapelyea Patent, none of which belongs to the State. I estimate the damage to standing timber at $250. In order to control the fire we plowed furrows on one side; on the other side we back-fired from an old road running through the woods.

Mr. Francis Bonneford, town of Hancock, Delaware county, N. Y.:

April 14, 1898. Fire burning from the 14th to the 18th; number of acres burned over, about 150; no State lands. Value of standing timber destroyed, estimated at $300. This fire, as near as I can learn, was caused by sparks from a locomotive on the Erie Railroad. As soon as I was notified I went to look after the fire, but did not have to call out any men.

Mr. Carlos A. Jordan, town of Elizabethtown, Essex county, N. Y.:

April 13, 1898. Caused by a man who set a brush pile on fire in a meadow. The fire caught in the grass and got away. About seventy-five rods of fence were destroyed. I warned out seventeen men. They worked half a day each, making eight and one half days. We made a trench with shovels and hoes.

July 10, 1898. This fire burned for eight days. It was on a mountain, where it started during the last drought. All we could do was to trench around it and hold it till rain came. I called out seven men. The total number of days' labor by these men amounted to forty.

Mr. Charles O. Bartlett, town of Jay, Essex county, N. Y. :

March 29, 1898. I saw the smoke from this fire and went there as soon as possible. It was on the farms of David Torrance and Thomas Bartlett. No timber was destroyed, but about twenty rods of rail fence were burned. It was started by some little boys who set fire to the dead grass. On arriving I found David Torrance and his son Frank there, at work with water pails and shovels. A strong east wind spread it on the pasture of Thomas Bartlett, but we succeeded in stopping it there, as it struck a piece of low, wet land.

April 11, 1898. This fire occurred on the farm owned by Wentworth Lewis. His son was plowing, and he fired a brush pile from which the grass caught fire. A strong south wind was blowing and he could not stop it. It ran into a piece of heavy hardwood timber, where it burned over fifteen acres. I do not think it will kill much of the timber. About fifteen rods of board fence were burned. I saw the smoke, and warned out men with shovels and pails, and proceeded immediately to the fire. Number of men called out to fight fire, sixteen; total number of days' labor by men called out, eight.

April 12, 1898. Number of acres burned over, one hundred; on Lots 25 and 26, Maul's Patent; none of it belonged to the State. Cause of fire—Andrew Sheldon set fire to some brush piles in his meadow. The west wind blew quite hard; it ran through the grass to the woods on both sides of the field. I was notified by telephone, and I proceeded to the fire with all the help I could get. It burned about seventy-five acres of timber, mostly poplar and white birch; also some Norway pine. Most of the popiar and birch will die. It also burned about eighty rods of rail fence belonging to Herman Boynton, and fifteen rods of board fence belonging to Edward Boynton. Number of men called out to fight fire, twenty. Total number of days' labor by men called out, twenty-five and a half.

Mr. R. H. Wilson, town of Minerva, Essex county, N. Y. :

June 12, 1898. About one hundred acres on Lot 113, Township 26, were burned over. No part of it is State land. Cause unknown. This fire was under the charge of Deputy Firewarden William Kayes. It covered quite a large territory, but when I looked it over yesterday I did not find any timber destroyed—just merely scorched. The leaves and trees are all green and nice where the fire burned.

July 14, 1898. Number of acres burned, about twenty-five, Lot 24, Township 30; not on State lands. This fire was in the district belonging to William Kayes, the Deputy Firewarden. It happened in a very dry time and in a place where the small bushes were very thick. It did not run over much ground, but it burned quite deep, burning everything out by the roots. If it had happened on my land I should say it had done me a favor, as it just about cleared the land. About ten rods of fence were destroyed. Cause of fire unknown, but I think it was caused by somebody smoking. As it was a very dry time and dry land, the only means of fighting it was by drawing water.

Mr. Sylvester A. Reid, town of St. Armand, Essex county, N. Y. :

April 13, 1898. Number of acres burned, about twenty, Lot 85, Township 11, Old Military Tract, Richards' Survey. I do not know the cause, but it started in an old intervale or meadow, in the dry grass, on land owned by Wesley Walton. I took one man and kept it from getting in fences that afternoon. The next afternoon we stopped it on Lot 64 by carrying water and wetting the ground in front of it. On the 17th it started again on Lot 85, and I called out four men. By back-firing we stopped it from getting on State land. I did not estimate the damage to timber when I reported this fire the first time, because I could not tell then how much of the timber was killed. Some of the trees are still living where it burned over the ground. I think the damage would be about $10.

Mr. E. C. Wiley, town of Ticonderoga, Essex county, N. Y.:

April 14, 1898. Number of acres burned over, one hundred. Value of standing timber destroyed, estimated at $200; no State land. The cause of fire, burning fallow. I employed B. B. Tillotson with team to carry men to the place, as it was spreading rapidly. His charges were $3. There were several cords of firewood piled on the lands that were burned over, but this wood was saved.

In a letter written several months after, Mr. Wiley says in relation to the fire of July 14:

In making my report I left the item of damages blank, because it was impossible at that time to tell whether the fire had killed the trees. I would estimate the loss at $50. The damage at Ferron Mountain, Ellice Tract, was little or nothing, as the fire was stopped just in time to save a great loss in timber.

Mr. R. S. Gile, district firewarden, town of Altamont, Franklin county, N. Y.:

September 18, 1898. Number of acres burned, one and one half; no State land. Cause of fire, either by sparks from a steamboat, or it was started by some unknown person; it was extinguished by carrying water in buckets. This fire was on the east end of Big Simon's Pond. The men called out were camping on the west shore, and no bill is presented for their labor.

October 6, 1898. This fire was set by a camping party; names unknown. It was a slow fire on second-growth land along the north bank of Raquette River, about one mile from the village of Tupper Lake, on the road to Moody P. O. It was a very stubborn fire to extinguish, owing to the dry leaves and duff. As I live within a short distance of the place, I got it under control without any help, except B. R. Byron and his men.

Mr. Henry R. Paye, town of Franklin, county of Franklin, N. Y.:

April 10, 1898. Number of acres burned over, fifteen, Lots 313 and 328, Township 10, Old Military Tract; value of standing timber destroyed, estimated at $25; second-growth poplar and pine. This fire was started April 10 in the afternoon. It was reported to me and I went to see about it that night. Then I went again the next morning and finished the work of extinguishing it. I stayed there until afternoon, but no more fire started up. Three men state that they saw these fires start up in three different places along a path that crosses these lots; and then they saw Daniel Doty come out from where these fires started.

April 13, 1898. Cause of fire not known; started on Lot 231, Township 10, Old Military Tract, on ground occupied by Louis Rumbard, but belonging to the State. No standing timber was destroyed, the ground being covered by an old slash grown up with small cherries and bushes. It started in the afternoon in Rumbard's meadow at a heap of roots around a stump. I think some of Rumbard's family could tell how if they would; but they deny knowing anything about how the fire got there. I went into the notch of the mountain the next morning and finished putting out the fire, which had mostly stopped in the night, except where it was smouldering in some old stumps and logs, which I extinguished with water.

April 16, 1898. Cause unknown; but all the said fires were near railroads. As they were some ways off, I ordered out a team to carry the men there and bring them back.

April 19, 1898. Number of acres burned, ten; cause of fire, locomotive sparks from the Mohawk & Malone R.R. This fire did little damage to the timber, but it destroyed fifty cords of hardwood worth about $50, and about ten cords of poplar worth $20.

Mr. Oliver Dupry, district firewarden of the town of Franklin, county of Franklin, N. Y.:

April 19, 1898. Number of acres burned over, one hundred; Lot 217, Township 9, Old Military Tract. This fire was started by a locomotive on the Chateaugay Railroad, and that is where most of the fires start nowadays. The railroad men take no pains to prevent them. There is not a man, so far as I can find, that the railroad companies furnish to prevent or extinguish fires. Their section-men will pass by a fire and pay no attention to it, unless the fire-warden is there to make them do so. There are small fires nearly every day on one or the other of the railroads.

Mr. Warren J. Slater, town of Harrietstown, Franklin county, N. Y.:

August 17, 1898. The above report shows that the fire was burning for three days, although the space burned over was very small. It was supposed that the fire was all put out on the 17th, but it afterwards started up afresh in the duff and was finally extinguished on the 20th. We carried water in pails.

Mr. Frederick Degon, town of Malone, Franklin county, N. Y.:

April 27, 1898. Number of acres burned over, five; no loss to speak of, except a piece of line fence which was damaged to the extent of $10. This fire was started by one Allen Bador, who burned a fallow on his own land without a permit. It escaped into a clump of small second-growth maples.

Mr. Netus Lancaster, town of Stratford, Fulton county, N. Y.:

July 16, 1898. This fire burned over about forty acres and was started by some unknown person. The ground had been burned over once before. By hard work we prevented it from running into the green timber, so that no trees were hurt or destroyed. We extinguished it by digging trenches with hoes and shovels, clearing away brush and carrying water.

Mr. B. F. Merwin, town of Indian Lake, Hamilton county, N. Y.:

July 7, 1898. Number of acres burned over, about four hundred; none of it State land. Location, northeast corner of Township 35, and southwest corner of Township 19. I don't consider the damage anything to speak of, as the lands had been cut over in the last two years. We fought this fire by using grubbing-hoes and shovels, digging trenches and throwing fresh dirt on the fire. We cut up the old logs and cleared a narrow strip or path of all leaves, etc., ahead of the fire and then set a back-fire. Men were stationed on watch to see that the flames did not cross this path. Some very good work was done.

Mr. Charles Payne, a citizen of the town of Indian Lake, Hamilton county, N. Y., writes as follows:

May 27, 1898. Col. Wm. F. Fox, Superintendent of Forests: Dear Sir—Mr. Hutchins was here to-day to investigate the fire that occurred in my fallow. The truth of the case is this: I had a turnip patch logged up last year, but could not burn it on account of wet weather. I plowed and dragged in my crops amongst the logs and heaps this spring and wanted to get them out of the way. So I set them on fire, and the fire ran onto George Virgel's land, but did not do any damage to timber. It only burned the leaves on the ground. I went to put it out, but the rain extinguished it. I live on Lot 86, Township 15, T. & C. P. I have occupied this land and paid taxes for twenty-three years, during which time I have never had a fire get out or do any damage; neither do I want to have any such thing occur.

Mr. H. B. Linstruth, town of Croghan, Lewis county, N. Y.:

April 13, 1898. Burned over about five acres, owned by United States Leather Company. The fire was caused by John Phillabaum, who set fire to a brush heap at his door so that he could get out of his shanty. The fire got the start of him and so his neighbors turned out and helped to put it out. I have charged for two days' attendance by myself. The flames were extinguished by whipping them, throwing dirt on the fire, and removing all leaves and rubbish from its course.

April 18, 1898. About five acres burned over on lands belonging to Theodore B. Basselin; no damage; cause of fire unknown. Lots of men own sugar bushes in vicinity, and so they turned out their forces to help stop this fire.

July 12, 1898. One acre burned over; no damage. Caused by the burning of an old log fence, and the wind drove the fire wild. We had to work hard in order to get it under control. All the neighbors turned in and carried water.

Mr. Duane Norton, town of Greig, Lewis county, N. Y.:

April 12, 1898. Number of acres burned over, about six hundred; located on Brantingham Tract; did not include any State land. Cause of fire: set by Frank Barker to clear a potato patch. I called out a large force of men, cleared the ground ahead of the fire, and back-fired some. Number of days' labor by men called out, sixteen. I cannot make an estimate of the damage at present, as the fire ran over the ground very fast, and the earth was moist under the leaves. I think it did but little damage to the timber, except where there was dry material around the butt of the trees. Mr. Barker is not responsible for anything, and if we should arrest him we could only lock him up, in which case we would have his family to care for. I think I have given him a good scare, and if he behaves in the future I would advise letting him off for the present, at least.

Mr. Edward Burdick, town of Lyonsdale, Lewis county, N. Y.:

April 11, 1898. About three hundred acres burned over; no State land; no standing timber burned. Cause not known. Back-fired early in the morning and watched it through the day. Seventeen men called out. It took more men to fight this fire on account of its being on both sides of Pine Creek, with standing timber all around it. It started on old burned ground on which there was nothing of any value. We stopped it before it got into the green timber. Fires do not burn deep so early in the season.

Mr. Stephen Waldron, town of Watson, Lewis county, N. Y.:

April 11, 1898. About one hundred acres were burned over, on Lot 213, Watson's W. Triangle; no State lands. Damage to standing timber estimated at $100. This fire was the result of carelessness in the use of fire for clearing land. From the circumstances it would seem that it was intentional. The man had no permission from me, nor was I notified of any wish or intention to set a fire. This matter should have attention from the Commission, as the parties were well advised of the law; but they have no respect for it.

April 14, 1898. About forty acres were burned over on lot 330, Watson's Triangle; no especial loss. I went to the fire, but did not find it necessary to order out any men. This fire was caused by carelessness in clearing land. The brush heaps were lighted during a very dry time. The man asked permission to burn his fallow, but I refused to grant it, calling his attention to the law, and telling him he must not start any brush fires in so dry a season, or at any time, without my permission. The people here pay no attention to the law.

July 23, 1898. About fifty acres burned over, none of which belonged to the State. Damage to timber estimated at $100. This fire probably started from a smudge left by some hunters who had killed and skinned a deer. A boat was found which was probably used by these hunters. The offal of a deer was left, and the place where the fire was kindled was easily seen, and from which the flames ran into the woods. I ordered out fifteen men and two teams, with plows and tools.

Mr. J. H. Bintz, town of New Bremen, Lewis county, N. Y.:

September 12, 1898. I have not made any report, for the reason that there have been no forest fires in my town. What little fires are made by the farmers in burning brush I make no report of. There was just one man that had a "foller" to burn. Before he started his fire he got his neighbors out to guard it. But I didn't allow any charges to be made.

Mr. Austin J. Larkin, town of Ballston, Saratoga county, N. Y.:

March 18, 1898. About two acres were burned over in woods near Ballston Lake. I think the fire was caused by an incendiary, as we saw fresh tracks of a man near where the fire occurred. I first saw a slight smoke rising from the woods in the afternoon. I watched it, and as the smoke increased I employed help. We repaired to the place and fought the fire until after dark. It was burning on a spot where timber had been cut several years before, and some of the young pines and hemlocks were twenty feet tall. At one place, where the trees were few, the ground was overgrown with grass and weeds. It was here that the fire started, and as it was dry, the fire ran every way, burning the hemlock and pine leaves from some of the lower branches, and setting stumps, etc., on fire.

August 29, 1898. I saw this fire myself about five minutes after the 1:55 train on the Delaware & Hudson Railroad had left Ballston Lake station. I employed two young men, and when we arrived at the fire an Italian woman came from her house, very near where this fire was burning the grass along the railroad fence. This woman brought two pails and dipped water from a small stream near by, which two of us carried to throw on the flames. The other man used a green brush and whipped the fire, which was spreading very rapidly toward the house. There was a strong wind blowing from the south at the time.

Mr. A. C. Hickok, town of Corinth, Saratoga county, N. Y.:

April 8, 1898. About eighty acres burned over; value of standing timber destroyed, estimated at $50. Fire caught from a locomotive on the Adirondack division of the Delaware & Hudson Railroad. Warned out eight men to fight it. A high wind prevailed, and fifty acres of pasture land were burned over in a few minutes. On my arrival I found the trackmen of the railroad working to stop it from spreading. It got into the valley near the brook, in some timber, burning an old mill and killing the trees. But we could not stop it entirely and leave it with safety, until after midnight.

Mr. Edward J. Wilson, town of Hadley, Saratoga county, N. Y.:

July 15, 1898. Burned area, about seventy-five acres; damage to timber, estimated at $250; loss in cordwood and fences, $24. Cause of fire: supposed to have been started by a bad neighbor, but this could not be proved. Dug trenches around it and confined it to the summit of the mountain. On July 19, heavy rainstorms extinguished it.

Mr. William Merrill, town of Johnsburg, Warren county, N. Y.:

April 7, 1898. Fire was set to burn grass off from a little back meadow by ——— on Lot No. 52, Township 12. It ran in the woods a little way, but did no damage. Mr. ——— is a young man just starting in life, and when I told him the penalty for his carelessness he was scared, and said he did not know about the law. He went with me and helped put out the fire, and said if I would not make him any trouble this time, he would abide by the law hereafter.

April, 9, 1898. Ten acres burned over; all State land; cause unknown, but supposed to have been started by parties who were picking spruce gum.

July 8, 1898. Fire on Lot 88, Township 11; supposed to have been set by a boy eleven years old. A barn worth $200 was destroyed. No timber injured.

July 16, 1898. I gave M. D. Pasco an order to burn his fallow on June 22. He set it on or about July 16. The fire spread, but we kept it on his own land. There was no damage except what was done on his own property. He wanted me to pay the men he employed to fight this fire, but I told him it was impossible for me to pay men for fighting his own fire.

Mr. Wilson J. Hall, town of Luzerne, Warren county, N. Y.:

November 8, 1898. Number of acres burned, about 150; damage to timber, estimated at $25. This fire was started without doubt by squirrel hunters.

Mr. William F. Woodward, town of Warrensburgh, Warren county, N. Y.:

April 7, 1898. Burned area estimated at five hundred acres; not on State land. Damage to timber, $500. About thirty tons of hay worth $180 were destroyed. This fire was first seen in the mountain on the southeast quarter of Lot 75. It may have been set to burn the mountain over in order to make better sheep pasture. On April 12 it was either set again or it had stayed in some old logs, where it was fanned into flames by the wind. It spread very fast, running across Lot 75 before noon. It burned a barn and about thirty tons of hay. The house caught fire also, but the owner got there in time to save it. I was notified April 13, in the forenoon, and I warned out some men immediately. I got a horse and wagon and went there. I took care of it until the rain came on the 15th.

July 17, 1898. About one acre burned over on Lot 62, Hyde Township; damage to standing timber, estimated at $10. Cause of fire unknown; but I think some one dropped fire in lighting a pipe while going through the woods. This lot is covered with pine and hardwood timber mostly. The poplar has been peeled. There were ten pine trees killed by this fire.

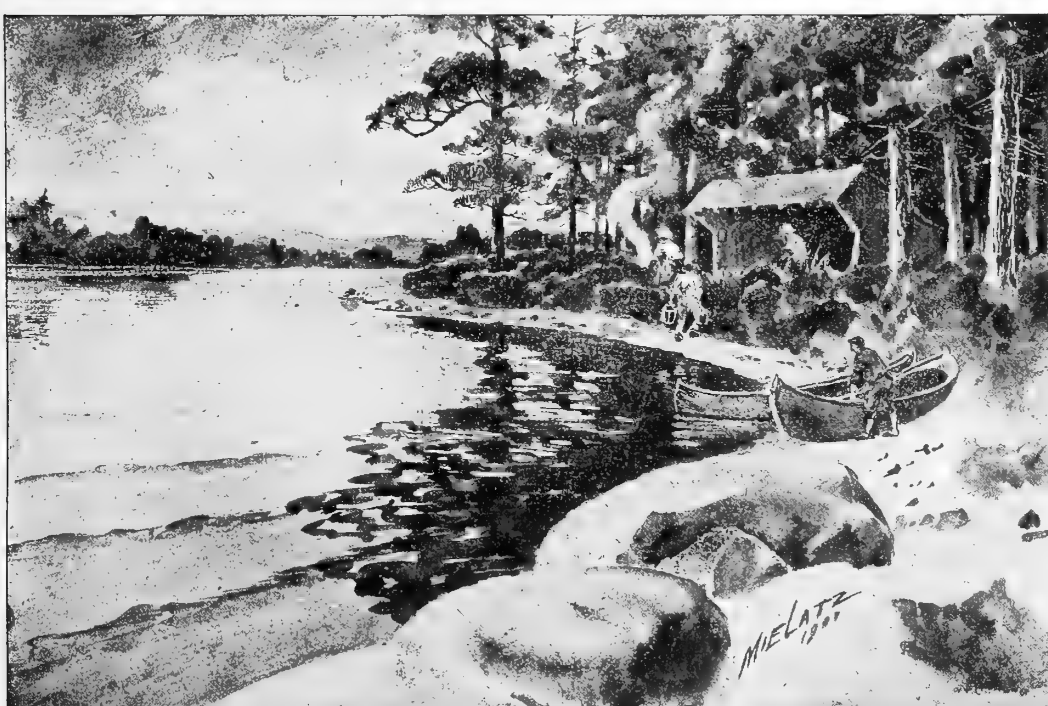
Mr. Patrick Crockwell, town of Dresden, Washington county, N. Y.:

April 14, 1898. There has not been a fire in my town since I was appointed firewarden. I have taken pains to notify parties that they will be held responsible for all brush fires set by them without notifying me; also hunting parties that camped in the woods. Our town has suffered a great deal from fire before I was appointed firewarden, but as long as I hold the office there will be less fires.

July 13, 1898. About two hundred acres burned over, none of which belong to the State. Estimated damage to standing timber, about $200. Cause of fire not known. Number of men called out, twenty-five. Total number of days' labor, thirty-eight. The leaves, muck, and everything were so dry that it was almost impossible to stop this fire; but by attending to it night and day we kept it under control. If I had not attended to it, it would have destroyed hundreds of dollars' worth of property.

Mr. E. H. Sturtevant, town of Fort Ann, Washington county, N. Y.:

July 12, 1898. Number of acres burned over, 150; value of standing timber destroyed, estimated at $100. Cause of fire: supposed to have been started by an Italian who was shooting robins for a potpie. Measures employed to check and extinguish fire: water pails, hose, shovels, axes, brush, poles, and anything that would or could do any good. Number of men called out to fight fire: forty-five men and boys. Total number of days' labor by men called out: about fifty, if all of them put in accounts. Some of them say they will not do so. I gave the boys only half price. Is that O. K.? This fire was on a rough, hilly and rocky wood lot, which was cut over the last two winters by Charles Curtis. He notified me of the fire and promised to return with four men to fight it until we could get a crew on the spot. I ordered more men there immediately, and had worked two and one half hours when he came and served a written notice on me that he would not help any more, as he had to do his haying, and said that it was my business to put out the fire. He retained a copy of this notice to put on file. If he had remained and helped us we could have stopped it without much trouble.



MORNING IN THE CAMP.

Sanitary Benefits of the Adirondack Forest.

THE strongest factor in the forestry movement at present is the demand for forest preservation—a demand which is supported strongly by the many people who utilize our forests as a health resort, and by the invalids who find within their shelter a natural sanitarium where relief can be obtained from various diseases.

The sanitary value of our forests cannot be overestimated. In addition to their furnishing a summer home for the overcrowded population of our towns and cities, a place where rest, recuperation and vigor may be gained by our highly nervous and overworked people, the healthful and purifying influence of coniferous forests has been thoroughly established. The belief that the atmosphere of evergreen forests has a curative effect upon persons suffering from pulmonary phthisis is a very old one. The old Romans sent patients with ulcerated lungs to Libra, where by breathing the healthful exhalations of the pines with which the country abounded, they are said to have lived many years freed from their complaints.

The testimony, based on personal, careful and scientific investigation of such men as Dr. E. L. Trudeau, of Saranac Lake, cannot be set aside. Himself an invalid restored to health by forest life, he has devoted himself to the question of environment in its relation to tuberculosis, and has demonstrated the value of the terebinthine forests of the Adirondack region as an agent in warding off pulmonary disease. He says that

"Twenty-five per cent. of the patients sent to the Adirondacks suffering from incipient consumption come back cured—a proportion only surpassed by the State of Colorado. As a sanitarium for the State and City of New York alone, the value of this region is inestimable, and many professional men will be at a loss where to send their suffering patients who are unable to pay the expenses of a trip to Colorado or California, unless some steps be immediately taken to save to the State this heritage that should be preserved for the people."

Dr. Alfred L. Loomis, of New York * (a well-known specialist on pulmonary disease), has also given scientific testimony to the value of evergreen forests as a therapeutic agent in lung affections. He writes:

"Having long since been convinced by my observations that evergreen forests have a powerful purifying effect upon the surrounding atmosphere, and that it is rendered antiseptic by the chemical combinations which are constantly going on in them, I invite attention to some conditions which may explain their therapeutic power. Such ambiguous terms as 'balsamic

* Deceased.

influence,' 'health-giving emanations,' and 'aromanized atmosphere' must be regarded as empty phrases, and meaningless as scientific explanations. The clinical evidence, however, of the beneficial effects of pine forests on phthisical subjects is unquestionable. The changes attributed to the persistent inhalation of air impregnated with the emanations of evergreen forests are such as to indicate that the atmosphere is not only aseptic but antiseptic; made antiseptic by some element which is not alone fatal to germ life, but at the same time is stimulant and tonic to normal physiological processes within the lungs. We are led to the conclusion that this antiseptic element of evergreen forests—an element which is not found elsewhere—is the product of the atmospheric oxidization of turpentine. It is evident that the local and constitutional effects of turpentine are those of a powerful germicide, as well as stimulant. Its presence in the atmosphere of the pine forests cannot be questioned. Again, ozone is said to be present in excess in the air of evergreen forests, and the beneficial effects of such air have been ascribed to this substance alone. But it seems evident that there is a close relation between an excess of ozone in the atmosphere and turpentine exhalation.

"Recent developments in the treatment of phthisis by gaseous injections, if they are found beneficial, are apparently due to the arrest of septic poisoning, and not to the destruction of the tubercle bacilli. It is my belief that the atmosphere of evergreen forests acts in a similar manner, and facts seem to prove that the antiseptic agent which so successfully arrests putrefactive processes and septic poisoning, is the peroxide of hydrogen formed by the atmospheric exudation of turpentine vapors. It is stated that wherever the pine, with its constant exhalation of turpentine vapor and its never-failing foliage, can be distributed in proper proportion to the population, the atmosphere can be kept not only aseptic but antiseptic by nature's own processes, independent of other influences than a certain amount of sunshine and moisture. It is not possible for everyone to take his weak lungs to an aseptic air; but it is posssible to render the air of most localities antiseptic. I would, therefore, impress on the public the importance of preserving our evergreen forests, and of cultivating about our homes evergreen trees."

The large number of consumptives in our State—reported at over 30,000—has caused a demand for a State sanitarium in which a part of these unfortunates may receive treatment. All who have given the matter any thought are of the opinion that this institution should be located at some place in the Adirondack forest, and the Legislature, having authorized the erection of suitable buildings for this purpose, enacted that they should be built there.

In view of the sanitary benefits which may be derived from a stay in our northern forests, and the recent action of the State in establishing by law a large sanitarium in the Adirondacks for consumptives, attention is respectfully called to the timely and interesting article on the Cottage Sanitarium at Saranac Lake, which will be found in the pages of this Report. It was kindly contributed by that most eminent authority on the subject, Dr. E. L. Trudeau, of Saranac Lake, N. Y.

The Adirondack Cottage Sanitarium.

By E. L. TRUDEAU, M.D., Saranac Lake, N. Y.

A RADICAL change in the views held by the medical profession as to the nature and treatment of that widely prevalent class of diseases of the respiratory organs known as consumption has taken place within the past twenty years. Formerly consumption was looked upon as an inherited disease, and one which was unfavorably influenced by exposure to cold and to trying atmospheric conditions; the cough was considered the result of such exposures, and the invalid was shielded from atmospheric changes and sent to warm climates in the hope of preventing him from "catching cold."

Now that we know that consumption is due to a germ which obtains lodgment in the system only after its resistance has been enfeebled by an acquired or inherited lessening of the natural resisting power of the tissues, the keynote of treatment is invigoration; and cold, stimulating climates are preferred by many physicians to warm ones.

We have also learned that climate is only one of several elements which may be utilized in the treatment of this disease, and that the principal factors which, in addition to climate, contribute to the cure of consumptives are an open-air life, rest, good food, and the regulation for months of the patient's daily habits of life as to exercise, diet, etc. All these conditions are best obtained in an institution built and carried on for this special purpose, and situated in a good climate.

Many years ago circumstances placed me in a position where, from personal experience with it, I realized the advantages of the Adirondack climate, and that the best means of restoration were unattainable to working men or women. The long time required to obtain a cure, or even an arrest of the disease by the climate and open-air method, and the necessary expenses it entailed when added to the loss of income incident to months of enforced idleness, seemed to put the practical application of this method of cure beyond the reach of the majority of individuals who have to earn their own living. An institution that would offer to working men and women, at a moderate cost, this opportunity and a return to a life of usefulness, seemed an urgent necessity, and induced me to attempt the establishment of such an institution and put the modern sanitarium methods of treatment to a practical test in the Adirondack climate.

The Adirondack Cottage Sanitarium was the first institution in America to attempt the cure of incipient tuberculosis in persons of moderate means. In 1884, by personal

MAIN BUILDING OF THE ADIRONDACK COTTAGE SANITARIUM.

appeals, a few thousand dollars were obtained by the writer, with which one small cottage and a wing of the intended main building were erected. Each year the work was developed step by step, and the running expenses met, principally through the generous aid of guests at Paul Smith's, Saranac Inn, and other hotels in the Adirondack region, who contributed and held annual fairs during the summer for the benefit of the institution. Its growth has been steady and uninterrupted, until a small village consisting of twenty-two cottages, accommodating one hundred patients, now stands on the original site where sixteen years ago the institution made so humble a beginning.

The Sanitarium is situated about a mile from Saranac Lake village, on a high hill which rises abruptly from the Saranac River, and well protected from the prevailing winds by a high wooded ridge, while the soil is sandy and the drainage excellent. A magnificent panorama of wooded slopes and high mountains, heavily wooded with evergreen timber, extends as far as the eye can reach, while the Saranac River can be seen threading its way through the distant hills until it is lost to sight among them.

The requisites for admission to the Sanitarium are that the applicant should be in the earlier stages of the disease, or, at least, that in the opinion of the examining physician he has a fair chance of more or less complete restoration to health, and that his pecuniary circumstances should be such that he cannot afford to pay the usual prices asked at the hotels and boarding-houses in the region. Every effort is made to reduce to a minimum the expenses of the patients who wish to avail themselves of the advantages of the institution. The regular charge—five dollars a week—is made to all alike, and includes everything except laundry and medicines, which are furnished at cost. No charge is made for medical attendance, no graded rates, and no accommodations for private patients.

The deficiency in the running expenses is made up each year by subscription. An attempt to place the institution on a firm financial basis has also been made; and, principally by personal appeal, an endowment fund of $150,000 has already been secured, which, it is hoped, by bequests and subscriptions may some day grow sufficiently to assure the permanence of this work for all time.

The Sanitarium also has a small free-bed fund, the income of which is applied to defray the expenses of patients whose resources have entirely given out. Last year nineteen were maintained for varying periods of time without charge, and twenty-seven others had their expenses paid by benevolent persons interested in the work.

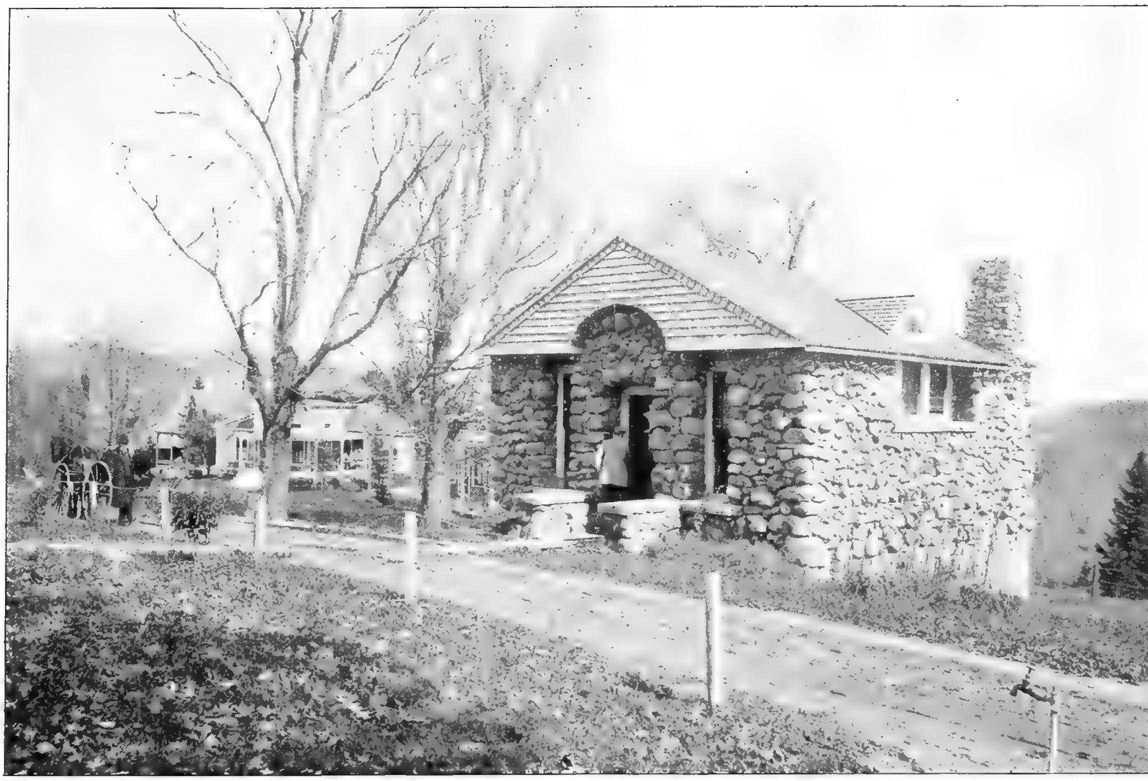
Applicants for admission are examined in New York city by one of the regular examiners—who give their services in this capacity without any remuneration—or, the patients apply directly at the institution and are examined without charge at Saranac Lake. The regular examining physicians in New York city are Dr. E. G.

Janeway, Dr. Walter B. James, and Dr. H. P. Loomis; and at Saranac Lake, Dr. E. L. Trudeau and Dr. E. R. Baldwin. During the first ten years of the Sanitarium's existence most of the applicants for admission in New York were examined by the late Dr. Alfred L. Loomis, who was the first to call attention to the value of the Adirondack climate in the treatment of consumption.

The Sanitarium is incorporated under the laws of the State of New York, and is governed by a board of trustees. Dr. E. L. Trudeau is the president of the board of trustees, and the institution is, and has been since its inception, under his medical supervision. There are two resident physicians—Dr. Charles C. Trembley and Dr. Lawrason Brown, and Mrs. Julia A. Miller is the superintendent.

Since the wards of general hospitals in the past had shown that aggregation is a real danger to the consumptive, the cottage plan was adopted from the first, in spite of the greater cost of building and operating an institution on this plan, although the germ origin of tuberculosis was not as yet generally accepted. The new light thrown by science on the infectious nature of the disease, and an experience of fourteen years in developing a sanitarium on this plan, have but strengthened my confidence in this method of construction, which represents an attempt at segregation, separates patients as much as possible from one another, and affords each individual so large an air space as to make it difficult, when rigid precautions as to the care of expectoration are enforced, for the buildings to become contaminated. Besides, it affords patients a regular walk to and from their meals, which are served in the main building, encourages them to lead an outdoor life, allows them to select as companions those who are congenial to them, and to avoid unnecessary contact with those who are not.

The cottages of the Adirondack Sanitarium are one-story buildings, accommodating from two to ten persons each; but the greater number have a capacity for four or five inmates only, and these have been found the most satisfactory. Each patient has his own room, opening into a central sitting-room in direct communication with the veranda, on which the outdoor plan of treatment is carried out, a good shelter from the prevailing winds being secured by means of a single glass screen. The partitions between the sleeping and general sitting-rooms reach but seven feet from the floor, an arrangement which gives the patient the benefit of the entire air space of the cottage, and allows of its being heated by a fireplace during the cool months, and by a hot-water plant during the winter season; but the walls which separate the sleeping rooms from each other reach to the ceilings, and are of solid construction. Good ventilation is insured by transoms located over the front verandas. These cottages, as well as all the other buildings on the grounds, are lighted by electricity. In the main or administration building are to be found the dining-room, kitchen, reception



LIBRARY OF THE ADIRONDACK COTTAGE SANITARIUM.

SANITARIUM COTTAGE OF THE ADIRONDACK COTTAGE SANITARIUM.

and general sitting-rooms, superintendent's and doctor's offices, rooms for servants and nurses; while the upper floor of the building is devoted to large rooms for a limited number of patients. The library, recreation pavilion, doctor's cottage, chapel, and infirmary are all separate buildings. Should any patient in one of the cottages become rapidly worse or be taken suddenly ill, he is at once removed to the infirmary, where every convenience for his care and proper treatment is at hand. The separation of those who are failing rapidly, or are acutely sick, from the comparatively well, not only furnishes the former with a constant and necessary attention and nursing which they require, but withdraws them from the daily observation of their more fortunate cottage mates, and prevents in these the depression which would otherwise occur from contact with the very sick. The success of the plan is attested by the general cheerfulness of patients while in the institution, who, contrary to what might be supposed, are very rarely depressed in spirits at their enforced exile.

In order to attain success in curing consumption, the first rule is to make as early a diagnosis as possible; for the earlier the disease is detected the better will be the prospect of effecting a cure or arresting the progress of the destructive process. The first few months after the onset of the disease present often the one golden opportunity of re-establishing the balance of health, and many lives are constantly sacrificed by the neglect of this opportunity. If the curability of the earlier stages of tuberculosis could be more generally accepted, and for this reason the grave responsibility which rests on the physician in making an early diagnosis better realized, the patient's best chances of recovery would not be so constantly sacrificed. That consumptives are rarely sent away in the earlier stages of their disease is shown by the fact that most applicants for admission to the Sanitarium have had symptoms of ill health for at least a year before they apply, and that it is necessary to refuse as unsuitable cases five out of every six who present themselves for admission. It has been found that sixty-eight per cent. of the truly incipient cases were discharged as apparently cured, while only eleven per cent. of the advanced, and none of the far advanced cases recovered.

The exact results obtained at the institution by the combined climatic and sanitarium treatment are difficult to express in figures, because they are generally influenced by the class of cases accepted. With advancing familiarity with the disease, and improved methods of diagnosis, our standards have also steadily altered, so that what would have been considered an incipient case fifteen years ago would be classed as an advanced one to-day in most instances. Furthermore, the term "cure" can also be used only in a relative sense, time as measured by years being the only criterion of cure. Of late the results obtained have been better than formerly, and this is due, no doubt, not only to improvements in methods and plant, but to the fact that more really favorable and early cases are available than formerly.

An idea of the best results obtained thus far can perhaps be gained by a glance at the following table, copied from the last three annual reports, 1897–98–99, provided the figures are considered together with the classification adopted. Patients who have remained less than three months are put in a separate class, as little can be accomplished in the way of permanent results while in the institution for so short a period.

A glance at the table shows the following: Out of 323 patients who remained an average of eight and three quarters months in the institution, 113 of whom were classed as incipient cases, 151 as advanced, and 59 as far advanced, 109 were discharged apparently cured, 104 with the disease arrested, 73 improved, 31 unimproved or failed, and 6 died. This gives the best results as yet attained at the Sanitarium: *i. e.*, thirty-three per cent. of apparent cures, and thirty-two per cent. of cases in which the disease was arrested.

323 PATIENTS WHO REMAINED AN AVERAGE OF 8¾ MONTHS.

Condition of patients when admitted	Apparently cured	Disease arrested	Improved	Unimproved or failed	Died
Incipient cases, 113, . .	82 72.56%	25	4	2	0
Advanced, " 151, . .	27 17.88%	67	43	13	1
Far advanced " 59, . .	0	12	26	16	5
Total, 323, . .	109 33.74%	104	73	31	6

If we study the gross results of the twelve hundred patients admitted during the past fifteen years, the result is as follows:

Twenty-three per cent. were discharged as apparently cured; fifty-six per cent. were discharged with the disease arrested or much improved; nineteen per cent. were discharged stationary or unimproved; two per cent. died in the institution.

I am quite aware that cure in tuberculosis is but a relative term, and that time is the only test of cure,—a test which becomes more and more discouraging as the period of its application lengthens and we become more and more familiar with the relapsing nature of the disease. Nevertheless we have attempted to determine as far as was practicable the permanency of the results obtained, extending over a period of fifteen years to date. Of the 1,176 patients discharged alive about one half are still living, and one half of this number have been heard from as being perfectly well. This proportion of one quarter of the whole number covers the entire fifteen years, and the percentage, of course, improves each year as more early cases are admitted. The permanency of the recoveries depends necessarily a good deal on the environment to which the patient returns. If he is obliged to go back to a laborious life or an indoor occupation he is much more likely to relapse than if it is possible for him to return to a good climate and an outdoor existence.

CHAPEL OF THE ADIRONDACK COTTAGE SANITARIUM.

GROUP OF COTTAGES OF THE ADIRONDACK COTTAGE SANITARIUM.

The education which the patients receive at the Sanitarium as to the nature of their disease and the methods to be relied upon in combating it, is of the utmost value to them, enabling them to preserve their health and avoid relapses after they have left the institution; and this education is not limited to themselves, but is imparted by them to the great mass of people with whom they come in contact.

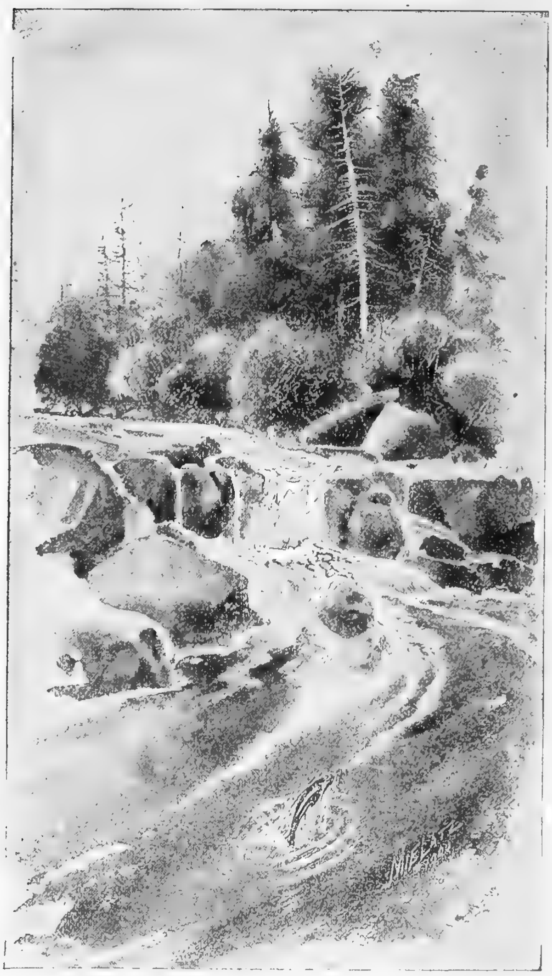
In addition, the attempt to cure pulmonary tuberculosis by institutional treatment, and the practical demonstration which it has given of the possibility of accomplishing this in many cases, have cast a ray of light on one of the darkest problems which confront medical science, and have proved an object-lesson which has, perhaps, not been without influence in creating the present popular demand that the State supplement private philanthropy in the establishment of similar institutions under its control.

Now that the State of New York has decided to assume the institutional treatment of tuberculosis as one of the practical means of combating this widespread disease, it is to be congratulated on having within its borders a region which experience has shown to be admirably adapted to the treatment of consumption.

AN EARLY START.

Adirondack Forestry Problems.

By B. E. FERNOW, Director New York State College of Forestry.



AN IDEAL BATTLE GROUND.

THE State of New York is the first and only State in the Union to have entered upon a definite policy of forest conservation, acknowledging the necessity and duty of the State to assume the protection of its most important watershed and of the forest cover thereon, and recognizing that in State ownership alone lies the assurance of its continued conservation.

Such a policy, now firmly established, presents a number of problems which are partly of an administrative, partly of a technical nature. Some of these are still partly unsolved, and the solution of others has not even been begun.

Ownership.

The main and fundamental one, the problem of ownership, has been practically settled by various acts of the Legislature, namely: in 1883, when the State determined to retain the forest lands which it then owned; in 1885, when it placed them in the care and custody of a Forest Commission; in 1890, when the first act authorizing the purchase of additional lands was signed by a democratic governor, with the memorandum affixed that the act was good but inadequate; and finally in 1897, when the Legislature and a republican governor created The Forest Preserve Board, giving it authority to acquire for the State, by purchase or otherwise, control of the entire region within an outline comprising three million acres more or less, or as much thereof as might appear desirable.

HOW A PROPERLY LUMBERED FOREST LOOKS,

THE TREE TOPS AND LIMBS HAVING BEEN REMOVED AND SOLD, AND THE BRUSH BURNED.

BURNING BRUSH IN THE COLLEGE FOREST.

The acquisition of lands has proceeded cautiously and slowly. Unfortunately, the State did not embrace the opportunity, when it existed, of acquiring these lands at a low price, and although purchases have hitherto been made in most instances at a reasonable enough figure, the delay has had three undesirable consequences, namely: first, to raise prices; secondly, to allow a further decrease of virgin forest lands and deterioration of the same by wasteful logging; and thirdly, to allow large tracts to be bought up by private individuals and clubs for game preserves. While at first sight the passing of lands into conservative private ownership does not appear objectionable, inasmuch as the object of the State, namely—a conservative treatment of the forest cover—may as a rule be expected from such owners, there is no absolute assurance of the continuance of such conservative treatment. Besides, not only would public ownership of the whole give more satisfaction to the people at large, but in the administration of its property the State could only be benefited by a consolidation of the same and the elimination of interspersed properties. Consolidation and uniformity of administration is perhaps more desirable in forest properties than in other properties. Take alone protection against fires. A careless neighbor's neglect in preventing the many causes of conflagration puts to naught the effort of the more careful. Again, accessibility and means of transportation are of first importance, while foreign possessory rights might often hinder the development of most desirable means of transportation.

Even now the State would not make a mistake, financially or otherwise, if it were to settle the ownership question at once, and acquire without further delay the balance of what it intends finally to own.

Administrative Problems.

The next problem is that of the administration of the property. At first a forest commission of three unpaid commissioners was charged with this duty of the "care, custody, control and superintendence of the forest preserve," and the law declared that "it shall be the duty of the Commission to maintain and protect the forests now on the forest preserve, and to promote as far as practicable the further growth of forests thereon"; also, to "have charge of the public interests of the State with regard to forests and tree planting, and especially with reference to forest fires in every part of the State."

In 1893 the number of the Commissioners was increased to five, with additional powers as to acquisition and lease of lands, and especially the specific power, with certain restrictions, "to sell the standing spruce, tamarack and poplar timber, the fallen timber and the timber injured by blight or fire." Another change was made in 1895, when an amalgamation of fisheries and game interests with the forestry interests was provided and the (five) Commissioners of Fisheries, Game and Forests were installed. The realization that the forest interests are decidedly more important than the other two interests has lately led to the change of name by which "forests" are first mentioned in the title of the Commission.

Whether by the consolidation any benefit has come to the forest policy is doubtful, although it would have been advantageous if the consolidation had been more in substance than in name. It would, for instance, have been advantageous to combine the functions of protecting fish and game and protecting the forest property in the same officers; especially within the forest preserve such arrangement would be only logical.

It has been suggested that the change from a five-headed commission to a single-headed one would insure greater efficiency. Theoretically, such a single-headed administration may be commendable provided a man of unusual capacity, broad-mindedness and experience is put in the place, just as the wise and moderate tyrant or king is said to represent the most beneficent government. With our democratic principles of government, however, it would appear that wherever public policy, not single will, is to be administered, a judicious council representing varied interests would be more apt to give satisfaction, provided that it relies for executive work on expert advice and assistance and on single responsibility of its executive officers. In the end the question of the personnel of the commission, rather than the number, is the important one, and still more important, the organization under the Commission and the objects to be attained through that organization.

The first object of the administration, naturally, must be protection of the property; and that means, with forest property, mainly against the dangers from fire. This is the first and foremost administrative problem. The only way to furnish that protection is by proper organization of the fire service, and by reducing the causes of forest fires.

Forest Fire Problems.

Forest fires in the Adirondacks are of very varying character, according to the condition of the ground on which the fire occurs. In the openings, in the slashes, in the sandy flats which used to be occupied by pines and which were burned over repeatedly after the lumberman had made the *débris,* on the rocky shores of lakes which the hunter's camp fire has wasted again and again, the fires run fiercely, fanned by the winds that have access here, burning up the young growth which is trying to establish itself. As a rule, when a fire breaks out in these wastes, it burns at least the entire area that had been burned over before, and also gradually eats into the hitherto

FUEL WOOD AND HARDWOOD LOGS.

A BELT OF TIMBER IS LEFT ALONG THE HIGHWAY FOR ESTHETIC REASONS.

untouched surrounding growth. In most cases, when such a fire has once gained headway it will run its course, all human efforts notwithstanding, until a rain, or a watercourse, or a swamp stops its spread; or until it has reached the green timber, where it may be checked. These are the dangerous fires and the most difficult to cope with.

On the other hand, the fires on the covered hardwood slopes are progressing slowly; they smoulder persistently in the soil, however, wasting the stored accumulation of vegetable mould, and causing the fall of trees without necessarily burning more than their roots. It is possible, with due vigilance and without great effort, to subdue these fires or keep them in check.

It is evident that different methods must be pursued in these different cases. The present law provides a system of firewardens whose duty it is to put out fires. This duty they may be able to perform in the last described cases; but it is almost if not entirely impracticable or impossible in the first class of cases. There are, besides, mechanical limitations to performing the duties of a firewarden over too large a territory; hence the appointment of a sufficient number of deputies, properly chosen, properly located and properly instructed, to act at least during the dangerous season, is necessary. Nor is it sufficient to have these firewardens employed only to put out fires, to go to fires when they have assumed dimensions. They should patrol their beats regularly through the dangerous season, prevent the starting of fires by their vigilance, and extinguish the small fires in their incipiency. The cost of such service, if efficient, will be large and an argument against it. As long as a fully organized forestry service is absent, in which the fireguards perform other necessary duties and useful work besides their patroling, the objection is valid.

Again, the personnel of the organization is of first moment; and even when proper persons have been chosen, only a constant inspection and oversight will keep the organization alive, its members on the alert.

A great deal could also be done by systematically subdividing the forest area, especially the dangerous slashes and openings, and gradually reducing the *débris* on the waste lands. If the State proposes to hold this property it might as well begin to improve it, to make it grow useful timber instead of weeds, and in doing so remove or reduce the danger of deteriorating these waste lands more. When such clearing and planting operations are actively begun it will be possible, and a financially sound policy, to employ also the necessary force for the protection of the young plantations. Moreover, greater care in the use of fire will beinculcated, when the true value of these waste lands, and the fact that an expenditure for their improvement has been made, forces itself upon the attention of the careless. As long as these areas are treated as worthless wastes it is natural that they are carelessly treated as such.

There is one serious drawback in existing arrangements which could readily be improved. It is the manner of paying for the service of fire fighting. At present, bills are audited and paid by the towns; the tedious delay of such payment is discouraging to the men who have to wait for the hard-earned money for many months. Authority to make the necessary outlay on the part of the Commission, for which the Board may then seek reimbursement through the town, is the ready remedy.

Technical Problems.

While these problems in the mechanics of administration are readily understood—and their solution is not difficult—the problems of technical management of the property are more difficult to solve. What is to be done with the forest owned and protected by the State? What policy is to be followed in its treatment, and what methods are to be applied?

The first legislation, instituting the Forest Commission, had in view the application of forestry methods to the management of the property; but the Commission failed to devise such technical management, and the people, as is well known, by constitutional amendment restricted the activities of the Commission by forbidding the cutting of trees on State lands, and thereby ruling out a large share of forestry work.

Knowing the history of this amendment we can assert that it was intended, not to establish a policy of non-use, and to exclude forever the application of such forestry work as requires the use of the ax, but rather to delay it until conditions should be more favorable for the employment of technical forestry management. If nothing else were to warrant this conclusion, the establishment of the New York State College of Forestry, with its experimental forest area within the limits of the proposed State Forest Preserve, must stand as an earnest that, ultimately, technical forest management is expected and intended, and not merely leaving Nature to take care of the forest cover.

There is, to be sure, no haste necessary to engage in such technical work; but even now the Commission is in position to do considerable preliminary work and prepare for the future.

There can be no question as to the first step in attacking the problem of technical management. As the physician bases his treatment on a diagnosis, so the administrator of a property must first become acquainted with its conditions. The first step, therefore, towards a technical management of the State's forest property must be a forest survey; *i. e.*, a technical description of the conditions of each parcel in such a manner that its character, conditions, and location can readily be referred to.

STUDENTS AND LOGGERS IN PERMANENT CAMP ON THE CORNELL FOREST RESERVE.

BOARDING HOUSE AT AXTON.

The Commission should know not only the acreage of the burnt lands and the virgin and the culled forest it controls, not only the location of each parcel of these, but the condition of each with regard to its possible treatment. Such a description can be satisfactorily made only by a practically educated forester, who, like the physician, diagnoses with a view to devising the remedy.

It is only when the condition of the whole or major part of the property is known that a harmonious, well-considered plan for its technical management can be devised and followed. It is then that the silvicultural as well as the administrative problems involved become apparent.

It was mainly for the solution of silvicultural problems that the New York State College of Forestry was endowed with an area of thirty thousand acres in the Adirondacks, the tract having been so located as to exhibit the greatest variety of problems that might be met in the entire Reserve.

The silvicultural problems can be classified into at least four groups, with any number of subdivisions, according to the character of the prevailing forest conditions. They will have to deal with the treatment of (1) virgin lands, (2) culled* lands, (3) slashes or burns, and (4) swamps.

Since the virgin lands in the possession of the State represent a proportionately small area, a few hundred thousand acres, they may, like the swamps, be left without detriment to future consideration. It is, therefore, to the culled lands and the slashes, of which the major part of the State property consists, that first attention should be directed.

Making Wastes Useful.

The slashes and old burns and openings of various kinds exhibit quite a variety of conditions, and admit, therefore, the possibility of a variety of treatment. But they are all alike in this, that in their present condition they present the greatest danger from forest fires, and that in most cases they fail to grow useful material. They are not only dead capital, but a menace to the standing timber. Not only do they furnish the best chances for the starting of fires, but, once a fire is started, the winds sweeping over the open drive the fire with such fury that human efforts to stop its progress are in vain. Usually the fire burns over the entire opening and destroys whatever effort Nature has made to recover the ground since the last fire.

In some places repeated fires have almost cleared the area of the old *débris*, and it is possible to begin at once, without preparation, the planting of valuable species.

* Lumbered lands from which the spruce or some other species have been taken.

In other cases there is need of clearing the ground more or less thoroughly of *débris* in order to reduce fire danger and make the planting practicable. The degree to which the clearing must be done varies, and so does the cost.

The College has started the solution of the question of how much clearing is needful and how cheaply this preparatory work may be done, as well as how cheaply a growth of valuable tree species may be re-established.

Sometimes Nature has covered the burn with a growth of aspen or birch, and, if left alone, gradually the more valuable conifers—pine, spruce, and cedar—would establish themselves by natural process. But even here the helping hand of man may hasten the process of useful occupancy of the soil by using as much of the volunteer crop for nurse purposes as may be desirable. Lanes are opened through the aspen growth at varying distances apart, and pines and spruces are set out in the lanes where they will be benefited by the light shade of the neighboring strips of aspen and white birch.

The species which have been chosen for this planting are entirely taken from the family of conifers. The conifers are the most useful of the trees of the temperate zone; they are required in largest quantity—the consumption in the United States standing as three to one, when compared with the hardwoods—and they promise to continue to hold their position in the market.

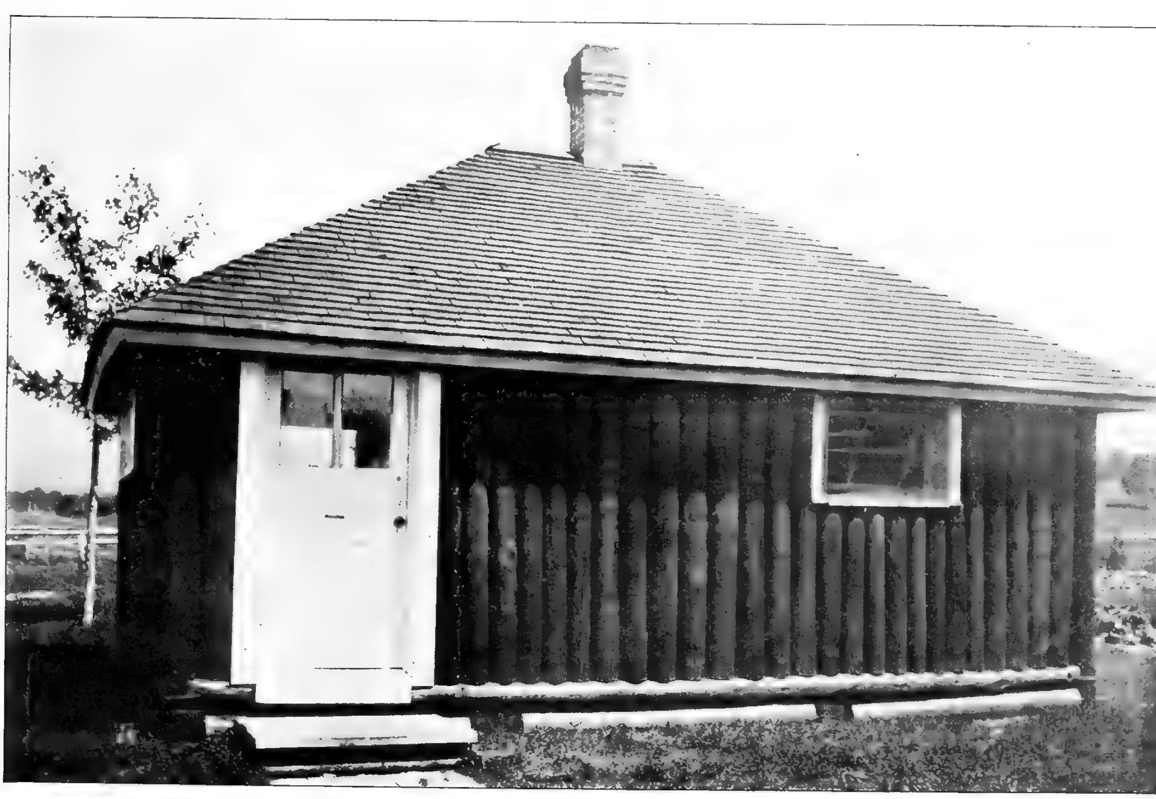
White pine is the king of the woods, and, with the development of the pulp industry, spruce is next to the throne; hence these two species should be specially encouraged. Moreover, the hardwoods have, in the struggle for the occupancy of the soil, various advantages which the conifers lack. They will propagate without much assistance, while the conifers, with their greater permanent and economic value, deserve, and, with their natural deficiencies in propagating, require the protection and encouragement which may be artificially given to them.

Besides the native white pine, which is in every respect the most desirable species to plant, growing rapidly into useful material, the Norway spruce has been favored. This was first done with hesitation, and mainly because plant material of the native spruce was not readily attainable, while the European species could be had in large quantities and most cheaply. In addition, the European spruce grows more rapidly and produces better material.

After observing older and younger plants and seedlings of this species in their new home for two seasons, expectations have been far surpassed by the behavior of the plants. Of the six or seven species planted, the Norway spruce has shown that it is more perfectly at home than any other, and promises to grow as vigorously here as it has done elsewhere in the United States. The seeds germinate most readily—very different from the white pine, which germinates slowly. The seedlings in the

NURSERY AT AXTON.

GROWING CONIFERS. ONE MILLION SEEDLINGS IN SIGHT UNDER SCREENS.



THE OFFICE AT AXTON.

nursery stand the drought—the unusual one of the summer of 1899—as well as the frosts of the region, making in their second year shoots of five to seven inches; three-year-old plants set out in the slashes appear among the weeds as born to the manor.

There will be croakers who predict failure in later life, but there is no warrant for such predictions. Whatever experiences there may have been had in this country, which might lead to such doubts, have not been had with trees planted under forest conditions, and certainly not in this region. I have no hesitation in recommending for quick results the use of this cheap and promising plant material, in combination with the white pine, with which it makes a most desirable mixed stand, the white pine growing somewhat more rapidly and needing the improving companionship of such shadier neighbor.

In addition, there has been used in larger numbers one of our native western conifers, the Douglas spruce *(Pseudotsuga taxifolia)* from Colorado, which appears also most promising from its behavior during the first season, although not as rapid as the Norway spruce. It is, unquestionably, the best material and the most adaptive species which the western mountain regions afford.

In somewhat smaller quantities, for trial, the Colorado white fir *(Abies concolor)*, the European and Siberian larch, and the Scotch pine have been used; the latter, cheapest material of all, set out on a sandy knoll, has made a most promising start in spite of the dry season.

Altogether some three hundred thousand plants have been set out on burned slashes, and the opportunity for judging what is most satisfactory will soon be at hand. The Axton nursery contains half a million seedlings, and a second nursery at Wawbeek will produce double that quantity, ready for use in the woods in two or three years' time.

One of the essential requirements in this reclamation of waste lands is adequate protection against fire. As I have pointed out, the greatest fire danger lies in these very areas; hence, special precautions to reduce the danger become necessary wherever the expenditure for planting has been made. Greater vigilance and special fire-guards will be required, and in addition, mechanical means can be employed to reduce the danger. Among these are to take in hand, as far as possible, the entire burnt area at one time, clearing and burning the *débris*, so that the cleared and planted area be bounded by standing timber or by water or marshy land; subdividing the area by ditches; or, better still, by lanes sown to grass, which can be kept in proper condition and serve as bases of defense in case of fire, so that the same may be confined in area. Old snags, especially dead pines, must be downed, as they are apt to be set on fire by lightning.

The question, I suppose, is asked: "Does it pay to reforest these wastes?" The answer is, that if the State really proposes to hold, protect, and improve this forest area as a whole, it does pay unquestionably, even were we to look at it merely as a work of internal improvement. And if, as the indications are, the cost of restocking these, at present, worse than worthless areas can be kept below ten dollars per acre on the average, it can be figured out even as a profitable financial proposition. This work of reclaiming wastes is, by the way, one against which no constitutional bar exists, and which, therefore, could be taken in hand by the Forest Commission without any change of present functions, if sufficient appropriations are made.

How to Manage the Culled Lands.

The other problem, that of handling the culled lands, is one presenting much greater difficulties. While the reclaiming of the waste lands is merely one of financial capacity and of expenditures which can be more or less accurately determined, the rational treatment of the forest lands requires not only much more skill, but their improvement, if it is to be kept within practically advisable expenditures, is dependent on market conditions, over which even the State may not exercise control. To understand the problem we must state the conditions.

The Adirondack forest is one composed of a variety of species, in which the hardwoods, birch, maple, and beech preponderate, and in which the conifers, pine, spruce, and hemlock, form a variable, more or less prominent part. The culling has been of the latter, so-called soft woods, especially pine and spruce, because they were most in demand and most easily handled and transported by water. As a consequence, after the culling process, the hardwoods, preponderating before, became still stronger, and only the tolerance of shade, which is a characteristic of the spruce, has maintained it in younger individuals, besides the decrepit old ones which the logger has left; while the white pine, which cannot reproduce itself under the shade of the hardwoods, is almost extirpated, except in occasional openings.

The hardwoods, while furnishing a full and pleasing canopy of foliage, which may mislead the uninstructed into the belief that he is looking upon a virgin woods, exhibit in the old specimens the decrepitude of age, dead branches and rotten heart, and many of the younger, thrifty-looking trees, upon closer investigation, also show the signs of decay as a result of the running fires which have swept over nearly every culled tract of the wild woods. This, then, is the condition: a forest of old decrepit hardwoods, deteriorating from year to year, with a tainted progeny struggling beneath, and a small though promising number of young spruces impeded in their development by the former, with occasional older trees that can be used as seed trees.

AXTON IN EARLY SPRING.

SURVEYORS' CAMP IN COLLEGE FOREST.—WAITING FOR THE APPETITE.

Can there be any question as to the changes which it is desirable to effect, if we apply the reasoning of rational political and financial economy? Remove the dead capital of old, hardwood timber, and replace it by a young, thrifty crop, growing into value, in which the more desirable conifers preponderate!

The silviculturist will have to decide how best to secure this young crop, which may be done by favoring the volunteer crop of conifers, by giving a chance for seeds from left-over seed trees to find a seed-bed and favorable light conditions for development, or by planting or sowing artificially.

But before he can apply his skill, the manager must have found a way of disposing of the hardwood crop. And here lies the pivotal point of the problem, as with most of the forestry problems that are to be worked out on financial basis in the United States; namely, in the market question.

If the silviculturist is to show his skill in producing a new crop, the old must be disposed of; not only must a market first be found for the sound merchantable saw-logs, but for the much more bulky and less valuable portion of poor cord-wood which, in the Adirondack timber, may readily be set down as exceeding in bulk two to three times the raw material. Where this cannot be done, the culled lands may still eke out an income by further culling of pulp material, etc.; but it is evident that this can only be at the expense and to the detriment of the value of the property, for it means removing the most valuable species, and reducing its chance for reproduction. In such cases nothing is left but waiting for economic conditions to change, until the old hardwood crop is salable.

One of the absolutely unavoidable conditions for marketing hardwood material is accessibility to railroad transportation, either for the raw material or the manufactured. Therefore, before the State may enter upon a policy which has in view the rational use of its property from a forestry point of view, it must change the provision which prevents railroad building over State lands. I do not advocate the indiscriminate opening of the State lands to railroad construction, but merely state that rail transportation is a necessity for successful technical management of these lands.

The State College of Forestry has been successful in securing a market for the hardwood material on its tract of thirty thousand acres, by inducing manufacturers of staves and of wood alcohol to combine in establishing plants. By such combination the fullest and least wasteful use of hardwood materials at present known is secured, since all sound material to a diameter of eight inches and a length of thirty-two inches can be used for stave-wood, while the retort and fuel wood used in the manufacture of alcohol takes the material down to three inches, thus securing the fullest possible utilization of all the material in the tree.

In the attempts to introduce more conservative methods of lumbering, it has been usual to restrict the cut to trees above a given diameter. By such restriction, possibly, a less wasteful use of the existing supplies may be attained, but the main object of the forester's art, namely, securing a valuable aftergrowth, is not at all, or most uncertainly, attained. The College has, therefore, not allowed itself to be bound down by any such mere commercial considerations. In its contract with the manufacturer it has reserved the right to cut or to leave uncut whatever trees it is desirable to leave or to cut, the College being the arbiter as to what, in a proper forest management, is to determine this choice. Old and large trees, therefore, may be left, be it for seed trees or for other reasons, and small or young trees may be cut, if by their removal an advantage is secured from the forester's point of view. Silvicultural considerations—*i. e.*, the condition in which the forest is left with a view of securing a new, more valuable crop—alone decide this question, except so far as financial or business considerations must modify the ideals of the silviculturist.

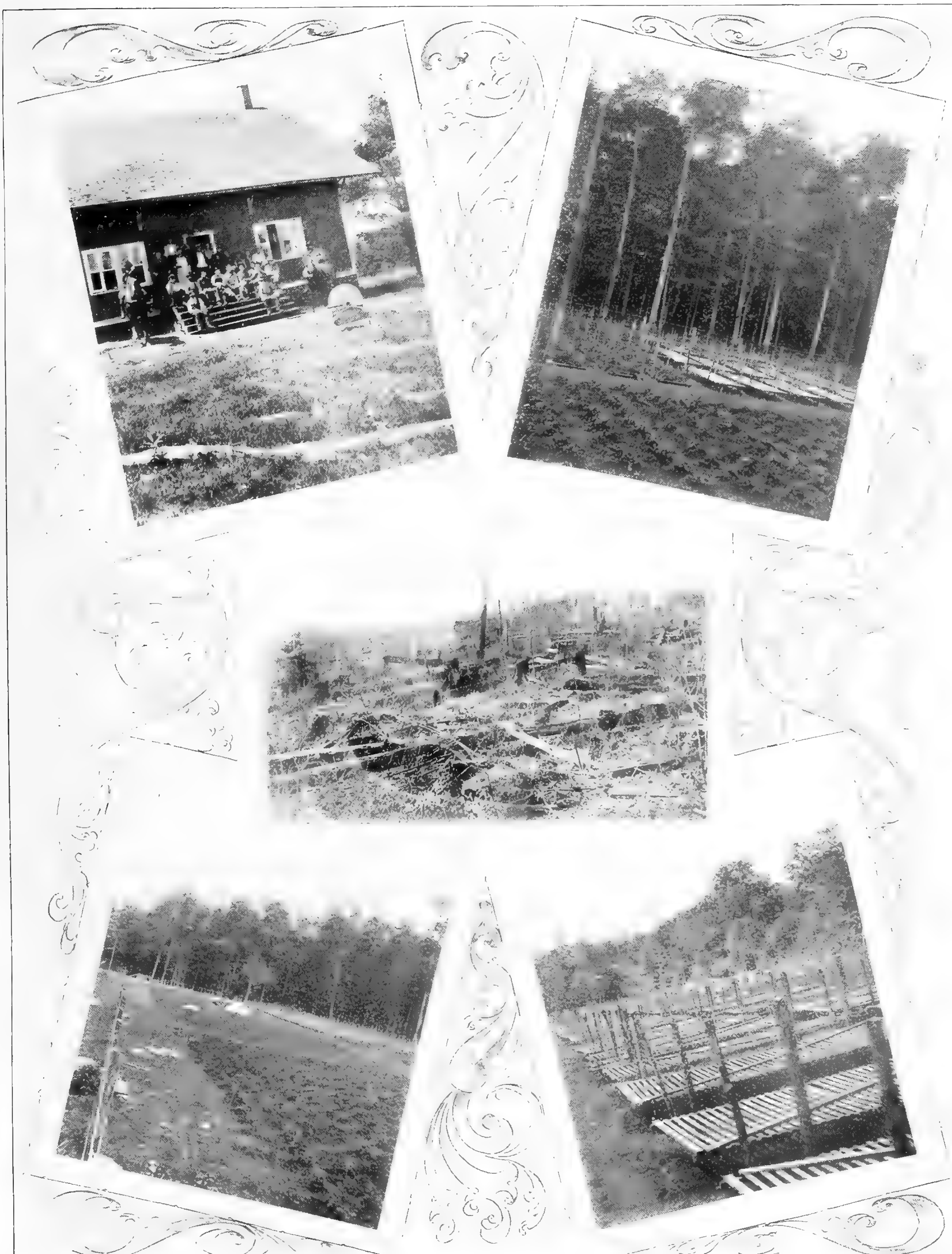
Since, finally, this reproduction of the wood crop, like all production, is an economic problem, the silviculturist, while he has the task of securing the new crop, must also *count the cost* and secure the result by the least expensive means and methods.

Briefly, then, the problem is: How to cut and dispose of the old hardwood crop most profitably, at the same time saving the young spruce which is on the ground, and leaving enough seed trees of the various kinds forming the forest to secure a desirable new crop of a mixture in which the conifers have the preponderance.

In some places this may be more cheaply and more effectively secured by cutting the old crop without considering the existing young growth, and replant by hand. This method would be called into requisition where the forest has been culled too severely, or where, for other reasons, the conifers are absent and their reproduction is desired.

In the contract under which the College is working, due to business considerations of the market, the amount annually to be cut is necessarily determined by the requirements of the manufacturer: *i. e.*, a certain, stated amount of material must annually be delivered. To the European forester and to those who attempt to propagate European methods of forest management in this country under a system of so-called "working plans," this basis for determining the cut, the absence of yield calculations, and of propositions for a sustained-yield management, will appear strange.

It is customary in Germany, and wherever German methods are blindly followed, to determine the capital stock of wood standing in a forest, to calculate how much this stock annually increases by growth, and then to determine from these data how much may be annually cut without impairing the wood capital; in other words, to



1.—A Modern Logging Camp in College Forest, Camp Wawbeek. 2, 4, 5.—Wawbeek Nursery, showing the Screens used to protect the young seedlings against excessive transpiration as well as frost. Beds are also covered with Balsam Brush for same purpose. Potatoes are grown the first year to mellow the soil.
3.—Burnt area which requires partial clearing of *débris* before planting.

harvest annually only that which does or ought to grow annually, at the same time reducing or increasing the cut, if the capital is deficient or excessive. This is called "sustained-yield management."

To apply this principle—perfectly proper for the settled conditions in the artificially reproduced German woods—to our decrepit Adirondack woods would mean lack of judgment as to the conditions under which it is to be applied. Measurements and calculations upon the basis of which the cutting is to proceed, while they have the appearance of a highly scientific foundation, are for our virgin woods really most insecure. Even the Germans, after a hundred years of attempt to determine, with a measurable degree of accuracy, the contents and the rate of growth of a selection forest—*i.e.*, a forest in which old and young trees of all ages and various species are mixed—have come to the conclusion that it is impracticable, and that a guess is almost as safe as the elaborate calculations.

The fine measurements, then, in our wild woods, which are made to establish so-called "yield tables" while no doubt of scientific interest would be most unsafe to base upon financial calculations, investments and practical management.

Moreover, the measurers have overlooked that in our woods which are run over again and again by fires, there is about as much *decretion* as there is *accretion*, and this decretion by decay in the heart withdraws itself from measurement.

But it takes no fine calculations, only common observation, to ascertain that our old timber is past its prime, and has been financially ripe for harvest, *i. e.*, growing no interest, for many years. Hence the proper policy is that stated at the outset: to replace as quickly as economic conditions warrant, the old crop by a new. How fast or how slowly this may be done depends upon the conditions in each case, and cannot rationally be determined by such a general rule as the sustained-yield management imposes.

Especially for the State, with its extensive holdings and without the necessity of securing a continuous and even annual revenue from these woods, there is no need to adhere to this principle, and to waste money and energy in finding out what the future growth will be. Let the next generation count the chickens for which we have secured the opportunity of development, favoring the better breeds. No fine measuring, calculating, and predicting of future incomes is necessary to assure us that the replacement of a decrepit old stand of timber by a vigorous new crop of better kinds is the true financial policy for the State. As slowly or as fast as market conditions and other esthetic as well as economic considerations warrant, the old, unprofitable investment of Nature should be changed into a new, live investment of art and skill, by practicing silviculture pure and simple.

Other Than Business Considerations.

There is no doubt that the majority of the people who were interested in the preservation of the Adirondack woods under State ownership never looked at the proposition as one involving business considerations; they did not conceive the woods in the hands of the State as objects of profitable exploitation, as a thing with which to do anything else but leave it alone. Some saw in the wilderness only a pleasure ground, a health-giving resort, a park to be set aside for the use of those who need and could afford the relaxation of a life in the woods. Others had conceived that the climatic influence of the forest cover on water supplies imposed the duty on the State to look to the preservation of the forest cover.

To the first proposition—namely, that the State set aside a pleasure park—that portion of the people who cannot afford to take advantage of it naturally objected; as to the latter proposition, that the water supply of the State required forest conservation, doubts regarding this relation and the need of State protection are by no means unfrequent or untenable.

But both these classes of advocates of State ownership of the woods have overlooked the fact that their objects are attainable without sacrificing the other functions which a forest is to fulfill, namely, the furnishing of wood supplies. It is not necessary to withdraw this large area of land from economic use; it is not necessary to make it an expense, a burden on the taxpayer. On the contrary, the protective function and the luxury function can be subserved as well as the economic function, by a proper system of forest management, which takes into consideration the esthetic as well as the business aspects of the property.

Forest preservation is attained in the same way as the preservation of mankind, by reproduction, by removing the old and giving a chance to the young crop. This involves the cutting of trees, to be sure; but if this is done with regard to securing a new growth of better composition, it is the rational method of forest preservation.

The forest policy of the State will only be completely and rationally rounded out when the State forests are managed for revenue as well as for the other benefits that may be derived from them under skillful foresters, such as the State College of Forestry is intended to educate.

Insects Injurious to Maple Trees.

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THE conditions under which shade trees are grown vary so widely from those under which the same trees live in the forest, that methods of controlling injurious insects found practicable in the one case can not be advised in the other. For this reason the present paper will be confined to insects affecting shade trees, and space limitations render it advisable to treat of only a few of the most injurious species affecting maples. It will be found, however, that most of these pests attack other shade trees, and that in one instance at least, that of the white marked tussock moth, the caterpillars prefer the horsechestnut; but as maples are the more abundant shade trees throughout the state, even this species is of greater importance on account of its injuring maples than because it attacks the horsechestnut.

Transformations. Before treating of individual species, it may be profitable to glance briefly at the life history of insects and the relation of the various stages to each other. All insects hatch from eggs, which present widely variable forms in different species and are frequently of exceedingly beautiful design. In certain cases the ova or eggs hatch within the body of the parent. Members of the very lowest or simplest order of insects, such as show fleas, slides or silver fish and their allies, undergo no transformation, that is, there is very little difference between the young and the adults. Among grasshoppers and related insects, there is what is called an incomplete metamorphosis or transformation. The young grasshopper, as it emerges from the egg, is a curious, wingless little creature, bearing a general resemblance to the parent and can easily be recognized as a grasshopper. As the little fellow increases in size, it casts its skin from time to time and with each molt the wing pads become longer and in the final change the wing cases are slipped off and the organs of flight are at liberty to perform their proper functions. In the stage before the final one, the wing pads may be as long as the fully developed wings, but the two stages may easily be separated by the position of these organs. In the adult the fore wings fold over and conceal the hind ones, while in the immature grasshopper the hind wing pads are outside of the fore ones. Many insects like cockroaches, walking sticks, dragon flies, true bugs and others develop in this manner, but not all resemble the adult so closely in the earlier stages as do grasshoppers.

The most marked changes in development are seen in butterflies, moths, flies, beetles and bees. Comparatively few understand the relations existing between the voracious caterpillar, the quiet brown pupa or brightly colored chrysalis, and the beautiful moth or butterfly. The young caterpillar emerges from the egg and at once begins feeding, casting its skin from time to time in order to allow of increase in size. This, the larval stage, is the period of assimilation and growth, and it is while in this form that most insects are destructive. When full grown, the caterpillar (Plate 1, figure 1) sheds its skin and changes to a pupa, a form which is usually brownish and subconical (Plate 1, figures 7, 15). This transformation is frequently preceded by the spinning of a cocoon (Plate 1, figure 14) or by the formation of an earthen cell. During the pupal stage no food is taken and only a very limited activity is possible. It is the period of reorganization. From the comparatively simple caterpillar, there is developed the delicate moth or butterfly, which in due time emerges from the shroud-like pupal case. After a time, pairing occurs, eggs are deposited and the life cycle again commenced. On account of the great changes from the caterpillar through the pupa to the adult, the identity of a species in the various forms can usually be established only by rearing. All insects presenting such marked changes in their development are said to undergo a complete metamorphosis or transformation, a change which will be found true, in endless variation, of all members of the bee, beetle, fly, butterfly and moth families.

A study of the habits of injurious insects in their various stages is the foundation of applied or economic entomology, for such investigations usually reveal one or more weak points in the life history of each pest that render its control comparatively easy.

White Marked Tussock Moth.

Notolophus leucostigma Abb. and Sm.

This insect appears to thrive best in cities and villages and some seasons proves a veritable scourge in certain localities. In Albany and Troy, the horsechestnuts are usually partly defoliated each spring and occasionally stripped of all their leaves by the voracious caterpillars of this moth. The lindens frequently suffer nearly as much, and the maples and elms come in for a goodly share of attention from year to year. The above is probably true to a great extent of most of the cities and larger villages in the state. The summer of 1898 was marked by the abundant presence of this insect, and the extensive defoliations which occurred at the time aroused the people to the necessity of fighting the pest. This was done so effectively that very little trouble with this caterpillar was reported in 1899.

Description. The full grown caterpillar has a coral red head, a pair of long black plumes just over it, a single one at the opposite extremity of the body, four delicate yellowish or white brush-like tufts on its back and just behind them, separated only by a segment, two small, retractile, red elevations. Along the back, except for the tubercles and tufts, there is a broad black band bordered by yellowish subdorsal stripes. Each side is dark gray, except the yellowish tubercles. A black line indicates the position of the spiracles or breathing pores, and below this latter line it is yellow, the legs usually being paler (Plate 1, figure 1). This gives the general appearance of the caterpillar after it has become half or two-thirds grown, and at a time when its depredations begin to be apparent. The recently hatched larva is a pale yellowish or whitish creature with long, irregular hairs. As it feeds, increases in size, and casts its skin (Plate 1, figure 5) from time to time, one after another of the characteristics of the full grown larva are assumed.

When maturity is reached, the larvæ spin their thin cocoons in the crevices of the bark (Plate 1, figure 4), interweaving their long hairs, and within this shelter transform to yellowish white pupæ more or less shaded with dark brown or black (Plate 1, figure 7).

The difference between the sexes in the adult stage is strikingly shown by comparing in plate 1, figure 2, an illustration of the male, with figure 3, a representation of the female. The former is a beautiful moth with large, feathery antennæ, tufted legs, and the wings and body delicately marked with several shades of gray and grayish white. On the other hand, the female is a nearly uniform gray, with simple antennæ, and but rudimentary wings.

The eggs are deposited on the empty cocoon under a conspicuous white mass of frothy matter (Plate 1, figure 3), which soon hardens and forms a very effective protection. The individual egg is nearly spherical, about $\frac{1}{25}$ inch in diameter, white or yellowish white, and with a light brown spot surrounded by a ring of the same color.

Life History and Habits. The winter is passed in the conspicuous, white, easily removed egg masses, the young emerging about the latter part of May in this latitude. They begin to feed on the more tender lower epidermis of the leaf and soon devour all but the principal veins. While young, the caterpillars frequently hang by a silken thread and with continued jarring many may drop to the ground. The growth of the caterpillars occupies a month or a little more, pupation occurring the latter part of June and early in July. In Albany most of the larvæ had pupated by July 7 in 1898, and some recently deposited egg masses were to be seen at that time. A few individuals spin up earlier than the mass and some do not till numerous egg clusters indicate that most of the insects have already completed the round of life.

From ten to fifteen days are passed in the pupal state. At the end of this period, the wingless female emerges and crawls upon her cocoon, pairing takes place, and immediately afterwards deposition of the eggs begins, as stated by Dr. L. O. Howard. They are laid in masses as described above, the eggs of a cluster ranging in number from 100 to 500, as given by several writers. In what appeared to be a good sized mass collected in Albany, there were 330 eggs. After her full complement has been discharged, the female dies and drops to the ground. In Albany there is normally one annual generation, but in New York city and vicinity and in Boston, Mass., there are two broods, while at Washington, D. C., there are three broods each year, according to Dr. Howard.

The young larvæ feed upon the under surface of the foliage (Plate 1, figure 6), and as they increase in size more and more holes are eaten, till, when full grown, all but the main ribs of the leaves, well represented in plate 1, are devoured. A peculiar habit, recorded by the late Dr. Lintner but not observed by others outside of Albany, is the girdling of elm twigs by the larvæ of this insect. This is caused by their eating a portion of the bark around the twig near the beginning of the season's growth (Plate 1, figure 8). The affected tips soon die, break off, and fall in numbers to the ground. The larvæ drop from the trees readily, specially when young, suspending themselves by silken threads, and then may be blown or carried considerable distances. When nearly full grown, the caterpillars travel to a great extent; this is said to be specially true of the larger ones, females, and more likely to occur if they are very abundant. At such times there may be quite a migration to other trees. The cocoons are found very generally on the trunks and particularly on the under side of the larger branches.

The wingless females, at the time they emerge from their cocoons, attract large numbers of the opposite sex. Dr. Lintner records an instance of one attracting one hundred males within an hour. Collections at electric lights in Poughkeepsie, N. Y., by Dr. Dyar, show that the males fly during July and into August.

Though this insect is commonly destructive to comparatively few trees, it has been recorded as feeding on a number of others, as the following list will show: Linden, horsechestnut, buckeye, maples (specially the soft and Norway), box elder, honey locust, apricot, garden plum, wild plum, garden cherry, choke cherry, rose, pear, apple, quince, ash, elm (several species), sycamore or buttonwood, butternut, black walnut, hickory, oak, birch, alder, willow, poplar, spruce, fir, larch and cypress.

This native species "ranges from Jacksonville, Fla., to Nova Scotia on the eastern coast and extends west certainly as far as Keokuk, Ia., and probably farther," according to Dr. L. O. Howard. It has been recorded as common in Nebraska, and reported as present in Oregon.

Natural Enemies. This insect has so many natural enemies, that account of them should always be taken in any effort to check the pest. It is probable that quite a number of birds prey on the caterpillars of this species. In a recent article, Mr. E. H. Forbush, Ornithologist to the Massachusetts State Board of Agriculture, has given a list of forty-seven species of native birds which have been observed feeding on hairy caterpillars. It has been known for some years that the robin, Baltimore oriole, black billed cuckoo, and yellow billed cuckoo will feed on the caterpillars of this species, and it is very probable that a number of others do the same to a greater or less extent.

The insect parasites are extremely valuable allies and should be encouraged in every practical manner. It has been shown by Dr. L. O. Howard, that in Washington, D. C., *Pimpla inquisitor* Say, illustrated below, and *Chalcis ovata* Say are the two species most effective in controlling this pest, and that large numbers of the former insect hibernate as larvæ within the cocoons of the host. Unfortunately these beneficial parasites are in turn the prey of others. These latter sometimes almost

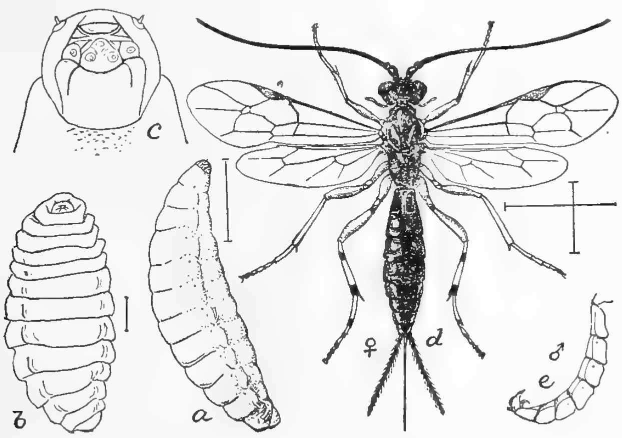


Figure 1.—PIMPLA INQUISITOR: *a*, full grown summer larva; *b*, hibernating larva; *c*, mouth parts of larva; *d*, adult female; *e*, abdomen of adult male from side—all enlarged; *c*, greatly enlarged. Lines beside figures represent natural size. (After Howard: U. S. Department Agriculture, Division Entomology. Tech. ser. No. 5, 1897).

exterminate the beneficial forms (those which prey directly on the caterpillars). One of the most common of these pernicious hyperparasites, *Dibrachys boucheanus* Ratz., is represented in the accompanying figure (2).

Remedies. The simplest and most satisfactory remedy is found in gathering and destroying the egg masses. Prizes were offered in Rochester, N. Y., in 1894, to school children gathering the largest number of egg masses, and most excellent results were obtained. In places where this is practically the only shade tree pest, this system or the payment of a bounty on the egg masses would undoubtedly result in the pest being kept under control at a comparatively small outlay. As the eggs are in a compact mass which is readily torn from the supporting cocoon, either by hand or some form of a scraper, the task is easily and quickly performed. Dr. Howard has recommended the use of creosote oil for the destruction of the eggs, since each mass has only to be moistened with the substance. In winter it is necessary to add some turpentine in order to keep the creosote liquid. On account of the female being wingless, a tree once thoroughly cleaned will not become reinfested very soon if larvæ are not abundant near by, and even then a band of loose cotton bound tightly near its middle around the trunk and the portion above the string turned down, will prevent their ascending and a consequent reinfestation. It should be kept in mind that only the eggs must be collected or destroyed, on account of the beneficial parasites which may occur in cocoons not bearing egg masses. This is specially true in the autumn and applies to a certain extent in the spring, since it has been shown that some parasites hibernate as larvæ within the cocoons of the host, and if these are collected and destroyed, it means the death of many beneficial forms. The egg masses are

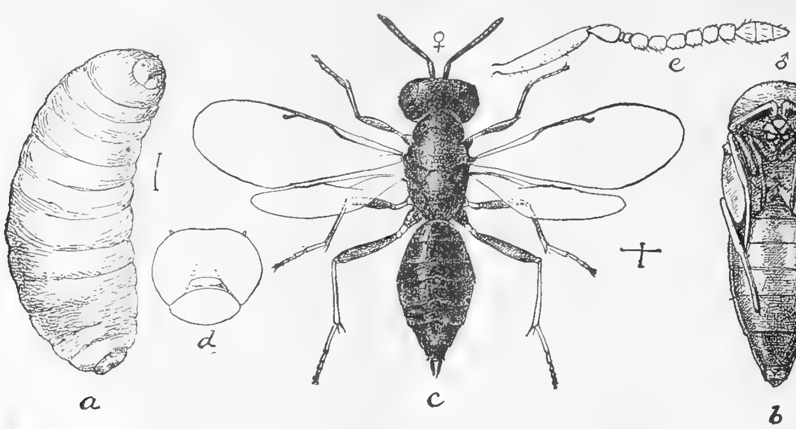


Figure 2.—DIBRACHYS BOUCHEANUS: *a*, larva; *b*, pupa; *c*, adult female—greatly enlarged; *d*, head of larva; *e*, antenna of adult—still more enlarged. Lines beside figures represent natural size. (After Howard: U. S. Department Agriculture, Division Entomology. Tech. ser. No. 5, 1897).

more readily seen after the leaves have fallen and in localities like Albany, where one annual generation is the rule, the gathering of the eggs may well be deferred until autumn, or, better still, until early spring, since there will then be less chance of destroying valuable parasites. As the young caterpillars begin to hatch the latter part of May, collection of the egg masses can not be delayed with safety after the middle of that month. In Boston, New York city and more southern localities, it may be necessary to collect in midsummer the eggs laid by the first brood of moths.

In case it is impracticable to collect the eggs, dependence must be placed upon spraying with some arsenical poison. This is satisfactory if properly done early in the season under favorable conditions. In many instances there will be more or less

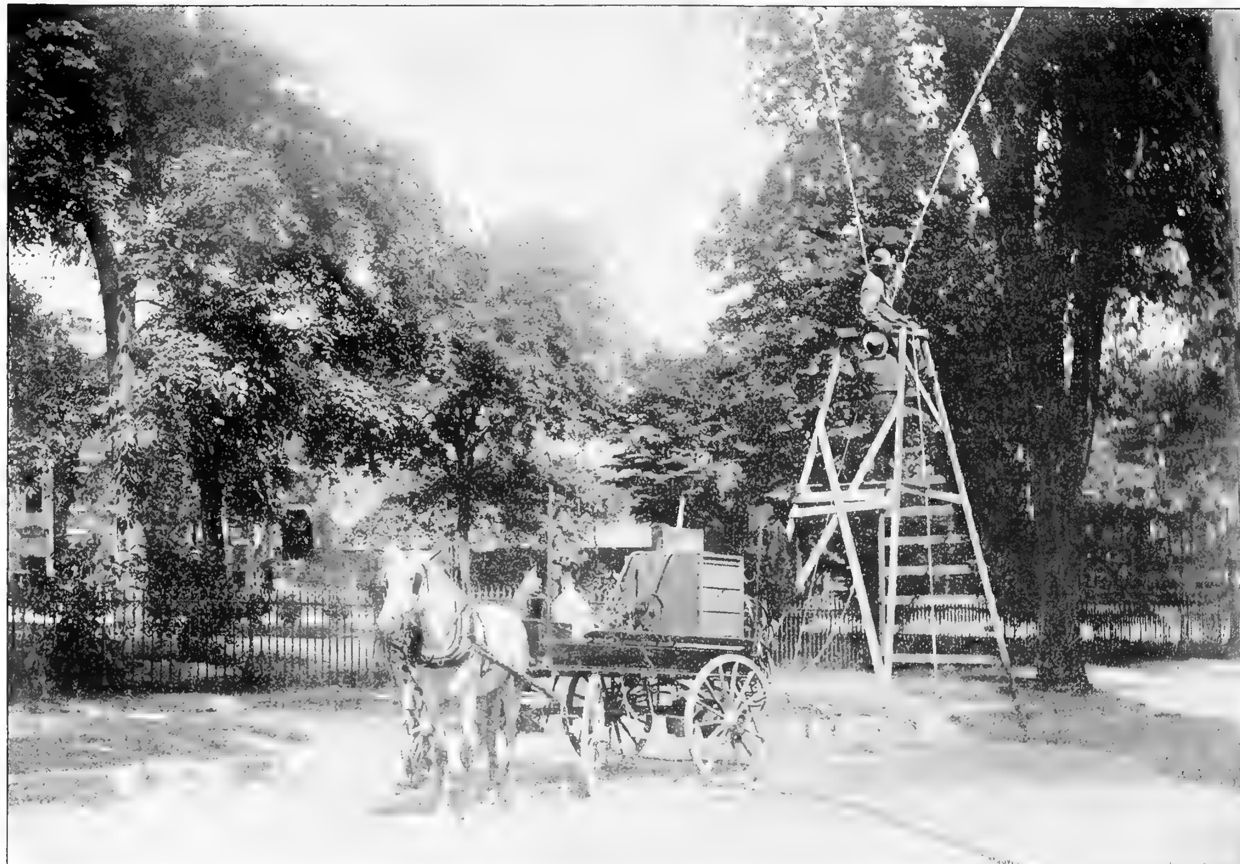


Figure 3.—POWER SPRAYING OUTFIT IN OPERATION.

delay and in practice it is very difficult to have the spraying properly done, and then there may be hindrances incident to several days or a week of rain at the time the poison should be applied.

Not a few wait till the trees show signs of serious injury and then ask for some means of stopping the ravages. Under such conditions, resort may be had to spraying with a larger proportion of poison in order to kill the caterpillars quickly or they may be shaken from the limbs, provided the tree is not too large. The latter means will give a certain amount of relief where practicable and should be supplemented by the use of cotton bands or other means of preventing the ascent of those shaken from the tree.

In order to spray trees successfully, certain rules must be observed. Apply the poison at the time the insects begin to feed and where they must eat it if the tree is attacked. In the case of this insect and the following, it is best to throw the spray on the under surface of the leaves so far as possible, as the young caterpillars prefer the tender lower epidermis. Do thorough work, that is, try to cover every leaf with the mixture and spray till the tree begins to drip, but no more. The finer the spray, the better, as a more even distribution is ensured. The poisonous mixture must be kept agitated while spraying is in progress. While a power spraying apparatus is the best, good work can be accomplished with hand pumps, but plenty of hose must be supplied as a fine spray can not be thrown far and it is, therefore, usually necessary to do more or less climbing. One pound of Paris green, one pound of quicklime, to 150 gallons of water is a very good spraying mixture for this insect. London purple may be used in place of Paris green, if desired. Though costing a little more, arsenate of lead is probably the best poison for most to use, since it adheres an indefinite time to the foliage, its whiteness renders it easily detected, and it can be applied in large quantities without danger of burning the foliage. It is prepared as follows: Dissolve eleven ounces of acetate of lead (sugar of lead) in four quarts of water in a wooden pail and four ounces of arsenate of soda (50% purity) in two quarts of water in another wooden pail. As the acetate of lead dissolves rather slowly in cold water, the process can be hastened by using warm water. Pour the resulting solutions into the spraying tank which should contain about eighty gallons of water. This poison may be used in much larger proportions without the slightest danger of burning the foliage.

Power Spraying Outfit. In the extended work against insects conducted by certain cities and villages, it has been found necessary to have apparatus that will admit of more rapid work than is possible by hand. This has led to the refitting of retired fire engines and the designing of more or less cumbersome outfits for this purpose. In all cases these makeshifts have been successful, though they are not usually so satisfactory in operation as those specially fitted for the purpose. Probably the best apparatus yet designed for spraying trees is that constructed under the direction of Dr. E. B. Southwick, Entomologist of the Department of Public Parks of the city of New York, which is the form used in Albany. The whole outfit is represented in the accompanying figure (3). It consists of a "Daimler" gasoline motor operating a Gould force pump—the motor and pump, weighing but 300 pounds, can be placed in the bottom of a spring wagon along with the one hundred gallon tank containing the poisonous mixture. This motor has the advantage of being almost noiseless in operation and is scarcely noticed by passing horses. It is very inexpensive to operate as a gallon of gasoline is sufficient for a day and it requires little attention. The smallest size Gould three-piston pump is the one used with the motor, though Dr. Southwick now recommends a larger one in order to utilize the power more fully. This apparatus, with the tank, 400 feet of ⅜ inch rubber hose and other necessary fittings, can be bought for about $500. Other engines and pumps could undoubtedly be used and would give excellent results. This power can easily supply four lines of hose, though in Albany it was found that not more than two could be used to advantage in most places.

Forest Tent Caterpillar: Maple Worm.

Clisiocampa disstria Hübn.

Stripping a large proportion of the foliage from maples has been a marked characteristic of this species for the last three years in many sections of New York. In 1897 and 1898, the sugar maples of Delaware, Greene and Otsego counties suffered most severely from the attacks of this pest, large areas being left with hardly a green leaf. The destructive work of this caterpillar in 1899 was more general than in the preceding two years, there having been complaints received from about half the counties in the state, and in some sections the depredations were worse than ever. This species appeared in force in many cities and villages, threatening thousands of handsome shade trees with defoliation, and had it not been for most energetic efforts on the part of local authorities and private individuals, many maples along streets and in parks would have been stripped of leaves. As this native species is generally distributed, its comparative abundance in a locality is due to natural causes, favorable or otherwise, and very rarely can it be said that the insect has migrated to any extent, except in a very local and restricted sense.

Description. This insect can be distinguished at once from the common apple tree tent caterpillar, *Clisiocampa americana* Fabr., by the fact that no conspicuous web tent is spun. This caterpillar (Plate 1, figure 13) has a row of somewhat diamond

Figure 4.—SUGAR ORCHARD DEFOLIATED BY FOREST TENT CATERPILLARS, ARKVILLE, DELAWARE COUNTY, JULY 8, 1898.

shaped, whitish spots down the middle of the back, while its close relative possesses a narrow whitish stripe in place of the dots. The egg belts (Plate 1, figure 12) encircling the more slender twigs, are smaller, usually with one or two wrinkles or depressions in the brownish, protective covering, and the ends of the belts are more abrupt than are those of the species usually found on apple trees. An average sized egg belt, collected in Albany, of the forest tent caterpillar contains about 150 eggs. If an egg is opened in September or later, a well developed, nearly black caterpillar with a few whitish hairs may be seen. The recently hatched caterpillars are nearly black with whitish hairs and are found clustered together or traveling along certain silk lined paths. After the second molt, the characteristic row of whitish spots along the back appears and as the caterpillars increase in size, the colors become brighter and more distinct. The white or yellowish white cocoons (Plate 1, figure 14) are spun in leaves on the tree or lying on the ground, in crevices of the bark, under stones, in fence corners and under almost any convenient shelter. Within the cocoon is found the dark brown pupa (Plate 1, figure 15). The moth is a light, buff colored, active creature (Plate 1, figures 10, 11). The male may be recognized by his richer coloring, smaller size and feathery antennæ (Plate 1, figure 11).

Life History and Habits. The winter is passed by the well developed larva within the egg shell. On the appearance of warm weather, the young caterpillars begin to emerge and if no food is at hand, await the unfolding of the leaves. From eggs received in early spring, young caterpillars emerged April 17. There is considerable latitude in the time of hatching, even in one locality, about a month as reported by V. H. Lowe, and there is a corresponding variation in the time the caterpillars attain maturity. As the young increase in size, they molt from time to time, leaving their cast skins in small clusters on the bark (Plate 1, figure 16). When not feeding, the larvæ may be found in clusters on the limbs. They also resort to such places when about to molt, an operation requiring at least a day or two. A wind or jarring causes these creatures when small to drop and suspend themselves with a silken thread, a position very annoying to persons obliged to pass under an infested tree, and as many shade trees were attacked last summer, this feature was painfully apparent. If the shock is sudden the caterpillars drop without spinning a web. As they become about half grown, they frequently form good sized clusters on the larger limbs and trunk of an infested tree. If the creatures are very abundant, they may strip the tree before full growth is attained and then be forced by hunger to invade neighboring orchards. The maple leaves represented on plate 1 show well the work of this insect. Ordinarily, as the caterpillars approach maturity, many of them forsake the tree and crawl in all directions. Thus in obedience to a natural impulse, they may crawl in numbers over walks, piazzas and swarm on sides of houses. This wandering, prior to

Explanation of Plate 1.*

White Marked Tussock Moth (*Notolophus leucostigma* Abb. and Sm.).

1. Full grown caterpillar.
2. Male moth at rest.
3. Female moth laying eggs on her recently vacated cocoon.
4. Several cocoons.
5. Cast skins of caterpillars.
6. Work of young caterpillars on under surface of leaf.
7. Male pupa.
8. Branch girdled by caterpillar.
9. End of branch broken off at the point where it was girdled.

Forest Tent Caterpillar: Maple Worm (*Clisiocampa disstria* Hübn.).

10. Female moth.
11. Male moth.
12. Egg belt encircling twig.
13. Full grown caterpillar.
14. Cocoon in a leaf.
15. Pupa.
16. Cast skins of caterpillars.

* Plates 1–3 were executed from nature, under the author's direction, by Mr. L. H. Joutel of New York city.

PLATE 1

pupation, occurs about June 1, the transformation to the pupa taking place from about the middle to the last of June. The insect remains in the pupa state about two weeks, the moths appearing the latter part of June and during July, mostly in the latter month. The eggs are deposited during July, a large proportion of them being laid on the lower twigs, but many are found over twenty feet from the ground and numbers even in the tops of tall trees.

Food Plants. Like the apple tree tent caterpillar, this insect can subsist on a large variety of plants. Its favorite species of oak in the southern states, as given by the late Dr. Riley, are those belonging to the same group as the black oak. In New York and adjoining states this insect is reported more frequently as defoliating the sugar maple than any other tree. This may be owing to the fact that large sugar orchards afford the most favorable conditions for the caterpillars in the north, and as the maples are of greater value than forest trees, complaints of attack are more frequent. The caterpillars have been reported by various writers as feeding upon the following trees and shrubs: Linden, maples, locust, peach, plum, cherry, rose, strawberry, apple, sweet gum (*Liquidambar styraciflua*), dog wood, "black gum," sour gum (*Nyssa sylvatica*), ash, elm, black walnut, hickory, walnut, oak, black oak, post oak, white birch, gray birch, willow and poplar.

Natural Enemies. Like the preceding, this species has a number of important natural enemies. A fungous disease is known to attack this caterpillar, but at present little has been done in attempting to disseminate it. One of the most fruitful methods of keeping the pest in check through the aid of its natural enemies, will probably be found in encouraging and protecting the native birds known to feed on it. Robins, orioles, chipping sparrows, cat birds, cuckoos, the red eyed, white eyed and warbling vireos, cedar birds and nuthatches have been observed feeding on forest tent caterpillars by Miss Caroline G. Soule. "The nuthatches would stand by a patch of larvæ lying close together below a tar band on a tree and eat so voraciously and with such an entire abandonment of self-consciousness that I could go close and put my hand on them before they would fly. This experience was repeated several times." Mr. E. H. Forbush, Ornithologist to the Massachusetts State Board of Agriculture, has kindly supplied me with the following list of native birds observed by him feeding on forest tent caterpillars: Oriole, black billed cuckoo, yellow billed cuckoo, crow, blue jay, redstart, nuthatch, wood thrush, chewink, black and white creeper, red eyed vireo, flicker and scarlet tanager. Mr. V. H. Lowe has observed the black capped chickadee feeding on the eggs and the

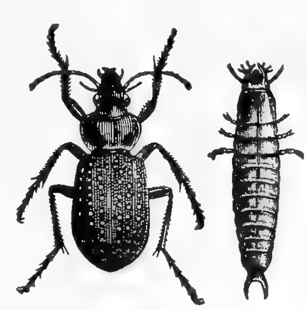


Fig. 5.—FIERY GROUND BEETLE. (After Riley).

robin on the caterpillars, beside others mentioned above. Professor C. M. Weed states that the robin, chipping sparrow, yellow bird and English sparrow feed on the moths.

The value of birds in keeping other pests under control is also strikingly shown in the experiment conducted by Mr. Forbush. In a typical orchard at Medford, Mass., a little trouble was taken to attract the native birds, the nests of the English or house sparrow being destroyed. The results were greatly in favor of protecting our indigenous forms. In the neighboring orchards it was evident that canker worms and tent caterpillars were very numerous, but in the orchard in question, the trees were seriously injured in only one or two instances, though no attempt was made to control the insects by spraying or other artificial means.

Our native birds are undoubtedly of great value and will richly repay any slight effort that may be made for the purpose of attracting them to a locality. Winter birds

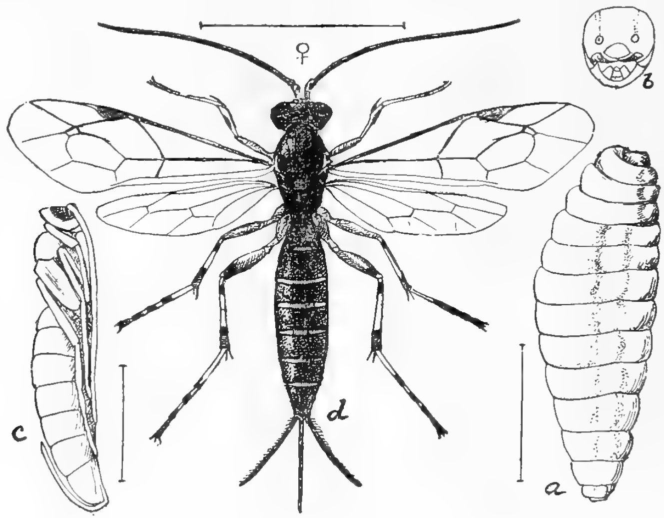


Figure 6.—PIMPLA CONQUISITOR: *a*, larva; *b*, head of same; *c*, pupa; *d*, adult female—all enlarged. Lines beside figures represent natural size. (After Howard: U. S. Department Agriculture, Division Entomology, Tech. ser. No. 5, 1897.)

may be induced to remain in a neighborhood by hanging in the trees pieces of meat or partially picked bones, and will spend much time in searching out and devouring numerous insects and their eggs, relying on the meat only when conditions are unfavorable for obtaining insect food. Migratory birds may be induced to remain in large numbers in a locality by providing them with suitable nesting places and materials, and by protecting them from cats and cruel boys. Thickets in the vicinity will afford shelter for certain species and if a few mulberry trees are set out, their fruit will serve to protect cherries, as the birds are said to eat the mulberries by preference. Most of these suggestions are taken from a very practical paper by Mr. Forbush.

A number of insects prey on this caterpillar. Several fierce ground beetles do valiant work in this way. The beautiful fiery ground beetle, *Calosoma calidum* Fabr., and *C. scrutator* Fabr. are the two species specially known as enemies of the forest tent caterpillar. Several parasitic flies attack this pest and a number of hymenopterous insects. Of the latter, one of the most important parasites is known as *Pimpla conquisitor* Say, which is represented in the accompanying figure. Whenever cocoons of the forest tent caterpillar are collected, they should be placed in a box and covered with a rather coarse wire netting, about $\frac{3}{16}$ inch mesh, so as to confine the moths but allow the beneficial parasites to escape.

Remedies. As a large proportion of the eggs of this species occur on twigs within twenty or thirty feet of the ground, something can be accomplished in winter by cutting off the infested twigs and burning the egg clusters, specially if the trees are not very large. But in the case of good sized maples, it is very doubtful if this could be done to advantage, and even with moderate sized trees there would probably be enough inaccessible egg belts near the top to stock the trees with a host of leaf consumers. At best, the collection of eggs can hardly be regarded as more than one of several repressive methods, no one of which can be depended upon in itself to prevent serious injury. The egg belts can be seen best on a bright day and if there is snow on the ground, it will be easier to find all cut twigs dropped to the ground. The collection and burning of the eggs is necessary in order to insure thorough work. A long handled pruning hook is of great service in cutting off the infested twigs.

As soon as the presence of the young caterpillars (indicated by the thinness of the foliage on the upper branches) is detected, much can be accomplished by crushing them as they collect on the limbs or by dislodging them with a brush or torch. If the latter is used, care must be exercised not to injure the tree. Many caterpillars can be jarred from the tree by using a padded mallet, or even violent shaking will cause some to drop. Driving the caterpillars from the trees by jarring or otherwise, must be followed up by some means of preventing their ascent. A band of cotton batting eight to ten inches wide tied tightly in the middle around a tree and the upper portion turned down over the string and allowed to hang loosely, is a difficult obstacle for caterpillars to surmount, so long as it remains dry. Wide bands of paper coated with tar or of sticky fly paper will also prevent the pests from ascending for a time. A band composed of equal parts of lard and sulphur is said to be an effective barrier. In one locality bands of cottolene were used to prevent the caterpillars from climbing the trees. When the pests are very abundant, it will not do to depend entirely upon shaking and bands, the dropping creatures must be collected on sheets spread under the trees before they are jarred, and then killed, or crushed as they collect under the bands. Nothing but the most vigorous measures will protect a badly infested tree from severe injury. The masses of caterpillars found on the larger limbs and trunk can be crushed in large numbers with a stiff broom or thickly gloved hands. A more agreeable method is spraying these clusters with kerosene emulsion, whale oil soap solution (one pound to four gallons), or pouring boiling water over them. For methods of preparing kerosene emulsion, see a subsequent page.

Thorough spraying with any one of the poisons described on a preceding page and in the manner directed, will kill these caterpillars very quickly. If they are nearly full grown and many are crawling to the sprayed trees from others, it is perfectly possible that all the foliage may be devoured before the caterpillars have eaten enough poison to kill them, but under most circumstances there need be little fear of the arsenical spray proving ineffective. The cost attendant upon this method will lead people to depend largely on other means. Even a hand spraying outfit requires some outlay, while if many trees are to be sprayed a power outfit, described on a preceding page, is the most economical in the long run.

After the damage has been done, many of the insects are within man's power and can be killed in their cocoons. From about the middle to the last of June, thousands of cocoons can be collected with little labor, and if this is done, opportunity should be given the parasites to escape before the cocoons are destroyed, as stated on a preceding page. Every healthy female pupa killed means one less egg mass to produce its approximately 150 hungry caterpillars another spring. During the summer of 1899, many hundreds of cocoons were collected and destroyed. Local authorities in Glens Falls, Saratoga Springs and several other villages offered the school children ten cents a quart for these cocoons. In Glens Falls, alone, 1,350 quarts of cocoons were destroyed through the efforts of the school children.

Leopard Moth.

Zeuzera pyrina Fabr.

In New York and vicinity, dead limbs may frequently be seen projecting above the leafy masses of many trees. These dead limbs and the sudden wilting of living ones are, in most cases, the effects of the destructive borings of the caterpillar of the leopard moth. This is probably the worst insect enemy of shade trees in the vicinity of New York city. It not only bores in slender twigs, but as the caterpillar increases in size it enters larger limbs and frequently works serious injury in the trunk before attaining its growth.

Description. This insect is most easily recognized in connection with its work. Boring within the smaller twigs, there may be found a pinkish or white caterpillar about three eighths of an inch long, with numerous well defined, darker spots or tubercles on its body, a brown head and thoracic shield and an anal shield of nearly the same color. Short hairs grow from the tubercles and are also found about the head and posterior extremity. The burrows in the larger limbs and trunk may contain caterpillars over three inches long, nearly white, and with larger, more distinct spots or tubercles than in the earlier stages (Plate 2, figure 4). The beautiful white moths marked with blue and black are well represented, the female, with wings folded at 2 and the male with them expanded at 3, on plate 2. The salmon colored eggs are about the size of a common pin head and in captivity are deposited in a large mass.

History and Distribution in America. This insect is another of the bad pests accidentally introduced within recent years. The earliest authentic record of its presence in America is the brief note given by Jacob Doll in *Papilio*, for February, 1882, stating that he had taken a living example in a spider's web the preceding June at Hoboken, N. J. Its destructive work was observed in 1884 by Dr. E. B. Southwick in Central Park, New York city. It was taken in 1887 at Newark, N. J., and in 1889 at Arlington and Orange, N. J. Col. Pike, in 1892, after describing the widespread ravages of the insect in Brooklyn, reported it as present at Astoria, New Rochelle, Jamaica, New Lots and Flatbush, and at a later date stated that the pest had made its way to almost all parts of Long Island and had extended into Connecticut. In 1894, Dr. Southwick characterized this pest as "one of the worst insects we have to contend with." Mr. L. H. Joutel of New York informed me recently that this species was present at Kensico, Westchester county, some 25 miles north of New York city. As this insect occurs in southern and central Europe and possibly in southern Sweden, we may expect the pest to make its way farther north. On this account, the last American locality given has exceptional interest, showing, as it does, that this borer is working northward. It is yet early to state how fast the pest will spread, but it will certainly do no harm to keep on the watch for the appearance of the insect in new localities in the state. Searching for indications of the borer's presence along the Hudson River will probably result in its detection in several new localities.

Life History and Habits. Moths may be taken from early June till the latter part of September. European authorities state that the female places her eggs in crevices of the bark in branches as well as the trunk. Since the young caterpillars frequently enter the twigs at the base of a bud (Plate 2, figure 11*a*), it seems quite probable that many of the oval, salmon colored eggs may be thrust between the stem and bud or under a bud scale. Several observers have noted the deposition of about 300 eggs by the female in confinement and some writers estimate that she may deposit as many as 1,000 eggs. When a young caterpillar enters a twig, it usually tunnels along the pith, eating away the wood here and there almost to the bark. The expelled frass at the

Explanation of Plate 2.

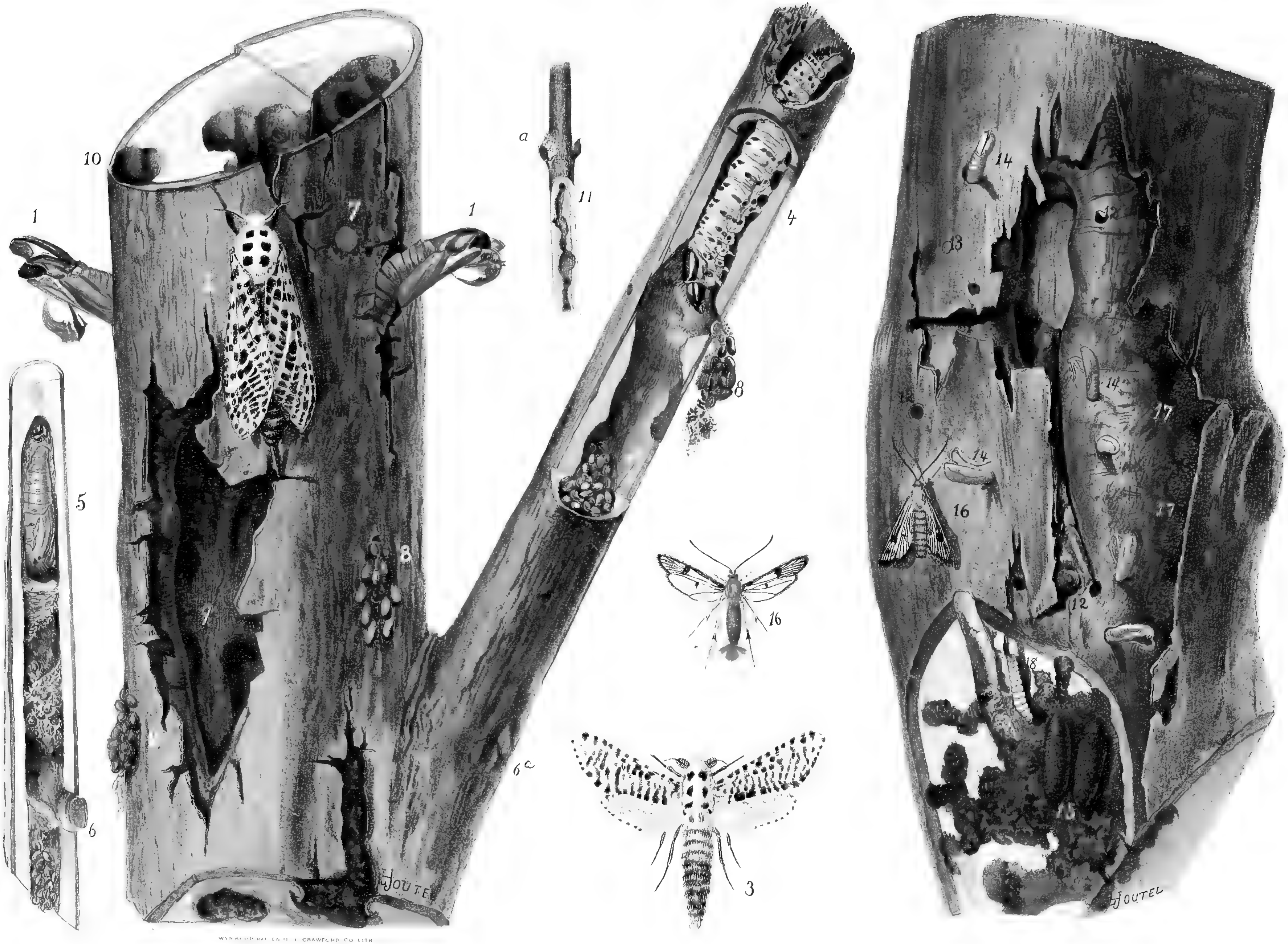
Leopard Moth (*Zeuzera pyrina* Fabr.).

1. Empty pupal case from which female moth has emerged.
2. Female moth with wings folded.
3. Male moth with wings expanded.
4. Nearly full grown caterpillar, probably a female.
5. Male pupa in its burrow.
6. Exit hole covered by a loose piece of bark which the pupa will push off as it partly emerges. 6*a*. Another.
7. Hole made for the pushing out of excrement and then closed by a silk web.
8. Same as above, but in use and with particles of excrement dangling by silken threads.
9. Work of caterpillar a preceding season.
10. Work of caterpillar the present season.
11. Young twig eaten by larva, point of entrance at *a*.

Maple Borer (*Sesia acerni* Clem.).

12. Hole from which pupal case has fallen.
13. Bark nearly eaten through ready for the pupa to push out.
14. Empty pupal skin.
15. Two cocoons as spun.
16. Moths expanded and at rest.
17. Excrement of caterpillars.
18. Caterpillar in its burrow.

PLATE 2



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JOUTEL

base of the bud indicates the point of entry. As the caterpillar works along the twig, it occasionally makes an opening for the expulsion of its frass, see plate 2, figure 8. After they have served their purpose, these orifices are closed by a web of silk, as represented at figure 7 on plate 2. This singular habit of closing these holes when no longer needed, probably affords considerable protection from insect parasites and it would also tend to prevent birds from finding the caterpillars so readily. The smaller twigs frequently wilt and break as a result of the work of this borer. The latter part of September caterpillars three eighths of an inch long were found, having probably hatched from eggs laid the latter part of the summer, and the larger borers, about one inch long, from eggs deposited earlier in the season. These creatures have a habit of leaving their burrows, wandering to another part of the limb or even to other branches, and commencing operations anew. As they increase in size, larger limbs are attacked and nearly full grown caterpillars are frequently found in the trunk. In the larger limbs and in the trunk, these borers make very bad work. Sometimes a caterpillar will nearly girdle a tree with a burrow just under the bark. Frequently several burrows run side by side, as represented in figure 10, plate 2. Many of the caterpillars will keep gnawing away just under the bark till an irregular chamber the size of a man's hand has been made. The bark covering these large wounds soon dies, breaks away and the following season there is an ugly scar, as represented at figure 9, on plate 2. In a short time small trees harboring several of these creatures are quickly girdled. Two years are required to complete the life cycle, according to most authorities. The first winter is passed by the small caterpillar, usually less than an inch long, in its burrow. The second winter it is nearly full grown (Plate 2, figure 4). The transformation to the quiescent pupa (Plate 2, figure 5) takes place in the burrow, the bark having previously been eaten nearly through by the caterpillar. Before the adult appears, the pupa works itself partly out of the burrow (Plate 2, figure 6) and the moth emerges, leaving the empty pupal case as represented at figure 1, plate 2.

This pernicious borer has been recorded as attacking eighty-three species of trees and shrubs. According to the observations of Dr. E. B. Southwick, Entomologist to the Department of Public Parks of New York, the elms and maples are most subject to attack, the horsechestnut, Ohio buckeye (*Æsculus glabra*), beeches, birches, dogwood, hickories, oaks, and walnuts suffering in the order named. Almost every species of tree and shrub in Central Park, except evergreens, was injured to some extent.

Remedies. Something can be accomplished by the destruction of the rather sluggish females before eggs are deposited. This is of most value where there are only a few small trees. In localities where this insect occurs, trees should be examined three or four times a year. The wilting of smaller twigs and the strings of expelled frass indicate the presence of this borer. Smaller infested branches can be cut off and burned, but as the caterpillars leave their burrows on slight provocation, their destruction should not be delayed long after cutting. Limbs broken off by storms should be collected and burned, as they frequently contain caterpillars of this pest. The borers in larger branches or in the trunk should be cut out and destroyed whenever possible. In some cases they may be killed in their burrows with a flexible wire. Dr. E. B. Southwick, who has had considerable experience in fighting the pest in Central Park, New York, has found that it pays to use carbon bisulfid on the more valuable trees. The insecticide is carried in an oil can and when a caterpillar can be located, the chemical is inserted in the burrow and the hole sealed with putty. The deadly fumes soon make their way to the borer and kill it with little or no injury to the tree. As the carbon bisulfid is very volatile, its vapor inflammable and explosive, great care must be taken to keep it from all fire. Mr. M. F. Adams of Buffalo, N. Y., who has tried some experiments in fighting borers, recommends the use of newly made hard soap in the place of putty for plugging the holes after the carbon bisulfid has been inserted.

Maple Sesian.

Sesia acerni Clem.

The riddling of the new tissues around healing wounds on maples is usually the work of this borer. The round holes through the injured bark and the brownish, powdery borings are very characteristic of this insect's work. This pest has a special fondness for the tissues growing over wounds, though occasionally it may be found operating on comparatively smooth trunks. It is generally distributed over the state and evidences of its work occur in many localities. Trees wounded from any cause find great difficulty in the comparatively simple process of covering exposed wood with bark after being attacked by this insect. Thus relatively insignificant wounds result in scars constantly increasing in size and finally in a badly disfigured, gnarled maple. When abundant, these creatures may nearly girdle a tree. Very serious complaints regarding this pest have been made in Michigan, Missouri, and even in Buffalo, N. Y., and it has been stated that this insect annually causes much damage to hard maples.

Description. These beautiful, wasp like, red tailed moths (Plate 2, figure 16) are not often seen by the casual observer. An infested tree frequently presents the appearance represented on plate 2. Near a partly healed wound there may be found a number of round holes (Plate 2, figure 12) and considerable brownish, powdery matter (Plate 2, figure 17), the excrement or frass of the borers. Empty pupal cases may frequently be seen in early fall projecting from the trunk as represented at figure 14, plate 2. On cutting into the injured wood, a whitish, brown headed caterpillar (Plate 2, figure 18) about one half inch long may be found in the latter part of the summer. In the early spring the silken frass covered cocoons (Plate 2, figure 15) may be found in the burrows.

Life History and Habits. The moths are most abundant at Buffalo, N. Y., from May 20 to June 15, according to the observations of the late Dr. D. S. Kellicott. The males have been seen by Mr. L. H. Joutel flying up and down the trunk of infested trees looking for a partner in much the same way as does the male of the lunate long sting, *Thalessa lunator* Fabr. The eggs are deposited on the bark of both soft and sugar maples, the female preferring as a rule to place them on roughened areas, specially in the vicinity of wounds, if one may judge from the injury inflicted. The eggs soon hatch and the young borers commence operations in the bark and sap wood. In the fall most of the caterpillars are about one half inch long and can easily be found in their burrows. The cavities made by the borers are nearly filled with frass. In the spring the caterpillar completes its growth, eats its way nearly through the bark (Plate 2, figure 13), then retires into its burrow, spins a loose silken cocoon and changes to a pupa. Shortly before the adult emerges, the pupa works its way partly out of the burrow, rupturing the thin piece of bark covering the outlet of its retreat in the operation, and the moth escapes, leaving the pupal case as represented on plate 2, figure 14.

This pest attacks both hard and soft maples. In some localities it is reported as most injurious to the former, in others to the latter. In Albany its work is most evident on soft maples. Woodpeckers are efficient aids in keeping this pest in check in forests, according to the late Dr. Kellicott.

Remedies. As the parent moth shows a marked inclination to deposit eggs on rough bark, the trees should be protected from injury by horses, boys and other agencies and the trunks kept as smooth as possible. The caterpillars bore near the surface and are easily dug out and destroyed. Infested trees should be inspected the latter part of the summer and the borers killed. The wounds in the trees should be carefully covered with grafting wax, paint or other protective substance. A plaster made of fresh cow dung and lime has been used for this purpose with excellent results. The deposition of eggs could probably be prevented to considerable extent by treating the trunks of the trees about the middle of May with a wash prepared as follows: Thin one gallon of soft soap with an equal amount of hot water and stir in one pint of crude carbolic acid (one half pint refined), let it set over night and then add eight gallons of soft water. Apply thoroughly to the trunk, specially about all crevices and wounds, from the ground to about six or eight feet high, and renew if necessary before the middle of June.

Sugar Maple Borer.

Plagionotus speciosus Say.

Sugar maples along the roadsides in the state of New York probably have no more serious insect enemy than this pernicious borer. The attacks of other insects upon our maples, specially the depredations of the so-called maple worm or forest tent caterpillar, *Clisiocampa disstria* Hübn., are from time to time pictured in most glowing colors, and while these other pests undoubtedly cause much injury, the fact remains that the sugar maple borer is quietly and unobtrusively carrying on its deadly work and in a series of years probably kills more of these popular shade trees than any other insect pest. In almost every city and village where sugar maples adorn the roadsides, evidences of the work of this borer are very apparent and in many of these places dead or nearly ruined trees are by no means scarce. The unthrifty condition of these maples is frequently attributed to drought, fungous diseases, leaking gas, pavements impervious to water, etc., whereas, in fact, the true depredators are gnawing within the trees.

Character of the Injury. Unlike many borers, this insect attacks trees in full vigor. The powerful, legless grub confines its operations largely to the inner bark and sap wood, and as it runs a burrow several feet long in one season, and as one borer will frequently work transversely half around a tree some eighteen inches in diameter, the dangerous character of this pest is at once apparent. The bark over the burrow, be it either a longitudinal or a transverse one, dies and the growing tissues forming underneath in the natural process of healing push the dead bark out, cause it to break and in the course of a year or two an ugly, naked scar is produced. A large patch of bark may be killed by several borers working near each other or possibly by one doubling back and forth, and the result is a large, unsightly area of exposed wood. The injury produced by a transverse burrow is shown at figure 7, and a blasted area resulting from the doubling of a borer or of the work of several near together is shown at figure 8. Two or three borers in the same trunk are very likely to nearly girdle a tree, if they do not kill it outright. Infested maples frequently have one or more large limbs killed by this pest. The base of the limb is girdled in the same way as the trunk, the first intimation of trouble in this manner usually being a sudden wilting of the foliage, followed by the leaves drying up and falling.

Description. The parent insect is a beautiful stout beetle about one inch long. It is black, brilliantly marked with yellow, as represented at figure 4 of plate 3. The borer or larva is a whitish, flattened, footless grub with brownish mouth parts. Small ones (Plate 3, figure 2), about one half inch long, are found in September just under the bark and come from eggs laid the same season. The nearly full grown borer (Plate 3, figure 3) is about two inches long, white, with some rosy tints and in other respects closely resembles the smaller ones.

Life History and Habits. The parent insects or beetles occur from the latter part of June till into August. Most of the eggs are probably laid during the latter two months. The place of oviposition (Plate 3, figures 1, 1*a*) may be recognized by the irregular discoloration of the bark, caused in part by the sap flowing from the wound and partly from the expelled frass or excrement, the latter often hanging in small

Figure 7.—Injury produced by a transverse burrow in a sugar maple about eighteen inches in diameter (original).

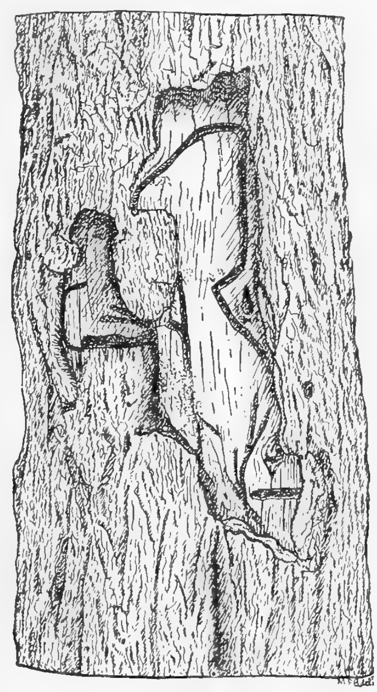


Figure 8.—Large dead area produced by the intersection of several burrows. Tree about fifteen inches in diameter (original).

masses from the point of entrance. I have found burrows about thirty feet from the ground, but most of them occur in the trunk or near the base of the larger limbs. The latter seems to be a favorite place for the deposition of eggs. The young borer passes the winter in a rather shallow excavation in the sap wood, the following spring renewing operations with increased vigor. The boring of the second season is largely just under the bark, the burrows being about one half an inch in width and one third of an inch in depth, and running in almost any direction, though usually longitudinally or obliquely upward and partly around the tree. Sometime during its life, probably in the second fall when the borer is about sixteen months old, a deep burrow is made,

Explanation of Plate 3.

Sugar Maple Borer (*Plagionotus speciosus* Say).

1. Place where egg was laid, showing excrement or borings thrown out by borer. 1*a*. Another more than normally discolored.
2. Borer or grub in September from egg laid the same season.
3. Nearly full grown borer.
4. Adult or beetle.
5. Hole through which the beetle escaped from the trunk.
6. Sawdust or borings packed in burrow.

Maple Tree Pruner (*Elaphidion villosum* Fabr.).

7. Grub or borer in its burrow, a portion of the twig being cut away to show its work. 7*a*. Small twig with only a thin shell of bark, the wood being nearly all eaten.
8. Pupa in the burrow. The base of both twigs represented has been nearly eaten off by the larva.
9. Adult or beetle.

Cottony Maple Tree Scale Insect (*Pulvinaria innumerabilis* Rathv.).

10. Active or recently hatched young.
11. Adult females, many eggs can be found in the woolly masses.
12. Leaf with many young scales on its under side.

PLATE 3

usually penetrating about four inches in an upward, oblique direction toward the heart of the tree and then running some distance parallel with the grain of the wood, as represented in figure 9, which was drawn from a photograph. At the end of this deep burrow the larva transforms to a pupa and from that to a beetle, the beautiful adult emerging from the trunk through an oval hole (Plate 3, figure 5) about three eighths by five eighths inch in diameter.

The only natural enemies observed preying on this insect are woodpeckers. Dr. Packard records having seen them at work. Mr. A. H. Kirkland has seen the hairy woodpecker, the downy woodpecker and the flicker feeding on white larvæ taken from beneath the bark of infested trees.

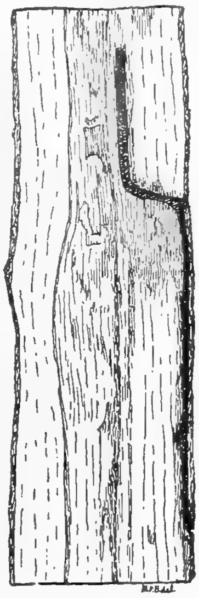


Figure 9.—Deep burrow in which the grub transforms to the beetle (original).

Associated Insects. As previously pointed out, the sugar maple borer attacks trees in their prime. It is well known to students of nature that an enfeebled plant invites insect injury by presenting favorable conditions for their multiplication. Trees suffering to any extent from the attack of the sugar maple borer are usually infested with the pigeon Tremex, *Tremex columba* Linn., a species which assists materially in the destruction begun by the beetle. The pigeon Tremex is a magnificent four winged fly about two inches long, with a wing spread of two and one half inches, and a prominent horn at the extremity of the abdomen; hence the common name of "horn tail" is frequently applied to this insect and its allies. This species may be recognized by its cylindric dark brown abdomen with yellow markings as represented in figure 10.

The larva or borer producing the pigeon Tremex may be distinguished at once from that of the sugar maple borer by its cylindric form, the possession of six legs on the three anterior body segments and by its making a nearly round burrow. The perfect insects make their way out of the tree through holes about the size of a common lead pencil, and during the summer months are frequently found around diseased maples and elms, sometimes with the ovipositor bent at right angles to the body as the female is inserting it for the purpose of laying eggs. This insect can hardly be regarded as very injurious since its operations are confined largely to unhealthy trees.

There is also another insect commonly found around trees badly infested with the pigeon Tremex, drawn there by the presence of its prey, the larva of the pigeon Tremex. The lunate long sting, *Thalessa lunator* Fabr., is a slender, brown and yellow insect about one and one half inches long and with a delicate "tail" or ovipositor about three inches long, whence its common name of "long sting." This beneficial parasite may frequently be seen with its long ovipositor arched over its back, and the membranes of its abdomen much distended as it forces its slender tool deep into the wood in an effort to place its eggs in the vicinity of a borer. The male is a smaller insect. On splitting open a log containing Tremex larvæ, the white, legless maggots of this parasite may be found sucking the life fluids from the borers. Like the Tremex, the females of the long sting emerge from the trunk of the tree

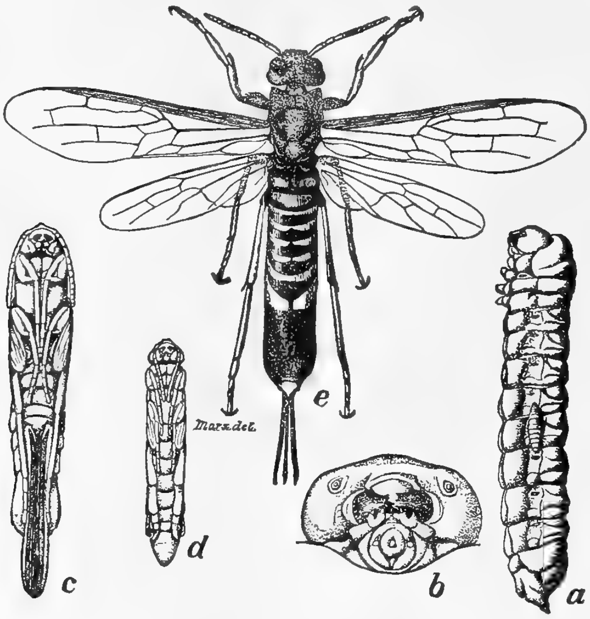


Figure 10.—PIGEON TREMEX: *a*, larva showing the Thalessa larva fastened to its side; *b*, head of larva; *c*, pupa of female; *d*, male pupa; *e*, adult female—all slightly enlarged. (After Marx.)
(Insect Life, Vol. I., Fig. 39, U. S. Dept. Agriculture.)

through holes about the size of a common lead pencil. The various stages of this interesting parasite are well represented in the accompanying figure (11).

Remedies. Badly infested trees should be cut and burned before the following June in order to prevent the maturing of the insects they contain. If the trunks of shade trees were treated early in July with the carbolic acid wash described on a preceding page, it is probable that deposition of eggs would be prevented to a considerable extent. Indications of oviposition should be looked for in the fall most carefully and the young borers should be dug out and destroyed. Wherever signs of recent boring occur, an attempt should be made to find the offender. The digging out will rarely do more injury than the borer would otherwise cause. If there is reason to believe a burrow inhabited but no larva can be found, the use of carbon

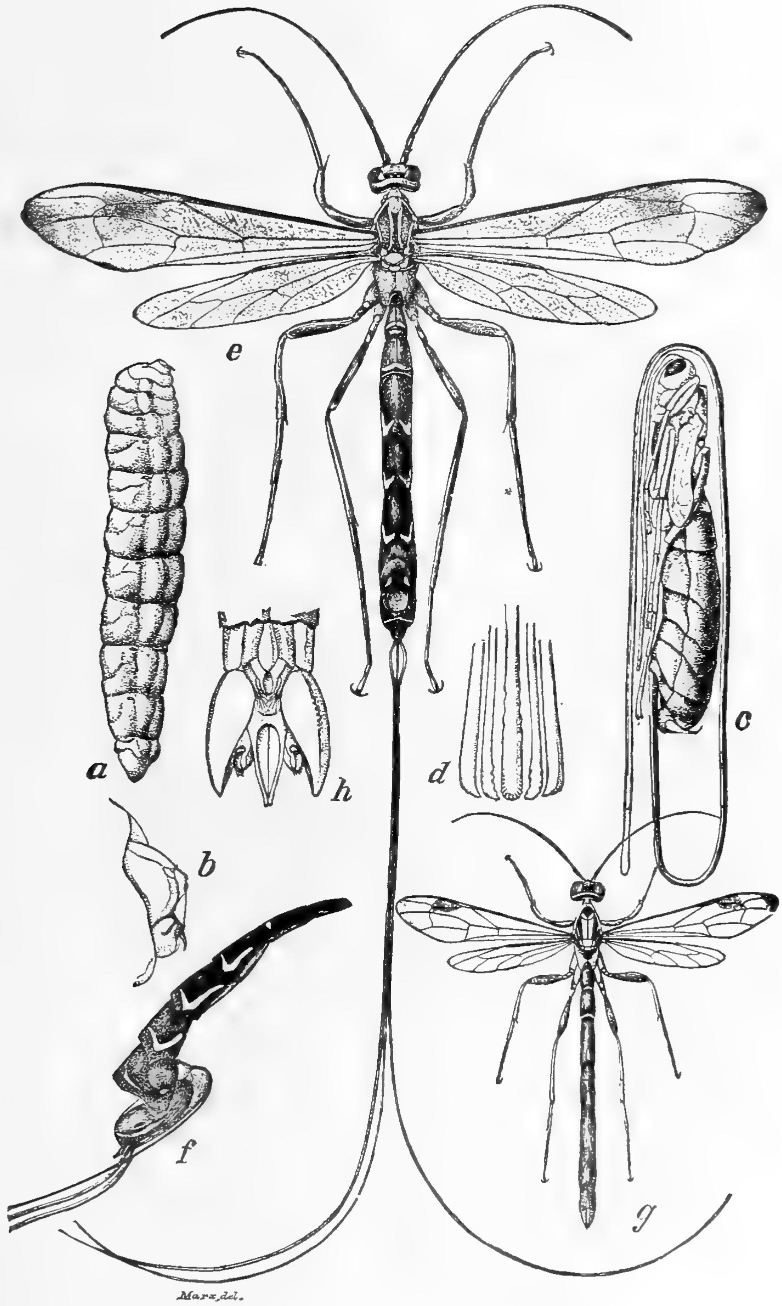


Figure 11.—The lunate long sting, THALESSA LUNATOR: *a*, larva; *b*, side view of head; *c*, pupa; *d*, tip of pupal ovipositor showing the five parts; *e*, female; *f*, side view of female abdomen; *g*, male; *h*, anal extremity of male, enlarged. (After Marx.)

(Insect Life, Vol. I, Plate 1, U. S. Dept. Agriculture.)

bisulfid, as described on a preceding page, is recommended. The sudden wilting of the leaves of a branch indicates that a borer is girdling it and an effort should be made to find the creature. Wounds made either by the borer or by a person looking for it, should be cleaned and plastered with a cement of fresh cow dung and lime, in order to hasten their healing.

In sugar maple groves, Mr. Kirkland advises that the underbrush be left as much as possible, as he has observed that the clearing up of the shrubbery has repeatedly been followed by severe injury from this borer. As the beetles are known to be sun loving insects, it is very probable that they would place their eggs where the conditions were most pleasant.

Maple Tree Pruner.

Elaphidion villosum Fabr.

This insect probably attracts more attention than any other species causing the same amount of damage. As a general rule it is not very injurious, except possibly to shade trees on lawns and along roadsides where symmetry and beauty are desirable requisites. Aside from damage to the trees, the falling twigs are a source of annoyance and form the one sign of the insect's presence most commonly noted.

Description. This species, like some others, is most easily recognized in connection with its work. A fallen twig is found to have its larger end nearly eaten off, as represented on plate 3, the cutting being nearly as smooth as that of a sharp chisel. The central burrow is plugged with sawdust and if the twig be whittled, a large proportion of its interior will be found eaten away and somewhere in the burrow there is usually a whitish grub with brown jaws (Plate 3, figure 7), our carpenter. The parent beetle is a rather slender, grayish brown insect (Plate 3, figure 9).

Life History and Habits. The parent insect is said to deposit in July an egg in one of the smaller twigs. The young larva feeds for a time on the softer tissues under the bark, packing its burrow with castings and working toward the base of the twig. Later it bores along the center of the limb, making a more or less oval channel. In the early fall our borer quietly eats away a large portion of the woody fiber, plugs the end of its burrow with castings and waits for a high wind to break off the nearly severed branch. In this manner the larva reaches the ground in safety. Late in the fall or in the early spring the change to the pupa takes place, the transformation to the perfect insect occurring in the spring, the beetles emerging from the limbs in June and continuing abroad till September. Occasionally the insect completes its changes in the portion of the limb remaining on the tree, but as a rule it drops with the severed branch. The life cycle is probably completed under natural conditions in one year, though when breeding in dry twigs the period may be considerably extended.

This twig pruner not only attacks maple and oak, two of its favorite food plants, but has also been recorded from a number of others. A few of the more important are: Apple, pear, plum, peach, grape, quince, orange, osage orange and hickory.

Remedies. The fallen branches usually contain the larva and should therefore be collected and burned sometime during the winter.

Cottony Maple Tree Scale Insect.

Pulvinaria innumerabilis Rathv.

This species is generally distributed throughout the greater part of the state, and occasionally becomes excessively abundant; specially on the soft or silver maple, one of its favorite food plants. This scale insect flourishes, particularly in certain seasons, on Long Island and in its vicinity. Sometimes the trees are fairly festooned with masses of conspicuous females. In 1890 it was so abundant in Brooklyn, N. Y., as to lead Mr. A. S. Fuller to report that thousands of trees were dying from its attacks. It was present in large numbers at Buffalo, N. Y., the same year and in 1898 many complaints of serious injury were received from widely separated localities.

Description. This pest most often comes to notice after the females have attained their full growth late in June or early in July and have excreted an abundant cotton-like substance, which protrudes from under the scale covering the insect, as represented at figure 11, on plate 3. Frequently the entire under surface of the limb is covered with these insects. The cottony fibers are full of minute eggs and young. A recently hatched scale insect is represented very much enlarged at figure 10, on plate 3. The young soon forsake the protecting filaments of the mother, wander to the leaves, settle along the veins as a rule, secrete a scaly covering and in the fall present the appearance shown at figure 12, on plate 3.

Life History and Habits. This species is very prolific. One female rarely deposits less than 500 eggs and must frequently produce over 2,000, as estimated by J. D. Putnam, who has published an exhaustive paper on this species in the proceedings of the Davenport Academy of Natural Science, of Iowa. Certain facts regarding the life history of this insect are taken from his treatise on this scale insect. The young leave the mother in immense numbers about the latter part of July, in the latitude of

Albany, N. Y., and establish themselves on the under side of the leaves. Some may be found on the upper surface and occasionally they attack the more tender twigs. The insects are yellowish for a time, the females showing deep red markings about the time the delicate two winged males appear, and later change to a brownish color, and migrate to the under side of the twigs shortly before the leaves fall. Mr. Putnam found that the males appear from August 1 to September 15, pair, and then die. The females pass the winter on the under side of the twigs and in the spring increase rapidly in size and secrete large amounts of honey dew, which gums the leaves and smears everything beneath the infested trees. The insects soon begin to excrete the familiar cottony matter in which the eggs are deposited and by July are very noticeable when present in numbers.

As is well known, this pest is most destructive to the soft or silver maple, though it occurs on many other plants. It also attacks other species of maples, elms and grape vines. The above named species are the more important plants which are most seriously injured.

Method of Distribution. The young of this scale insect are carried from tree to tree in about the same manner as allied species. Birds, other insects and even spiders frequenting infested trees are often compelled to assist in the distribution of this pest by the active young crawling on them as they rest on the twigs. Once a young scale is on a bird's foot or on an insect, there is a good chance that it will be carried to another tree before it leaves its host. Winds probably aid somewhat in the dissemination of the pest, and it is undoubtedly carried on infested trees which may be shipped to distant parts of the country.

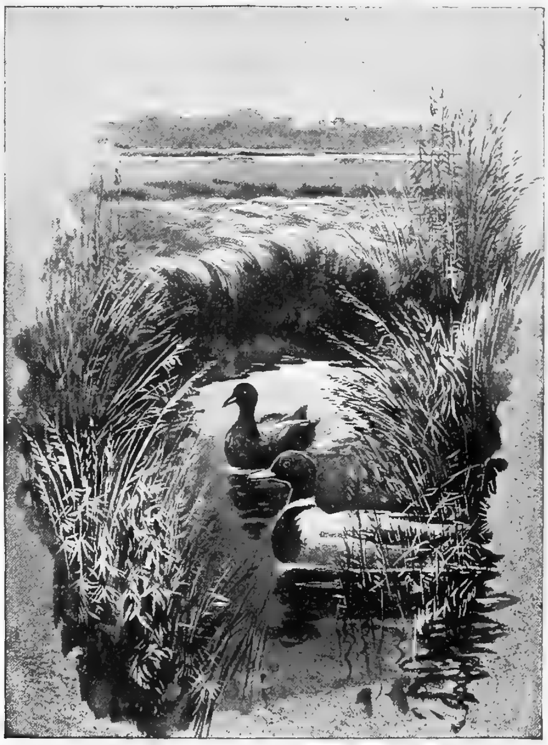
Natural Enemies. Fortunately this prolific insect has a number of natural enemies which undoubtedly do much toward keeping it in check. The twice stabbed lady bird, *Chilocorus bivulnerus* Muls., is one of the more common insects found preying on the pest in New York. The fifteen spotted lady bird, *Anatis ocellata* Linn., *Hyperaspis signata* Oliv. and *H. bigeminata* Rand., are allies of the first mentioned in checking the cottony maple tree scale insect. An interesting lepidopterous enemy, *Lætilia coccidivora* Comst., was reared by Professor J. H. Comstock from this scale insect. Larvæ of lace wing flies, *Chrysopa* species, were observed by Mr. Putnam preying on the young. A species of harvest mite attacks this pest, according to Miss Murtfeldt. Two hymenopterous parasites, *Coccophagus lecanii* Fitch, and *Aphycus pulvinariæ* How., have been reared from this scale insect.

Remedies. Brushing with a stiff broom will dislodge many insects. This should be done before the young scatter and would be more effective if the brush was dipped frequently in kerosene emulsion or other insecticide. Professor C. M. Weed states that this pest can be fought with a considerable degree of success by washing them free the tree with a stream from a hose. Where there is a good head of water this might prove the best method of controlling the pest. Otherwise, infested trees must be headed in and sprayed with kerosene emulsion at the time the young appear. Prepare the emulsion as follows: Dissolve one half pound of hard soap in one gallon of boiling water and while still hot add two gallons of kerosene and emulsify by passing rapidly through a force pump till it assumes a uniform creamy consistency and oil does not separate. Dilute this with ten parts of water before using. In limestone regions use the sour milk emulsion composed of one gallon of sour milk and two gallons of kerosene; emulsify and dilute as described above.

TIME AND PLACE FOR PLOVER.

Forestry on Sandy Soils.

By Prof. JOHN GIFFORD, D. Œc.*



THERE are vast areas of sand lands throughout the Eastern United States, especially along the coast and in the neighborhood of the Great Lakes. They exist in such quantities and are in such a deplorable condition that their treatment should be a matter of national concern. Sand lands may for a time produce good agricultural crops, but for reasons which I shall explain more in detail later, they are far more fit for the production of forests. To maintain their fertility for agricultural purposes by the application of manures is difficult, and sooner or later they are abandoned and left to nature.

The reversion of sand farm land to forest is common even in the South, where, owing to favorable climatic conditions, it is capable of producing several special crops for a considerable length of time. The term "reversion," as the derivation of the word might imply, is not used here in the sense of a backward step; for the abandonment of sand land to forest growth is rather a step in advance—a step toward that ideal classification of land in which every acre produces the crop to which it is best adapted. A great deal of our best land is still in forest, and on the other hand, much of our farm land is unfit for cultivation.

Sand land was cleared in early times because it was easy to clear. In the beginning, owing to the large amount of humus which it contained, it produced heavy crops. In the course of time its fertility was exhausted, and finally the farm was abandoned—

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not "abandoned" in the strictest sense, but allowed to "revert" in the course of time to forest. In our South this process of reversion is often very simple, especially when the adjoining woods are of pines. The winds sow the seeds, the pigs root them into the soil, and soon there appears a rich, thrifty young growth of pines. The process is often slower. First come grass and briers and a host of similar pioneer herbaceous and shrubby plants. Soon scattered red cedar, holly and cherry appear as forerunners, the seeds having been dropped by passing birds. Persimmon, sassafras, hardy oaks, and here and there a pine, appear. The edges gradually close in on the old field; the solitary forerunners become surrounded and hard pressed by their progeny; the open spaces are gradually filled in by whatever may chance to fall by the many natural means of seed dissemination. In New England abandoned farms are often quickly clothed with a dense growth of white pine. In less favored regions birches, poplars and cherry first appear; and, later, balsam, maple, spruce and pine find a foothold.

In the case of constant burning on the sand lands of our South the condition is reversed. One by one the weaker species perish until nothing is left but a few hardy forms which in time also succumb, leaving the sand white, bare and unproductive. By "sand land," sandy loams are not meant. These must be rated among our choicest fruit and vegetable soils. I refer to pure, coarse, sandy soils, such as exist in immense areas throughout the coastal plain of the eastern portion of this country. The value of these lands for agricultural purposes depends mainly upon their location. Their productivity is also dependent upon moisture and temperature conditions. There are few soils too dry and sandy for the production of sweet potatoes and melons. At the same time the demand for these materials is so limited that only a comparatively small proportion of this sort of land will ever be needed for their production. The fact that when divested of timber these lands can be bought for twenty-five cents to one dollar per acre is evidence enough of their value for agricultural purposes, in spite of the ease with which they may be cleared.

The statement is common that forests should be relegated to the waste lands of the earth. The term "waste land" is often indefinite and misleading. A land which will produce forest is far from waste land. In districts where a forest crop pays as well as an agricultural crop it is of course proper to produce forests, even if the land will yield heavy crops of wheat and corn. Very often soils which are unfit for agricultural crops are the very best soils for the production of forests, and *vice versa*. Our western prairie land is a fine agricultural soil, but poor for forests. A soft, coarse sandy soil is poor for agricultural crops but good for forests, provided there is sufficient moisture. Every piece of land should produce those things for which it is best adapted, and few will deny that sand land is more fit for forests than for any other crop.

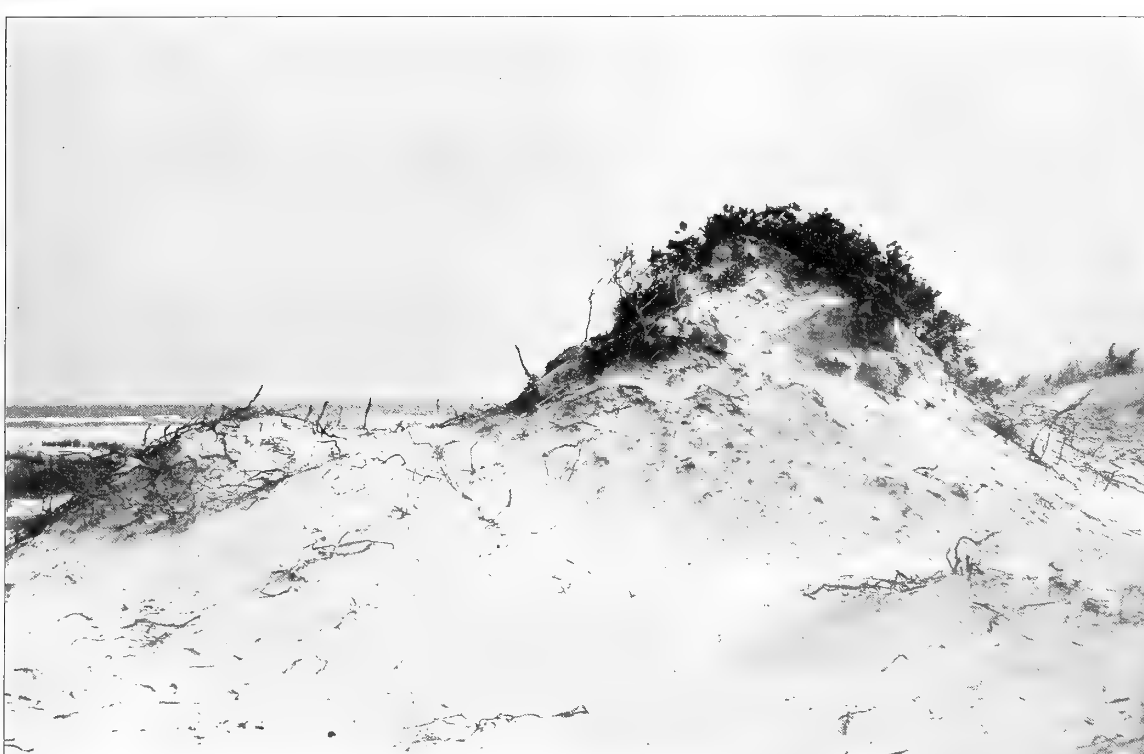
It seems to me that the treatment of sand lands is one of our most urgent problems. They exist in enormous quantities, they are unfit for profitable agriculture on a large scale for any length of time, they are excellent for the production of forests, and, in fact, actually improve under their influence. Many people wonder at the fact that eastern lands are no longer capable of producing the amount of grain which they formerly yielded. It seems to me plain that the great store of fertility, the accumulation of ages of forest growth, has been exhausted. We may analyze our soils with the greatest of care, and add manures in large quantities, but nothing is equal to the action of the forest in the restoration of fertility if the proper course of treatment is followed.

The term "virgin soil" carries with it the notion of great fertility—fertile in that it contains the decomposed detritus of the forest. There is attached to it the notion that it has and can only exist once. In the old world many soils have been rejuvenated many times. In fact, it is quite the custom in many districts in Europe to cut the forest, clear the land, cultivate it for a few years, and then plant it again in forests. If agriculture must be practiced on sand soils, the forest should be one of the series in the rotation of crops. Since sandy soil is easily shifted by the wind, and since, owing to its consistency, it easily loses its fertility when exposed to the action of sun and weather, and since forests love a loose, warm soil and improve in turn its quality, it seems to me that the two should always be inseparably associated.

Sand varies in nature commensurate with its manner of formation and the conditions to which it has been in times past more or less subjected. It may have been deposited by glacial action and afterwards shifted by the wind as in the Adirondacks, or washed up by the waves and then piled by the winds in dunes, as along the southern shore of Long Island and in the neighborhood of Lake Ontario, or deposited in beds along the banks of rivers. Sand is an indefinite term applied to many materials which are often essentially different in constitution, although similar in that they consist of coarse, irregular, non-coherent granules. True sand is pure silica, although it is usually mixed with other materials such as particles of shells, magnetic iron, and even, as in several instances, specks of gold.

Sand is often cemented with lime, organic matter, iron, etc., into hardpan, which is often troublesome, but ordinarily it is loose and porous to a great depth. The productive ability of a sand soil is very largely dependent upon the size of its granules, upon which in turn depends its ability to imbibe plant-food and moisture. Sand almost always looks sterile and forbidding; but it is unsafe to judge a soil for forestal purposes from the appearance of its surface. A sand soil may look, in fact may be absolutely sterile on the surface, and yet a few inches below be rich in plant-food. The appearance of the surface of such a soil would condemn it of course for agricultural but not for forestal purposes, because the roots of trees would soon penetrate

A DUNE IN THE PROCESS OF FORMATION THROUGH THE ACTION OF BEACH-GRASS, ON THE JERSEY COAST.



THE TOP OF A DUNE ON THE JERSEY COAST, HELD BY A PATCH OF BAYBERRY.

into its deeper and richer layers. The young trees would start with difficulty, but, if there is sufficient moisture, grow later with surprising rapidity. A study of the annual increment of our southern pine forests on coarse, sandy soils would convince even the most skeptical of their adaptability for such purposes. A visit to most of the sand lands of Europe has convinced me that it is improper to despise either sand or mud.

The great disadvantage of sand soil is its inability to hold moisture and plant-food. This is a much greater disadvantage to agriculture than to forestry. In fact its porosity and looseness is often an advantage to forest growth. It permits the easy penetration of the roots, and affords to them an abundant supply of oxygen. If exposed to the leaching and beating action of rain, the surface layers of sand soil are soon deprived of plant-food. In a well-cared-for forest on sand soil the surface is always protected as much as possible against the destructive action of sun, wind and rain. Trees have the advantage of agricultural crops in that they penetrate to a much greater depth, and thus utilize the nourishment which would be otherwise unavailable. This is deposited in the leaves on the surface. These leaves decompose into humus, which protects and enriches the soil. The fact that sand becomes extremely hot is often a great disadvantage. The fact that it is naturally a warm soil is rather an advantage to the forest in that it can never become seriously hot and dry if properly protected by the canopy above and the leaf-mould and litter on the forest floor. The shifting of sand is a great disadvantage to agriculture because it injures and often actually buries young crops. When covered with forest it is of course stable. Tillage is primarily for the purpose of rendering land loose, porous and mellow. It has of course also in view the removal of weeds. In coarse sand, tillage is useless, if not harmful, for the soil is already too loose and porous. Unless sandy land is constantly fed with manure it deteriorates. It may be an advantage to let fields which are covered with rocks lie fallow for a time. They will no doubt improve in quality. With sand soil, however, it is otherwise. I am convinced that there is little, if any profit in the cultivation of sand lands. Hundreds of young pine groves on abandoned farms in our South are evidence enough of the best use to which such soils may be put.

There is, however, some reason for the practice of agriculture on such soils. It is the place for the one-horse farmer. Owing to the nature of the soil he is able to plow it at any time when the frost is out of it, and do it with ease with one horse and a small plow. It produces good sweet potatoes and melons, and there is time for berries to ripen before the extreme drought of summer. It is poor farming, however, at best. When the forest is treated as an essential part of the farm and as one of the series in the rotation of crops, such farms become forest-farms, and the system deserves no doubt to be classed as a modern, intensive combination of agriculture and forestry. There is an approach to this forest-farm notion on the eastern shore of Virginia. Almost every farm has its forest. These forests vary in age from fields of young trees as thick as wheat to forests fit for the mill. The ground of these forests is usually free from litter and brush. If one happens in this region at the proper time he will see men, women and children raking the forest litter. This litter is spread evenly on the fields. It produces a fine grade of sweet potatoes. When a field becomes fallow it is abandoned. Then the neighboring pines furnish the seed, the winds sow it, and the pigs root it into the soil. Soon the field is covered with a beautiful greening of pines. The removal of the litter prevents fire, and a kind of forestry is practiced without foresters and forest laws. Although far from an ideal system of management, this, under the circumstances, is not bad. Although, as I shall explain later, the removal of this litter is detrimental to the growth of the pines it is on the whole good, in that it insures their existence.

From what I have already said it will be plain to the reader that the forest performs two very important functions—soil-betterment and soil-fixation.

Soil-Betterment.

The agencies which are active in modifying the nature of the surface of this earth are usually classified as atmospheric, aqueous, igneous and organic. The organic agencies are ordinarily allowed small space. The potency of vegetal agencies is usually underrated, in spite of the fact that they materially modify both atmospheric and aqueous influences. The present-day activities are of course puny in comparison with those of the carboniferous age. At the same time great changes are in progress in the nature of the earth's surface through the agency of the forest. Its influence is most apparent in those regions in which it has been destroyed, or by comparison with those regions in which it does not exist. It is the instrument by means of which mankind may harness and control the unruly forces of Nature. Man may by his carelessness let loose these destructive forces, and calamities of various kinds follow. Fertile regions have been turned into deserts; and floods, avalanches, earthslides, shifting sands, fevers, and strong winds have been engendered or freed from the restrictions under which they have been resting. On the other hand, by the application of forest planting and engineering skill, avalanches and earthslides have been prevented, shifting sands fixed, sterile soils rendered productive, and malarial lowlands healthy.

As samples of the action of trees, consider the mangrove, the great land-former of tropical shores; or of the willow, that Cinderella of trees, the great protector of river banks. The willow loves to grow even in abandoned land, utilizing a neglected corner in a poisoned pasture, clothing with abundant green the most hopeless moors

SAND BLUFF.

SAND DUNE.

and marshes. Although covered at times with water, it holds the soil of banks tenaciously and captures the sediment, which would otherwise wash hither and thither. The Dutch hold boisterous rivers in check by means of it, and with its aid form fertile farms of mud, which would otherwise wash into the North Sea. The Swiss and French hold their mountains in place by forests, and were it not for the forests of pine in Gascony, great masses of sand would shift from place to place with every caprice of the wind.

The forest not only enriches the soil, but it is a soil-former. Even the most tender rootlet, because of the acidity of its tip, is able to dissolve its way through certain kinds of rock. This, together with the acids formed in the decomposition of humus, is a potent and speedy agent in the production of soil. The roots of trees have no difficulty whatever in penetrating limestone rock, and in coral islands whole forests may be seen growing in a total absence of real soil. Other rocks, such as granite, which contain soluble constituents, are disintegrated by the action of the acids resulting from the decomposition of vegetal matter; as the rock crumbles soluble inorganic materials are released, which enrich neighboring soils. In view of the destruction occasioned by the carelessness of mankind, it is a consoling fact that Nature, although slowly, is gradually improving her waste lands. If not interrupted by fire, the barest rock and the fallowest field, under conditions which may be called unfavorable, will become in the course of time forest-clad and fertile. Here and there in the Adirondacks, on the tops of large rocks, may be seen dead pine trees which have been killed but not consumed by fire. Their roots are bare and rest on rocks which are also bare. Many of these trees have reached large proportions. No doubt these rocks were once covered by a deep layer of soil—sufficient at any rate to produce large pines. This mass of humus, beginning with the lichens and mosses, must have been ages in forming. Fire sweeps these rocky tops and ledges clean, and leaves the grim old pines standing, forming targets for lightning, by means of which they are being shattered. The lichens and mosses have begun again, other herbaceous and woody plants will follow, and trees will finally come; but the process is a slow one, which is liable to many interruptions by fire. Where fires have burned on these mountains, the soil which is left soon washes away, and ages elapse before the cycle is again complete. When the forest is destroyed in mountainous districts it is water which finishes the work of destruction. On sand land when fire has swept the surface clear, it is the wind which picks it up, and shifts it hither and thither. Sand has the advantage of a mountainous district, however, in that it furnishes at once a deeper rootage.

Most of those trees which succeed best in sand soils have a deep root system. Although not perhaps in such striking degree as in rocky regions, the chemical action of roots and humus is also active in sand. Although silica is an obstinate substance it is slowly corroded and comminuted by the action of vegetal matter, so that even sand soil, under the action of the forest, is rendered physically, as well as chemically, better. The most important point in this connection, however, is the fact that forests bring the rich materials from the deeper layers of the soil and deposit these in the form of litter on the surface.

Immense quantities of this surface material are wasting every day through the action of fire. Upon this material the lasting fertility of the soil depends. Upon the fertility of the soil the perpetuity of the forest depends; and perpetuity is the keynote of forestry. The removal of litter from a soil which is already rich is like stealing a small sum of money from a very rich man; the removal of litter from hungry sandy soil is like stealing bread from a starving beggar. On this question of humus volumes have been written. Half of all the troubles of European foresters are due to the persistency with which the peasant clings to the old communal right to remove the litter for manure. In times of poor crops the German Government permits the collection of humus from state forests by the peasants. A load of well-rotted leaf-mould is equal in fertility to a load of barnyard manure.

Of course there are many kinds of humus, some of which are of little value for manure. Peat and swamp muck, for instance, are sour and only partly decomposed. Good humus is never formed in regions which are too dry, too cold or too wet. Good humus is never formed in direct sunlight. It needs shade, sufficient moisture, warmth, oxygen, and a host of animals and fungi, which aid in the process of aeration and fermentation. Humus or leaf-mould is a great storehouse of nitrogen and other plant-food, and an efficient mulch or blanket for the protection of the soil and the conservation of moisture. By means of it the soil is protected from the destructive drying action of sun and wind, and from the beating and leaching action of rain. It increases the capillarity of the soil. It fills up the interstices of the soil with rich, spongy, juicy matter, and thus obviates the main objection to a sandy soil, which is its coarseness. By means of it imbibation by capillarity of the water from below is possible. Humus, then, is not only the great storehouse of plant-food, but the place in which it is being constantly produced. It is not only a sponge which holds water, but a blanket which prevents excessive evaporation, and which sucks up the water which would otherwise slip away.

The formation of leaf-mould is something more than mere oxidation. Hundreds of fungi and bacteria are concerned in the process. In addition, the animals of the soil, especially the earthworm, play a very important role. These industrious creatures not only aerate the soil by the channels which they form, but actually eat it, extracting from it what they may need, and casting out the rest in the form of a rich, friable soil.

LAKEWOOD (N. J.) DRIVEWAY THROUGH THE PINES.

A SANDY PINE WOODS FROM WHICH THE LITTER HAS BEEN REMOVED TO PREVENT FIRE. GROWTH HAS BEEN EXTREMELY SLOW IN CONSEQUENCE.

The Danish forester pays much attention to the earthworm, and a forest soil in his estimation is not in good condition until fairly alive with earthworms. Beech forests may be seen in Denmark close to the salt breezes of the North Sea on sand land blown and washed up by the winds and waves. The floors of these forests are covered with leaf-mould and alive with earthworms.

For the production of leaf-mould a forest is of course necessary; but it must be the proper kind of forest. It must be a forest with the proper kind of canopy and affording the proper kind of litter. It must give the proper amount of shade and must protect the floor from the action of wind and rain. The forest canopy and floor are interdependent; they act and react upon one another. The admission of light causes the humus to dry up and interferes with the processes of fermentation. An interference in the formation of leaf-mould interferes with the supply of plant-food and moisture to the roots of the trees. The quality of the soil is of as much importance to the European forester as the quality of the wood which he produces. He has planted the beech everywhere because it improves the quality of the soil to a greater extent than any other species, owing to its dense foliage, even at an advanced age, and to the heavy fall of leaves, which quickly disintegrate into the richest kind of leaf-mould. The beech is planted on sand lands whenever the soil is in fit condition to produce it. When sand soil has reached the stage where it will support beech its future fertility is easily maintained.

Sand soils are hungry, and consume immense quantities of humus because of the abundance of oxygen which they contain and because of their warmth. The Danish forester regards the planting of pine as a necessary evil. It is planted on sand lands because it requires less moisture and plant-food than deciduous growths. Under its influence the soil is slowly improved until the planting of deciduous growths is possible. It paves the way—it is the pioneer. For that reason pines are common on poor soils in almost all countries, even in the tropics. They grow in those regions where deciduous growths fail. In regions which are not subjected to constant burning they are gradually crowded out by broad-leaved species.

It is not my intention in this connection to underrate the value of the conifers—quite otherwise. Were it not for the conifers many of our sand soils would be hopeless deserts of shifting sand. They are a step toward that ideal stage of soil fertility in which trees of any kind may be produced. After the soil has been enriched by the action of broad-leaved trees, the pine will grow all the better and produce a finer grade of wood. Perhaps the most productive forest of all is the coniferous forest with an underwood of a good leaf-mould-forming hardwood, such as the beech. In fact, our finest white pine has been produced under these conditions, the sugar maple in many instances forming the underwood. In the Adirondacks the conifers have been cut and the underwood is left. Young conifers should therefore be favored, and, perhaps, in spots, planted, with as little interruption in the canopy as possible for the sake of the soil. The farmer cultivates his land by tillage—the forester by regulating the light conditions of his forest, by encouraging certain beneficial species of trees and soil animals. The forest is not a mere assemblage of trees. It is a great unity consisting of the birds, the bees, the worms, and fungi, besides trees and many other things, each of which plays a role of more or less importance. It is a great machine, a series of wheels within wheels, all dependent upon one another, and all influenced by one another's activities.

The pine is not of course the only tree which plays the role of pioneer. There are the poplars and birches in the North, which are the salvation of many burned-over areas. Their seeds are carried long distances in immense quantities by the winds; they germinate quickly and soon clothe black unsightly burns with a coating of rich light green. The blackness of these burned-over areas draws the sun to such an extent that artificial planting with less hardy sorts could not be otherwise than failures. Soon after they have become covered with poplars or birches, narrow lines may be cut in the thickets and conifers planted. Owing to the shelter which these young poplars, birches and cherries afford, the chances for the survival of the conifers are good. In the course of time, spruce and pine work into these thickets naturally. Later, maples and other trees find a foothold, and in the course of time there is formed a mixed woods of conifers and many hardwoods. If these burned-over areas, especially in sandy districts, are burned over repeatedly, it is of course a long time before even the poplars, birches and cherry can gain a foothold.

What may appear to the novice to be a weed, may be a shelter tree and soil protector in disguise. A weed is a plant out of place, and any tree which serves the purpose of protection is decidedly in place in a region such as the sandy soils of the Adirondacks, where much protection is needed against the rigors of winter and drought of summer. When, however, this shelter tree begins to crowd or interfere with the growth of a more valuable neighbor which is no longer in need of its services, at that moment it becomes a weed.

In irregular, open forests weeds are of course much more troublesome than in a closed regular forest with a dense, even canopy. Even then the few shade-enduring weeds are able to survive; but these are ordinarily so few in number and so unobtrusive that they are of little consequence.

Before considering the subject of soil-fixation I should define more in detail the role played by micro-organisms in furthering forest growth. There has been discovered lately a mode of life which is peculiar. It is called *symbiosis* or mutualism. It is when two organisms are united for the good of both. It is not parasitism, because a parasite is a robber who steals his food and gives nothing in return. Neither is it the

ARCACHON, FRANCE.

IN THE BACKGROUND IS THE PINE-COVERED DUNE-LAND, IN THE FOREGROUND OYSTER-PARCS.

case of two organisms taking advantage of one another, because both are modified in a slight degree, at least to suit one another's needs. In the cases of which I shall speak later, it seems that the host-plant, or tree on the roots of which these fungi or micro-organisms live, gives little in return for what it receives. It would seem, therefore, that the tree is more of a parasite, if it is at all parasitic, than the fungus which lives upon its roots. The organs on the roots of plants, or rather the formation which is produced by the union of root and fungus, have been named "mycorhiza" or fungus-roots. One class of these mycorhiza is abundant on the roots of certain plants and lives in the humus of the soil, acting as intermediate agents in supplying nutritive material, especially nitrogen, that most essential ingredient of plant-food. According to several authorities, these mycorhiza may be found on the roots of almost all trees. Experiments seem to show that the rapid growth of several species of trees, especially the beech, is due to their presence.

It is on the roots of leguminous plants where the action of micro-organisms is most marked. They are extremely common on the roots of locust trees in the form of tubercles containing masses of these organisms, which are called "bacteriods" because of their resemblance to bacteria. It is in fact a bacterium, and has received the name of *Rhizobium leguminosarum*. It is to the presence of these organisms that the richness in nitrogen of leguminous crops is due. They give to clovers their great value as green manures and soil-improvers. What clovers are to the agricultural world, leguminous trees are or may be to the forester. It is due no doubt to the presence of these organisms that the locust tree is able to grow in sterile places. The locust produces one of our most durable woods, with an ash richer in inorganic constituents than most of our hardwoods. It grows with great rapidity on poor soils. This is probably, at least in part, due to the presence of these bacteriods on its roots. What is true of the locust is probably true also of many other leguminous trees.

A very great deal in reference to these mysterious beings, in comparison with what will probably soon be known, is still unknown. I have mentioned these agents which work in the humus of soil to show that when we destroy or remove the humus from the soil we remove a whole menagerie of living things which are constantly working for the betterment of the soil and the life of the forest which covers it. When farmers say that fire "cooks the life" out of a sandy soil they are saying what is literally correct.

Soil-Fixation.

When unrestrained by a forest cover, both wind and water play havoc with soil. Gales of wind and downpours of rain are not required to produce this damage. It occurs with almost every breeze and every rain. The soil on mountain sides is washed into the valleys, and in clayey countries, even on gentle slopes, great gullies are the result of the destructive action of water unless the cover of vegetation is sufficient to hold it in place. On the steep mountain sides of Europe, in order to prevent earth-slides and destructive floods, protection-forests are fostered. In the case of a torrent, the erosion begins in the little streamlets of the mountains—imperceptible at first, but soon an immense volume of water descending on all sides into the channel course. At first it is only loaded with silt; but rocks, stones and timber soon accumulate in the channel course. This powerful mass, by undermining the banks, receives constant additions until the whole is dumped into the level plain, where the stream emerges with diminished force. In many places, by persistent work the Swiss engineers and foresters have prevented whole mountain sides from slipping and huge masses of rock from crushing the villages in the valleys. Their boisterous streams, which are fed by perpetual snow, must be constantly watched; and by walls of stone, wattle-work, and a host of ingenious devices, they chain these forces until the trees which they have planted can gain a footing that will hold the soil and rocks in place. The same amount of water falls as ever, but the soil and *débris* which cause most of the mischief are held firmly in place by the forest cover.

In sandy soils, owing to their porosity, there is never any danger from the action of water. This very looseness, however, which prevents the erosive action of water, exposes the soil to the play of the wind unless it is held in place by the roots of plants.

Along the shores of oceans and other large bodies of water, especially in the region of the estuaries of large rivers, there are usually immense masses of shifting sand. It is not within the scope of this paper to describe the formation of these sand-banks. It is sufficient to say, therefore, that they usually begin as long sand-bars behind which there are sheets of still water. These shallow bays in the course of time fill up with mud, becoming salt marshes intersected by thoroughfares, salt ponds, and winding creeks. In the meantime the long, flat sand-bars have developed into sea islands, or beaches. When the tide falls, the sand of the shore, ground into powder by the waves, and dried by the sun and wind, is blown in the direction of the prevailing winds, usually inland. The sand moves like snow until it meets an obstruction, when a dune, or sand-hill, forms, equal in height to the obstacle. A section through a dune shows a beautiful stratification, the sand having been deposited in thin layers, always varying, however, with the nature of the sand, the velocity of the wind, and

WATTLE WORK, TO HOLD UP AN EMBANKMENT, IN GERMANY.

the obstructions, large or small, which it encounters. These dunes are not hurled bodily by the breezes, but little by little, forming and reforming, forward and backward, changing, in fact, with every caprice of the wind, gentle and almost imperceptible during a light sea breeze, but a stinging, blinding sand-blast in times of gale.

In spite, however, of all these minor changes, the sand mass is generally moving, perhaps only a few inches a year, in the direction of prevailing winds. A great deal depends upon the day winds; for at night the sand is damp and firmer. And so mountains of sand are formed which are often held temporarily by hardy plants which have gained a precarious footing, but which sooner or later, unless watched and fixed, begin to shift, engulfing meadows, farm lands, lakes, bays, inlets—in fact, anything unable to check its course. Very often these dunes are held by a natural growth of plants, and even in many cases when the conditions were different, forests have grown. In places where these forests have been destroyed, the dunes have become restless, and in other instances, where great changes have occurred in the shore line, the forest holding one set of dunes has been, or is being, overwhelmed by those of more recent formation.

There are several instances where lighthouses have been increased in height because of the sand which had engulfed them. On the North Carolina dunes, chimneys projecting above the sand belong to the houses of an old fishing village. In France and other parts of Europe, villages have been buried. At Soulac, in Gascony, a cross was discovered projecting above the sand. Further investigation showed that it was attached to a steeple, and later a well-preserved church was excavated. The church is now in use.

The sand of dunes, although it varies in nature throughout the world, is extremely fine on the eastern coast of America. It beats through cracks in dwellings, frosts the window-glass, and sifts into one's pockets, shoes, clothing and hair.

On the Pacific coast there are few dunes. In the region north of the Columbia in Washington and Oregon there are extensive accumulations of sand, behind which there are bays, as along the Atlantic coast. A part of this area is covered with the beach pine *(Pinus contorta)*. A large part of the magnificent park of San Francisco consists of shifting sands which were blown and washed up from the sea and have since been fixed and improved. There are extensive dunes in the region of the great lakes, especially in Michigan; and in Ontario farms are being invaded by moving sand-banks. On the Atlantic coast there is an immense area of shifting sea-sand. These dunes, in all their stages, may be seen to advantage on Cape Cod, the New Jersey coast, Long Island, and Cape Henlopen. Here and there along the shore excellent bathing-beaches are being damaged, the coast is constantly changing, and in many places valuable harbors are being invaded and inlets choked with sand. In places which were formerly salt bays, filled with oysters and fish, there are now fresh, stagnant pools. In fact, the vast area occupied by the Dismal Swamp of Virginia was once an arm of the sea. A short distance under the mud may be found oyster shells which grew upon the bottom when this swamp was a salt-water bay. Some day the sand may choke up the inlets of Albemarle and Pamlico sounds, and there will form great fresh-water ponds in which the cypress and other fresh-water vegetation will grow. Inlets are constantly changing on the Jersey shore, and canals have been dug to the sea to let in the salt water in order to prevent the destruction of the oyster industry.

On Cape Cod three immense ridges of dunes have formed, which are moving inland toward the town and harbor at the rate of from ten to fifteen feet per annum. The board of harbor and land commissioners, in charge of these lands, has begun to systematically fix these sands by extensive plantings. An immense dune may be seen near Avalon, New Jersey. In its lee there is a luxuriant forest of red cedar, holly, sour-gum, maple, magnolia, hackberry, oak, mulberry and other trees, with masses of grapevines and Virginia creepers. It is a picturesque sight from the crest of the dune, which equals the trees in height. The trees, in fact, constitute the obstacle that has formed the dune, which is leading to their own destruction. On the land side there is a dense mass of dark-green foliage, beyond which there are green meadows intersected by thoroughfares and bays. On the ocean side there is a mass of sloping sand, out of which project the jagged trunks and branches of smothered trees. The fine sand comes from the great ocean mill, ascends the dune, and falls over its crest in minute cascades. When a stiff breeze is blowing, it skims along the surface and shoots over the crest like a sand-blast, trimming the tops of the trees as flat as though shorn with shears.

This ocean sand is not always sterile and unproductive. It is generally mixed with particles of other substances, such as magnetic iron, shells and mica. Its texture and density are such that there is sufficient capillarity to keep it moist. Beach sand, which appears so barren in a bare and shifting condition, is able to produce a magnificent growth of forest trees in protected positions. The immense oaks and hollies on the Jersey beaches and the beach forest near Scheveningen in Holland attest the ability of the beach sand to support vegetation.

Europe affords the best examples of the complete reclamation of shifting sands, barren heath lands, marsh lands, and other waste places; for the density of population has forced the inhabitants to be less lavish with land and less wasteful of resources than are the people of America.

Extensive dunes have been reclaimed along the Baltic and North seas. At the founding of Copenhagen, for instance, in the eleventh century, the island was clothed

A PLANTATION OF BEACH GRASS ON THE DUTCH DUNES.

A BLEAK BIT OF COAST.

with extensive forests. The woodlands passed gradually from the hands of the Government, and were stripped of trees. The drifting sands of the north shore moved, in the course of two centuries, several miles inland, covering farms and villages. Now the sands are held in bondage by extensive forests of oak and beech.

In Holland the beaches were guarded, because they served as natural dikes for the protection of farm lands. The marsh land was drained and tilled, creeks became canals, and the dunes, a menace to other countries, served to protect the industrious Dutch from incursions of the North Sea.

Much could be said of experiences with dunes in other parts of the world. It is, however, in France, in the department of Gascony, that we find the most striking and valuable object-lesson, and of this I shall speak more in detail later.

Shifting sand is not confined to the seashore. There are immense areas of it inland in many parts of the world. Were we to destroy the forest cover on the coastal plain of the Eastern United States, it would become a mass of shifting sand—sterile, desolate and unfit for habitation, although capable of producing some of the finest and most valuable woods of the whole world. It is, of course, in regions where sand accumulates and shifts in great masses that it looks most formidable. Much damage, however, is being done in an unnoticeable and apparantly harmless form on almost every sandy farm. Delicate crops are cut off close to the ground by the sand-blast, and the finer particles of the soil are picked up and transported long distances by even ordinary winds. The wind has a great parching power, and unless the soil is protected by hedges or belts of forests, its liability to shift increases accordingly. Were it not for forest belts and high turf fences and hedges in Denmark, a large part of the country would blow into the sea. In fact, so serious is the action of the wind on such soils that protective forest belts against the prevailing winds are essential. It would be well to cultivate such soils in narrow strips, alternating with strips of such crops as crimson clover, with here and there belts of trees. In such regions it is well to encourage industries which require slight or no cultivation of the soil, such as apiculture and poultry culture. These may well be classed as subsidiary forest industries. In speaking of bee-culture, Prof. Howard, of the Division of Entomology at Washington, says: "This branch of agricultural industry does not impoverish the soil in the least; but, on the contrary, results in better seed and fruit crops. The total money gain to the country from the prosecution of bee-culture would undoubtedly be placed at several times twenty million dollars annually, were we only able to estimate in dollars and cents the result of the work of bees in cross-fertilizing the blossoms of fruit crops."

Poultry, especially turkeys, have been extensively used in combating insect pests, and, in many instances, with great success. It is even reported that a man in Salina, Kansas, keeps a flock of one thousand turkeys, which he rents to his neighbors for the purpose of ridding their farms of grasshoppers.

In sandy districts all farms should be forest-farms—that is, farms which are at least sixty-five per cent. forest. The necessary fire lanes in a pine-woods district ought to furnish sufficient land for cultivation. A fire lane two hundred feet in width on the outer edge of a one-hundred-acre piece consumes thirty-five acres of land, which is quite as much as one man can comfortably till. One of the most interesting large inland sand regions is the Banat Sand Desert of Hungary. Here large quantities of the American locust have been planted because of its great ability to hold soil in place. The good qualities of this tree are much more fully appreciated in Europe than in America. Owing to its extensive root-system and root-suckers it is a good soil binder. The wood is highly valued in Hungary for the manufacture of agricultural implements. Almost everywhere throughout Europe the locust is used to hold up railroad embankments. The trees are often cut back close to the ground and form a solid matted coppice growth which holds the soil firmly in place, and adds at the same time to the stability and safety of the road, saving also the cost of frequent repairs. Shifting soils are usually temporarily held in place by sand-binding plants, such as beach-grass, wattle-work, fascinage, and brush-work in general. These are usually temporary means of holding the soil in place until, at least, belts of trees may be established of sufficient height to break the force of the prevailing winds.

In many instances along the coast where the great ocean mill supplies an exhaustless quantity of sand, which is being heaped up constantly by the winds and waves, it is necessary to construct a huge embankment in the lee of which trees may be grown. This artificial dune is held in shape by beach-grass. Later on I shall describe more in detail the formation of this protective dune and the use of grasses in keeping it in shape. In regions in which there is not an exhaustless quantity of sand, such as comes from the shores of great bodies of water, plantations of grass are not necessary for the fixation of the soil until trees may gain a footing.

The shifting of the sand is prevented in such cases by brush-work. In France, brush is placed upon the ground just as shingles are placed upon a roof, with now and then a shovelful of sand to hold it down. Among this brush-work are sown the seeds of the Maritime pine, which may be bought in almost any quantity at the country grocery stores. These pines soon sprout, grow rapidly, and there is no danger of shifting sand so long as the supply from the ocean is shut off and the ground kept covered with a growth of some kind.

In other places brush fences are used. These are placed at right angles to the prevailing winds and serve to protect the soil from their injurious influences. Between these fences seeds are sown or small trees planted. Sometimes these fences are only pieces of brush stuck side by side in the ground; in other instances they partake of the nature of wattle-work and fascinage,—that is, the brush is carefully woven in

AN AVENUE ON THE CREST OF A SAND-DUNE IN HOLLAND.

between stakes which are driven at short intervals into the ground. It is not necessary to describe these works in detail—they are all simply devices to protect the surface of the soil from the action of the wind until the young forest is able to perform this function and take care of itself.

Along the shores of oceans where there is a constant supply of sand brought inland by the winds, an artificial dune to cut off this supply is necessary. The wind is able to move the sand along the surface, but unable to lift it up over this artificial dune. In the Eastern United States, where the prevailing winds are west winds, which if not obstructed blow the sand back into the sea, there is little danger lurking in these sand-dunes in comparison to the shores of the Bay of Biscay, where villages were buried and the whole country called the Landes rendered practically uninhabitable in consequence of their presence.

The condition of the Landes was directly due to the immense dunes which arrayed themselves in lines along the shore of the Bay of Biscay. They moved inland and covered villages, and clogged up rivers and inlets. The rain which fell in the Landes was unable to escape into the ocean. It banked up behind the dunes and flooded large areas. During Roman times these sand masses were wooded and stable, but, in the hands of the French peasants, they were stripped and rendered mobile. The damage done by these moving sands so increased that the Government officials studied the work and devised and executed plans; and now, thanks to De Villers, Chambrelent and Bremontier, the pioneer workers, the Dunes and Landes are covered with a beautiful growth of the Maritime pine. The region is now a famous health resort, combining the beauties and pleasures of the seashore with those of a well-managed pine forest, extending almost to the edge of the ocean.

Other industries have started, the people have improved, and the country is more fruitful and beautiful, so that, through the agency of trees, a new province has been practically added to France.

The prosperous condition of this country is due to the pine trees which hold the sand and to the littoral dune which prevents fresh supplies from coming from the ocean. The safety of the country is due to this artificial dune, and the stability of this artificial dune is due to the gourbet or beach-grass.

A littoral dune was constructed straight along the shore from the mouth of the Gironde to Bayonne. It is simply a bank of sand of certain dimensions, with a certain slope suited to the condition of affairs. This protective, or littoral dune, is formed as follows: a double fence is constructed of brush, or of palisades driven in the sand. This stops the sand which comes from the ocean. Soon a ridge of sand forms, equal in height to the fence. A double fence is used, as it gives breadth to the dune, and stops the sand which blows through the fence on the ocean side. As soon as a ridge of sand is formed as high as the fence, the old fence is pulled up, or a new one built on top; and so on, until a dune of the height desired is formed artificially. The proper height of a protective dune is thirty-three feet. It should slope twenty-five degrees towards the sea, and may be sixty degrees on the land side. The dune must be at least three hundred feet from high-water mark. After the dune has reached the proper size, it is kept in shape by the sea marram (*Amophila arenaria*). This peculiar plant, called gourbet in France, is exclusively used for fixing the sand on the littoral dune. It has long, much-divided rhizomes, and will grow well only when covered with fresh sand. The dune must always be kept in shape. If sand accumulates in any one spot in undue amount, a draft is formed, which may end in a breach of the littoral dune. Gardes cantonniers are stationed along the dune, to watch it closely, and here and there on this long, straight sand-bank groups of men and women may be seen digging up the gourbet in places where it is too thick, and planting it where needed. Constantly the dune is watched and mended; the forest, villages and fields in its lee are dependent upon it, and it in turn is dependent upon the humble but persistent gourbet.

In many instances, even where there are no encroaching dunes from the sea, but where the soil is extremely unstable, it is often deemed advisable to use grasses and other sand-binding plants for its fixation; but this is now seldom done. It was formerly considered necessary in Holland and France to always precede the planting of trees, or the sowing of tree seed, with sand-binding grasses. At present, however, sand-binding grasses are seldom used, except close to the sea on the littoral dune, where it is extremely difficult, if not impossible, to start an arboreal growth. Good catches of pine seed have been secured by simply sowing it on the surface. It is better, however, to cover the ground with brush. This is often necessary, also, in order to secure a good catch of beach-grass. Direct sowings of tree seed have been successfully practiced in France, Holland and on Cape Cod.

Sand-binding grasses are therefore only absolutely necessary on the littoral dune. In fact, elsewhere they may be a disadvantage, in that the beach-grass is a dune former. Hundreds of dunes all along our coast may be seen in all stages of formation, due to the action of the beach-grass. On sandy inland soil the crab, or finger-grass, is excellent. In addition to holding the soil it yields excellent fodder.

The greatest soil-binders on our coast are the bayberries. When a dune once becomes fixed by a good growth of the bayberry, nothing short of a very severe gale will uproot it. It is the most persistent sand plant on the coast of eastern America. A large number of leguminous plants will grow well on our coast, and I have often thought that *Lupinus perennis*, the purple lupine, should be more extensively planted on unstable sands. It is not the salt air or wind which limits the species along

A PINERY ON THE DUNES NEAR ARCACHON, FRANCE.

our shore, so much as the sand-blast or the sand which the wind carries with it, which the tender shoots of almost all species are unable to withstand. The species which do best under the circumstances are those which have tough foliage, such as the beach-grass, bayberry, holly, etc. In the lee of some sort of a protection a great variety of species will grow luxuriantly. This may be seen all along the Jersey and Long Island coasts.

Among the species of trees in the latitude of New York, which do well on sandy soils, the following are worthy of special mention: *Pinus rigida* (pitch pine), *Pinus Virginiana* (scrub pine), *Pinus sylvestris* (Scotch pine), *Pinus Austriaca* (Austrian pine), *Pinus echinata* (smoothbark pine), *Juniperus Virginiana* (red cedar). Hardy oaks (*Q. minor, Q. rubra, Q. tinctoria, Q. alba,* etc.); *Robinia pseudacacia* (locust), poplars, especially *Populus deltoides* (Carolina poplar), sassafras, *Ilex opaca* (holly), and *Prunus serotina* (black cherry).

In many sandy districts in South Jersey I have seen the Carolina poplar growing with great rapidity. When we consider the great amount of wood of this species which is sold, perhaps more than that of any other, that it grows with great rapidity in very inhospitable situations, and that it may be very easily and quickly propagated from cuttings, it deserves first rank in the list of species for future planting on poor soils in southern districts, such as the pine lands of Long Island and of New Jersey.

Long Island Coast.

Much that I have said here is applicable to Long Island, a large part of which consists of sandy and gravelly land. A journey by rail from New York to Montauk is quite sufficient to convince one that there are many thousands of acres of sandy land on this island which are fit only for forest. It has been cut and burned over so often that there is little left but a scrubby growth of pine and coppice oak. No wonder the soil is poor. Still, the patches of woodland on private preserves which have been cared for, are evidence enough of the capabilities of this soil for the production of wood.

No region could be more favorably located as to markets and transportation facilities, and no region could be more easily protected from fire. This sandy plain forms a long strip along the southern shore of the island. It is crossed by many streams, which are of great service in preventing the spread of fire. Along the shore of the mainland there are many fine estates, representing an immense amount of wealth. Here one may see many beautiful preserves, trout hatcheries, hunting grounds, golf links, etc., etc. There is only a small population of the kind of people who set fire purposely, as in the country further south, where natives fire the bush to improve the pasture and huckleberry crop. In fact, there ought to be little difficulty in arousing sufficient interest in favor of forest protection to prevent the recurrence of forest fires year after year. Indeed, it seems strange that so broad an area of land should be neglected in the midst of such wealth, and with the interest of such a large number of influential people involved.

Bordering the mainland there are large bays which are separated from the ocean by a narrow strip of sand beach. These beaches consist of fine sand; but there is little serious shifting, except in cases where the sand threatens to clog up inlets. These beaches are mostly held in place by beach-grass and bayberry, and in several places by a low arboreal growth. There are no menacing dunes as in France, although the principles of sand-fixation and betterment might be advantageously applied in many instances on these beaches. At Easthampton there are many fine estates close to the shore. Although exposed to the ocean winds, many varieties of trees are growing there luxuriantly. It shows what is possible on a sandy soil close to the sea. One may travel a long distance in this country before he finds a more attractive resort. In fact, in the neatness, good taste, skill and care which are bestowed upon it, it rivals and reminds one of the charming resorts on the sands along the coasts of Holland and France. Aside from its extremely favorable location, with good transportation facilities both by rail and water, with its great diversity of soil and its population of wealthy and intelligent citizens, Long Island is of special interest to the botanist.

It is practically the northernmost extension of the Carolinian zone—it is the spot, if such a spot actually exists, where the North and South meet. It is the place where many southern species lose their hold. Many plants which are common in New Jersey are either extremely scarce, or do not exist at all on Long Island.

Pinus echinata, the short-leaf or smooth-bark pine, which is so common in New Jersey, occurs on Staten Island, and perhaps here and there on Long Island. It is, however, extremely scarce. Long Island has been long settled, and there has been for many years much cutting and burning. This may account for the scarcity of a few species.

As one moves northward, however, through the Atlantic coastal plain, one species supersedes another, and as one enters Long Island from New Jersey, the short-leaf pine gives way to the pitch pine (*Pinus rigida*). The pitch pine, in company with a few hardy coppice oaks, forms the growth on much of this sandy land.

Pinus Virginiana, the scrub-pine, which is common also in Jersey, does not, I believe, reach Long Island at all; although it may be found on Staten Island.

Chamaecyparis thyoides is very common in southern Jersey; in fact, nothing is more characteristic of this region than the dense dark swamps of this cedar. This tree may be found on Long Island; in fact, even as far north as the southern coast of

Maine. It is, however, scarce. I have no doubt it was once much more plentiful. It may be easily grown on damp, sandy or mucky soil, and no species is more worthy of encouragement.

The sweet gum—liquidambar or bilsted—which is so common in New Jersey, is rare on Long Island. The black jack oak (*Quercus Marilandica*) which is characteristic of the dry, sandy plains of New Jersey, occurs in a few places on Long Island. The Spanish oak (*Quercus digitata*), which is so common in Jersey and Delaware, is, I believe, not found at all on Long Island. *Magnolia glauca* is found only in one or two places. In fact, many of the plants which are common a little farther south become rare on Long Island. The general appearance of the growth is similar, however, to that of the pine lands of New Jersey in spite of the absence of several species.

The gnarled and stunted pines, the coppice oak of several kinds, the red cedars and black cherries, with here and there a sassafras and a persimmon, tangled swamps along streams of clear water, old fields coming up in pines, frequent forest fires, etc., all remind one of southern New Jersey and Delaware. The locust grows with great luxuriance on Long Island. The soil of this sandy plain is, I am quite certain, capable of producing, if properly treated, a heavy crop of trees. It was once covered with a luxuriant growth. The coppice oak still shows great vigor, although it has been carelessly cut and burned over many times.

The fact that Brooklyn secures its water supply from a part of this district, and that other places on the south shore may use it for the same purpose, increases the desirability of a good forest cover.

It is not my intention to define this region in detail. I would simply emphasize the fact that here there are thousands of acres of land fit only for the production of wood, in one of the most favorably located regions on earth. It is land which has been abused for years, but is quite capable of rejuvenation. It will support a great variety of trees, owing to favorable climatic conditions. It is an excellent place for tree nurseries. This sandy plain, although narrow, is at least fifty miles in length. On this area wood enough to supply all local demands might be easily produced. Rich men already own large preserves on this island. It is to be hoped that others will buy the rest and convert it into a well-managed forest to show what private enterprise may do in this line. There is no better place for such experiments. If it will pay anywhere in this country it will pay on Long Island.

Dune Fixation on Cape Cod.

I append here an interesting letter on the work of dune fixation on Cape Cod, received recently from Hon. Leonard W. Ross, of Boston:

Replying to your inquiry of recent date, concerning the work of reclaiming the sand wastes of the "Province Lands" on Cape Cod, it gives me pleasure to say that the result of our work since 1895 proves that the problem has been solved, so far as it applies to this area.

The "Province Lands" are owned by the Commonwealth of Massachusetts, and are under the supervision of the board of Harbor and Land Commissioners. These lands, containing over three thousand acres, as well as several thousand acres adjoining in the towns of Provincetown and Truro, are situated at the extreme end of Cape Cod, constituting an "arm," which makes out several miles into Massachusetts Bay, and consist entirely of a clean, sharp sand. I understand that borings have been made to a depth of more than one hundred feet without finding any other geological formation. It was formerly covered with a strong growth of, principally, pitch pine (*Pinus rigida*) and mixed hard woods—maple, beech, birch, red, black and white oaks, with a strong mixed undergrowth of clethra, azalea, amelanchier, dwarf cherry, bayberry, wild roses, etc.

The necessities of the people who settled on the Cape—formerly a thriving population engaged in fisheries, but now grown to a municipality of some five thousand inhabitants—required this wood and timber for domestic uses. It was therefore cut, and in a ruthless manner, thus giving the strong winds a hold upon the sand, which immediately began to drift inland, or toward the town and harbor, and it has kept up a more or less successful drifting for many, many years.

Legislation intended to restrict the careless cutting of the growth has been enacted in varying forms and degrees periodically for the past nearly one hundred years, but while well intended, it generally failed of successful enforcement.

The National Government was finally appealed to. Appropriations amounting to sixty-three thousand dollars were made and expended in building jetties and bulkheads (which were either buried in sand or carried away by wind and storm), and in the planting of beach-grass, which, it was thought, would make a successful growth and "bind" the sand. This *did* hold the sand in place for a time, but not receiving constant care and watchfulness, it, too, was in time "blown out" in the more exposed places, and buried many feet deep, where the wind finally deposited the sand. In the interior portions, where the trees were not cut, they have been largely covered and smothered by the sand hills, there being trees now forty feet or more in height with only the tips of their topmost branches visible.

I was consulted in 1894, and in 1895 work was commenced on the extreme outside dune (there are three of them) in the most exposed part. The bare sand areas, from which the sand was blown inland over a much greater area, was first covered by planting clumps of beach grass (*Calamagrostis arenaria*) in alternate rows about eighteen inches apart (see the remnants of these rows in picture No. 1), which made a fairly satisfactory growth, and "fixed" the sand by arresting its movement until a stronger or woody growth could be established among it.

This permanent or woody growth consists of *Pinus maritima*, *Pinus Austriaca*, *Pinus rigida*, *Pinus sylvestris*, *Quercus rubra* and *tinctoria*, *Myrica cerifera*, *Genista scoparia*, etc., which we have found to succeed the best. I have tried many other species, consisting of willows, poplars, thorns, tamarix, etc., but with only partial success. At the beginning of operations we established a nursery on the lands in a sheltered spot, where many thousands of young plants were produced,

No. 1.—PLANTATION OF BEACH-GRASS AND PITCH-PINE ON CAPE COD, FOR THE FIXATION OF THE SOIL.

No. 2.—PLANTATION IN FOREGROUND, MOVING DUNE IN BACKGROUND, ON CAPE COD.

of excellent quality, especially in root growth. These were transplanted later to their permanent situations, many of the native plants having been collected in near-by territory, and transplanted to the "outside," and with fairly good success. We have, however, practically abandoned this process as too expensive, as we find that direct seeding produces satisfactory results in all places where the sand is quiet.

Picture No. 1 shows part of the "outside" sand dune, where operations were begun in 1895. On the level foreground are pitch pines (*Pinus rigida*), ten to twelve inches high when transplanted, now thirty to forty inches, in a vigorous and healthy condition. At the bottom of the slope is a patch of *Genista scoparia;* above this, and extending to the top of the ridge, the principal growth seen is bayberry, among which there has been planted lately pine and oak seed, not yet old enough to be seen in the photograph. The original rows of beach-grass may be seen nearly exhausted; but I can assure you that no wind can remove the bayberry, and I am confident that two more years' growth of this will completely cover the ground here.

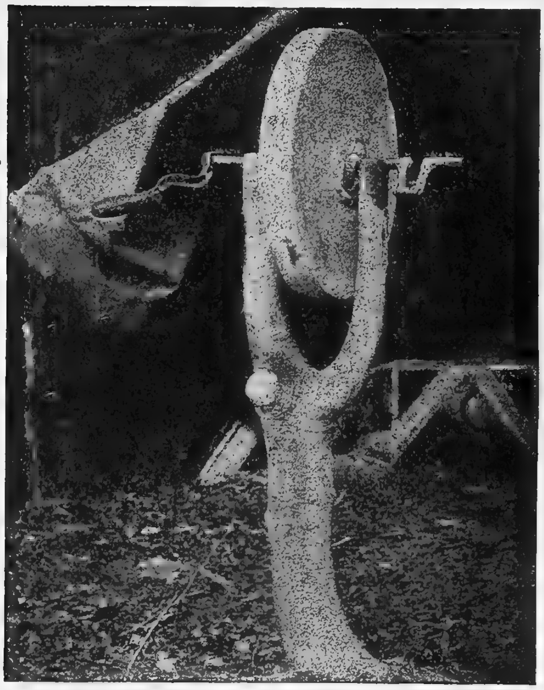
Having fixed this area from which the sand was being blown, we go to the greater area on which it was deposited, to be seen in picture No. 2. Here may be seen a scattered natural growth of beach-grass, among which, on the right foreground, are oaks, then a patch of the several varieties of pine, and beyond this, oak again. These are all thriving and healthy, from twelve inches high up to thirty inches, and have grown from seed planted here in spring of 1895. In the distance may be seen the "face" of the second dune, which looks now as did the first one when we began operations.

Yes, the problem is solved. I am not now officially connected with this work. It is being carried forward by the efficient superintendent, Mr. James A. Small, of Provincetown, to whom I am indebted for these photographs. But I shall always feel a keen interest in the place, and shall look back upon it as a pleasant experience.

A SCENE ON THE DUTCH DUNES.

Working Plans for the State Preserve.

By OVERTON W. PRICE.*



A FORESTER'S MAKESHIFT.

AT the request of the New York Forest, Fish and Game Commission, the Division of Forestry of the Department of Agriculture is now engaged in the preparation of working plans for the New York State Forest Preserve. Field work was begun in June, upon Township 40, and it is hoped that the working plan for this township will be ready for submission to the Legislature by the first of January, 1901.

A working plan is, first of all, a plan for lumbering. It specifies the diameter limit to which trees shall be taken, and includes estimates of the yield. It fixes the areas to be logged over, forecasts the profits to be realized, and sums up the whole situation from a business point of view. In so far, it treats of what is to be done in the forest entirely from the standpoint of the lumberman, and it is based upon the same study of local conditions that any good lumberman makes before he fells a tree. The lumberman's working plan, however, generally considers only the most profitable way of harvesting the merchantable timber. The forester's working plan is made with a view also to the removal of the mature timber in such a way as to hasten the production of a second crop. In spite of much that has been said to the contrary, there is no other radical difference in purpose between the two. Both wish to make the forest pay as high an interest as possible upon the capital which it represents. The lumberman is usually content to receive returns only once from the same area. The forester lumbers with a view to lumbering again. Exactly the same study of the quality and amount of merchantable timber, of the conditions for its transport, and the market open to it for sale, is necessary under lumbering and under forestry. It is with this fact in view, and with the realization that no one is better fitted than the

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CHRISTINE FALLS.

(ON SACANDAGA RIVER, JUST BELOW BURNHAM'S MILLS.)

practical lumberman to make this study, that the services of Mr. Eugene Bruce have been obtained to assist in drawing up the working plan for the New York State Forest Preserve.

After the possibilities for profitable lumbering have been investigated thoroughly, the next step in the working plan is to fix those modifications of ordinary logging which may be necessary in order to avoid damage to the forest and to better the condition of those trees which are the basis for future crops of timber. From the necessity for these modifications has sprung a good deal of wholesale abuse of lumbermen and lumbermen's methods. The fact that until recently there have been no examples of practical forestry in this country has generally been disregarded. That the American lumberman has failed to be moved by emphatic statements that his system is wrong, is not remarkable. In waiting to see definite results of systematic forest management before changing his own methods, he has shown only his characteristic common sense.

One of the modifications which may be advisable under forestry is the raising or lowering of the diameter limit under which logging ordinarily goes on. It may become necessary to lower it in order not to impair too seriously the density of the forest and the probability of its reproduction. It may also be best to vary it upon different areas, because the silvicultural condition of a forest changes constantly, and in the struggle for existence between the trees, some kinds require assistance in one locality and other kinds in another. Particularly in dealing with the Adirondack spruce, which seldom forms a pure wood, but generally occurs in mixture with faster-growing trees, the diameter limit, or in other words, the number of trees to be left to serve as seed trees and also as the nucleus for a second crop, must be raised or lowered in accordance with the chances of the spruce to hold its own in the mixture.

Where over-mature trees of doubtful soundness are shading promising young growth, their removal is for the good of the forest. Under ordinary lumbering, they would be left standing unless they contained sufficient merchantable timber to realize a fair profit. Under forestry, cases arise where they should be cut out, even if their sale no more than covers the cost of logging them.

In the forest under systematic management, young growth and trees of less than a merchantable diameter have a value, because they represent the basis of future cuts. They must, therefore, be protected as far as is practicable, where logging is going on. In the Adirondacks, the use of other species than spruce for building skidways and for filling in roads, is in line with this policy. Bulletin 26 of the Division of Forestry, "Practical Forestry in the Adirondacks," by Henry S. Graves, shows that it is possible in several ways to limit the damage at an expense which is trifling in comparison with the excellent results obtained.

Another point to be considered in the working plan is the best means of eliminating all unnecessary waste. High stumps, the failure to run the logs well up into the tops, lodged trees left in the woods, and any other form of slovenliness, are as foreign to good forestry as to clean lumbering.

In framing the rules to govern logging, the forester has to consider not only the treatment which the forest requires from a purely silvicultural standpoint, but also the bearing which the application of silvicultural measures will have upon the profit to be made from lumbering. To arrange his cuttings solely in accordance with the silvicultural requirements of the forest would in almost every case mean outlay instead of income. It is here that his technical knowledge and his business ability are most severely tested.

As a working plan contains directions for the lumbering of a forest with a view to the future production of crops of timber, it must, in order to justify these directions, state how large the future crops are likely to be in a given number of years, after the area has first been logged over, in addition to furnishing estimates of the present merchantable stand. Since upon these estimates are based largely the rules of the working plan as to the amount of lumbering to be done now, how heavy it shall be, and how soon the same area is to be cut over a second time, and the handling of the forest generally, they must reach the highest degree of accuracy practicable.

The methods employed by the Division of Forestry in obtaining an estimate of the stand consist of actual measurements of the diameter of all trees, with a record of their number, quality, and kind, upon a given portion of the area to be taken in hand. Strips, usually one chain wide and ten chains long to the acre, are run upon compass courses through the forest. All trees within this strip are calipered and recorded upon a separate blank which is kept for each acre run. In addition, notes are made of the merchantable quality of the timber and the silvicultural condition of the stand. These strips are distributed in such a way as to pass through all types and qualities of the forest. They are then worked up for general average and are used as factors in calculating the total amount of standing timber. In order to work up the present merchantable stand into cords or board feet, tables are employed which have been constructed from actual scale of felled trees of different kinds, and give their contents on a basis of diameter at four feet from the ground, the height at which the trees in the strips have been calipered. In several cases there has been opportunity to compare the results, obtained by these "valuation surveys," with the actual cut taken afterwards from the area for which they furnished an estimate. The comparison has shown for them a degree of accuracy not only quite sufficient for the purpose in hand, but which bids fair to prove the entering wedge in inducing lumbermen to abandon cruisers' estimates for a similar system of measurement.

LOWER CHRISTINE FALLS.

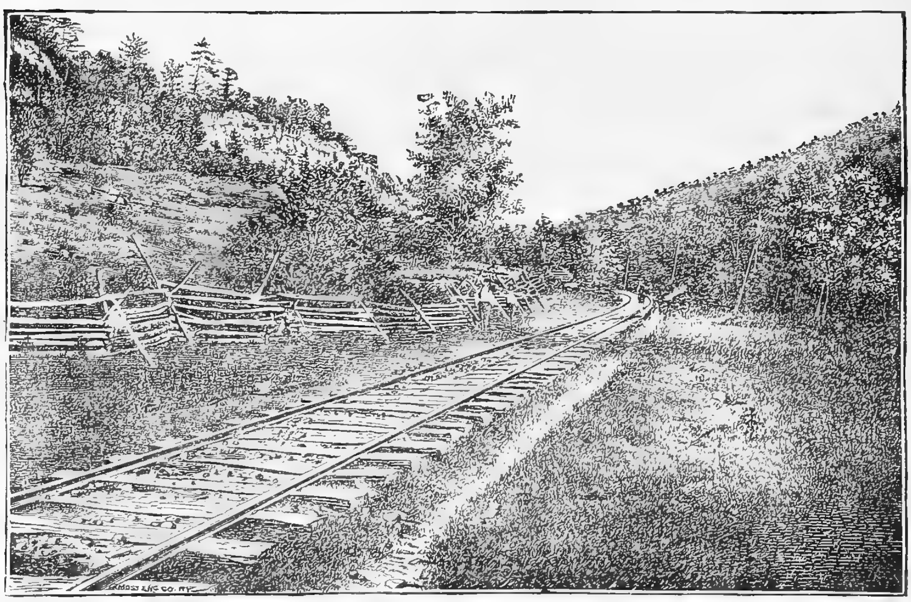
(ON SACANDAGA RIVER, JUST BELOW BURNHAM'S MILLS.)

To determine the amount of merchantable timber which the forest will produce in a given period, it is necessary to know the rate of growth of the different kinds of trees and the size and number of immature trees now standing. The latter is taken from the valuation surveys, the former from what are called "stem analyses." These consist in the determination of the age of felled trees by counting the rings. The age and diameter are taken at the end of each log; the length of the merchantable stem, the percentage of heart and sap wood are found, and other measurements are made which aid in determining the rate of growth of the tree in height and in diameter, and other points in its life history. A number of these analyses are made of each kind of timber trees present in the forest. The results are worked up, averaged, and thrown together into tables, of which the most important in fixing the future yield are those which show the number of years required by trees of different sizes and kinds to grow one or more inches in diameter. Knowing the present stand per acre of trees below a merchantable diameter, the forester now has a record of the rate of growth of other trees of the same size and kind and grown under the same conditions, from which to determine how long it will be before these immature trees reach marketable size; and from his volume tables he can calculate what their contents will be. From the knowledge at his command, he can show the comparative advantages of cutting to different diameter limits, can determine the annual or periodic yield which the forest is actually producing, and can show just what the results will be in the production of future crops of timber, if the young trees which will form them be preserved.

Upon the New York State Forest Preserve, the other important considerations involved in framing the working plan are the protection of the forest from fire, and the treatment of those areas which are of importance in influencing the run-off of streams. The former necessitates thorough investigation, with a view to preventing fire in the future and to the best management of those areas which have already been burned over. The latter, which has been undertaken in collaboration with the Hydrographer of the United States Geological Survey, is of no less importance. It includes the classification of the forest lands as regards their value as catchment areas, which will fix those which must be classed as protective forest and will require a particularly careful and conservative method of treatment.

Systematic forest management should show good results upon the New York State Preserve. Practical forestry has been proved in the Adirondacks and has been found to pay. It will pay also upon the Preserve, both in money and in those indirect returns which will result from the maintenance of so large and important a body of forest land and the production of a steady supply of timber.

Until the repeal of the clause of the 1894 amendment to the State constitution, which prohibits all cutting in the New York Forest Preserve, the application of practical forestry will naturally be impossible. This clause entails an annual loss to the State equal to the amount of timber which goes to waste each year. It cuts off entirely what might be made an important resource, and it does not tend to the improvement of the forest itself. When it was passed, there was some reason to fear that if lumbering were once begun upon the Preserve, it might be difficult to regulate it. The State is now in a position, however, to base the management upon conservative methods and to see that they are carried out.



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