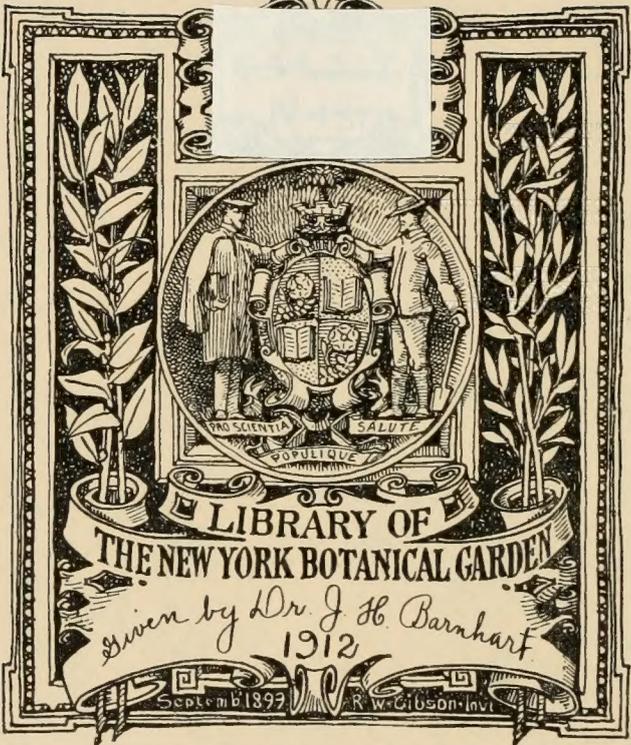


*State of New York*  
FOREST, FISH & GAME  
COMMISSION

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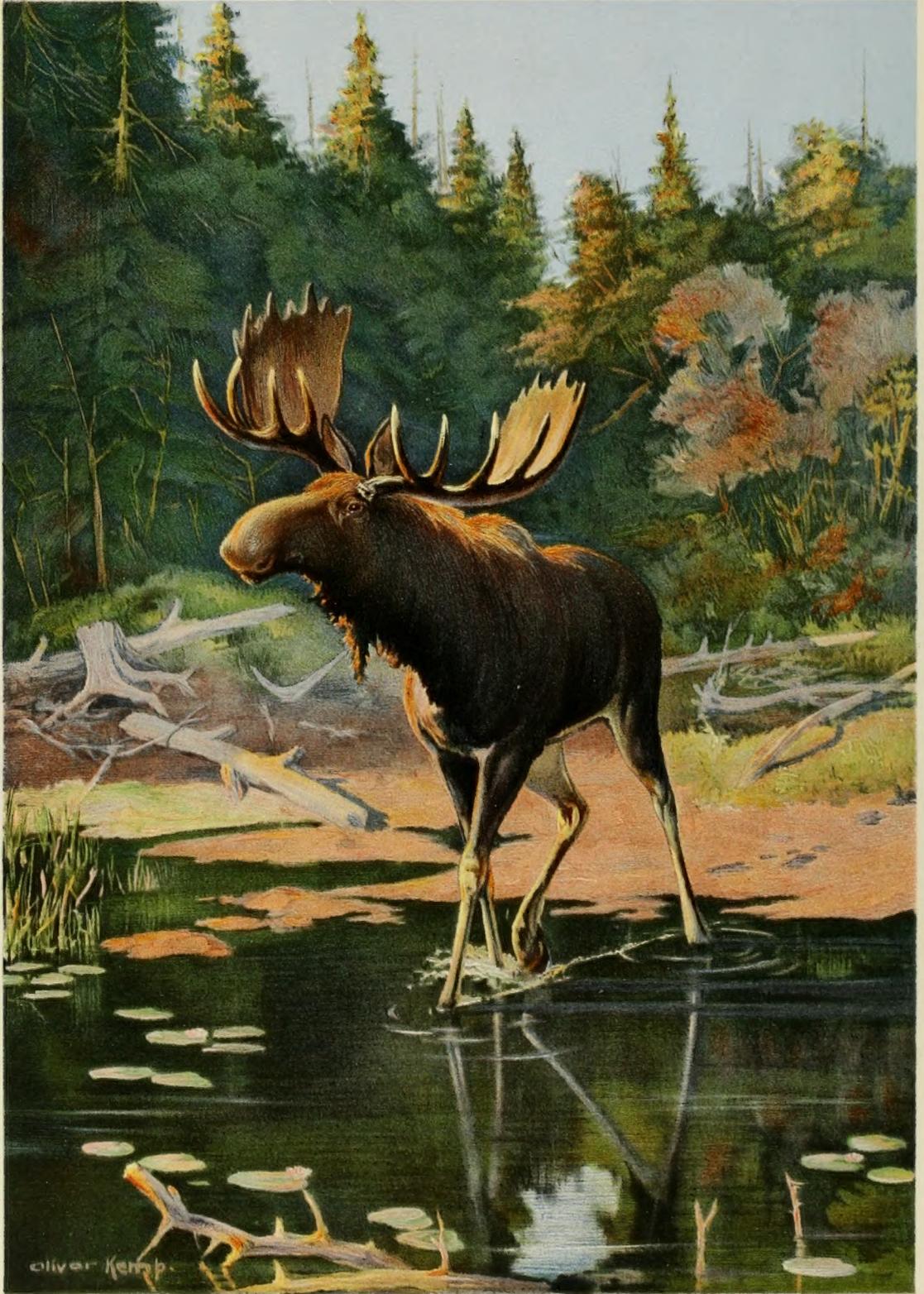












Oliver Kemp

THE MOOSE

Seventh Report

of the

Forest, Fish and Game  
Commission

of the

State of New York.

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ALBANY, NEW YORK.

1902.



Seventh Report  
of the  
Forest, Fish and Game Commission.

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Albany, N. Y., January 30, 1902.

Hon. S. Frederick Nixon,

Speaker of the Assembly:

Sir:—We have the honor to submit herewith, as required by law, the official report of this Commission for the year ending September 30, 1901.

Very truly yours,

Timothy L. Woodruff,  
Dewitt C. Middleton,  
Charles H. Babcock.

# State of New York.

## Forest, Fish and Game Commission.

Timothy L. Woodruff, President, - - - - - Brooklyn, N. Y.  
Dewitt C. Middleton, - - - - - Watertown, N. Y.  
Charles H. Babcock, - - - - - Rochester, N. Y.

## Standing Committees.

Forestry, - - - - - Commissioner Middleton.  
Fishculture and Hatcheries, - - - - - Commissioner Babcock.  
Shellfisheries, - - - - - Commissioner Woodruff.

## Assistant Secretary.

John D. Wish, - - - - - Albany, N. Y.

## Superintendent of Forests.

William F. Fox, - - - - - Albany, N. Y.

## Chief Game Protector.

J. Warren Pond, - - - - - Albany, N. Y.

## Superintendent of Shellfisheries.

B. Frank Wood, - - - - - Jamaica, N. Y. •

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WAPITI, OR ELK



**S**HE preliminary report of the Commission, which was first published in 1901 as directed by law, is supplemented in this volume by articles on various subjects relating to forests, fish and game. Some of these papers were written by officials connected with this Department; the others were contributed by well-known authorities in response to the solicitation of the Commission.

The thanks of the Commission are due to Mr. Madison Grant, Secretary of the New York Zoological Society, for his article on the Moose, which has an especial interest at this time on account of the effort now being made to restock the Adirondack forests with this species of big game; to Maj. W. A. Wadsworth, President of the Boone and Crockett Club, and late President of the New York State Forest, Fish and Game Commission, for his paper on the Wapiti, or so-called American Elk, a timely paper, also, in view of the carloads of elk recently liberated in the North Woods; to Hon. George Chahoon, late Senator from the Adirondack district, for his interesting description of the Black Bear, the protection of which is now urgently demanded by sportsmen and by residents of Northern New York, and to Dr. Tarleton H. Bean, Chief of the Department of Fish and Game at the World's Fair, St. Louis, who contributed the article on the Fishes of New York. The colored plates depicting the various species of fish are by Mr. S. F. Denton and are fully up to the high standard of artistic work displayed by him in illustrating the previous reports of this Department. The illustrations of large mammals are in the best style of Mr. Oliver Kemp, while numerous text and full page illustrations are from the fine drawings of Mr. Henry S. Watson. For the many figures illustrating the article on the Food and Game Fishes of New York the Commission

is indebted to the courtesy of Hon. George M. Bowers, U. S. Commissioner of Fish and Fisheries, who furnished the original plates for reproduction in this Report.

Especial attention is called to the highly instructive and valuable paper on the Economic Value of Birds to the State, kindly furnished by Mr. Frank M. Chapman, Associate Curator of the American Museum of Natural History, whose professional qualifications as an ornithologist of national reputation render him fully competent to discuss this phase of the forestry question in an authoritative manner. In order that Mr. Chapman's article might be properly illustrated, the State Printer secured the services of Mr. L. A. Fuertes, the famous bird painter, who presents here a series of beautiful pictures that form a valuable addition to the text.

The Commission desires to acknowledge, also, the co-operation given by Hon. George W. Rafter, of the State Water Storage Commission, who prepared the paper on the Future Water Supply of the Adirondack Region; and Prof. E. P. Felt, State Entomologist, who continues his series of papers on insects injurious to forest trees.

The publication of this volume has been attended with considerable outlay; but the instructive character of its pages and beauty of its illustrations must surely commend it to the public as worthy of the expense.



ONE OF THE FAITHFUL.

# REPORT

of the

## Forest, Fish and Game Commission.

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



A SUNSET.

IN presenting its annual report, as required by law, the Forest, Fish and Game Commission summarizes the work of a year characterized by activity, economy and accomplishment.

The consolidation of the departments dealing with forestry work has, to a considerable extent, increased the duties of the Commission; but the many important problems arising in connection with those duties have been attacked with energy and settled in whole or in part to the advantage of the State.

Particular attention has been given by the Commission to the planting of trees on denuded tracts of land, where barren areas have been caused either by an unwise harvesting of the native timber crop, or by fire, or both. There are many of these denuded areas on State land, and the extensive experiments made by the Commission have shown that, at a remarkably small expense, these barren places can in time be replaced by a healthful and valuable forest growth. Thousands of trees have been successfully planted in

the Catskill region, and preparations have been made to plant hundreds of thousands in the Adirondack region, and it is believed by the Commission that this work has successfully solved one of the great problems in connection with the Forest Preserve. The experiments show that large appropriations will not be necessary to secure an extensive renewal of the forest.

In this connection, attention is particularly called to the report made on the tree-planting work by the Assistant Superintendent of Forests. Unfortunately his services will not be longer available to the State, as he has been recently called to fill a much more lucrative position. The beginnings made by the Commission through him will, however, be continued in the future, and the State will have the advantage of the work which has already been done and the provisions which have been made for carrying it out.

The Commission regretfully announces the loss of the State Fish Culturist, Mr. A. N. Cheney, who died suddenly at his home in Glens Falls on August 16 last, after a brief illness.

Attention is respectfully called to the appended reports of the Superintendent of Forests, the Chief Protector, the Superintendent of Shellfisheries, etc.

The following recommendations are made for your consideration:

That a constitutional amendment be provided for the application of scientific conservative forestry to State lands.

That a constitutional amendment be provided to permit the leasing of small camp sites within the Forest Preserve.

That a constitutional amendment be provided which will permit the sale or exchange of detached parcels of land outside the Adirondack Park, not in the Catskill region, for land within its boundaries.

That steps be taken, through the purchase of forest lands, to prevent the cutting of hardwood for commercial purposes, and especially for acid factories within the Adirondack Preserve.

That spring shooting of wild fowl and birds of all kinds be prohibited.

That a license fee of fifty dollars be imposed on non-resident hunters, excepting members of organized clubs in the Adirondacks who shall present certificates of membership, and Adirondack landowners.

That provision be made for the licensing of guides.

BY THE COMMISSION.

JOHN D. WHISH, *Assistant Secretary.*

# Report of the Superintendent of Forests.

To the Forest, Fish and Game Commission :

**D**URING the past year the work of the Forestry division of your department has included the operations incidental to forest protection, the prevention and extinguishing of woodland fires, the suppression of timber stealing and trespasses, land surveying, forest surveys and timber measurements, map making, tree planting, land classifications, litigation of land titles and settlement of disputed claims, eviction of objectionable squatters, the purchase of forest lands, the collection of statistics showing the yearly output of forest products in the State, and the various other duties connected with the care and maintenance of the Forest Preserve.

## Area of the Preserve.

The official list of public lands mentioned in the last report has since then been completed and published. This volume, containing 367 octavo pages, shows the location, lot number, acreage, and source of title of 5,934 separate parcels of State land, each of which has its own surveyed boundary and distinct chain of titles. The greater part of them are one-half mile square, containing 160 acres each; of the others, many contain 200 acres each. Then there are various smaller parcels ranging in size from 10 to 160 acres; and, in some instances, where a township has not been allotted, the parcels vary from a quarter to an entire township, which in the Adirondack region contains from 25,000 to 30,000 acres.

From the list of lands scheduled in this publication, together with additions made since its issue, it appears that the area of the Forest Preserve is as follows :

COUNTIES.	ADIRONDACK PRESERVE.	ACRES.
Clinton, - - - - -	- - - - -	20,105
Essex, - - - - -	- - - - -	231,764
Franklin, - - - - -	- - - - -	159,633
Fulton, - - - - -	- - - - -	21,426

COUNTIES.	ACRES.
Hamilton, - - - - -	578,340
Herkimer, - - - - -	146,733
Lewis, - - - - -	4,530
Oneida, - - - - -	6,637
St. Lawrence, - - - - -	34,683
Saratoga, - - - - -	11,588
Warren, - - - - -	108,283
Washington, - - - - -	2,129
	<u>1,325,851</u>
CATSKILL PRESERVE.	
Delaware, - - - - -	12,936
Greene, - - - - -	4,269
Sullivan, - - - - -	888
Ulster, - - - - -	64,237
	<u>82,330</u>
SUMMARY.	
Adirondack Preserve, - - - - -	1,325,851
Catskill Preserve, - - - - -	82,330
Total Forest Preserve, - - - - -	<u>1,408,181</u>

### Adirondack Park.

The area of the Adirondack Park, of which the State owns only a part, is 3,226,144 acres. So many persons are apt to think or speak of the Adirondack Park and the Forest Preserve as being the same, it may be well to state that, of the 1,325,851 acres in the Forest Preserve lands of Northern New York, 1,163,414 acres are situated within the Park, and the remainder, 162,437 acres, are outside the boundary or "blue line" as shown on the last edition of the Adirondack map issued by your Commission.

The actual acreage of the Adirondack Park is greater than the area indicated by the figures given — how much so it is difficult to say. The statement of area as reported here is based on the assessed acreage of each lot, which, as we have learned by experience, is generally less than the real acreage when determined by a careful survey. Most of the lands in the Adirondacks are bought and sold by the assessed acreage, the old conveyances specifying the number of acres and always qualifying the statement with the words "more or less." Whenever we have found it necessary to make a careful survey and chaining of a lot, parcel or township, we have

discovered almost invariably that there was a surplus, that the lot "overrun" the acreage called for in the various deeds, and on which the assessment is made.

This condition is largely due to the loose methods of work in use by the old surveyors who made the original allotments. They used a drag chain, and ran the lines as fast as they could, some of them being paid by the number of acres surveyed instead of by the days worked. Whenever, in their haste or carelessness, they failed to tally a chain there was a corresponding increase of unrecorded area; and, in some instances, as stated in their field notes, the colonial surveyors "threw in a few chains for good measure."

It would be difficult to estimate, even approximately, how far such methods have contributed to the difference between the assessed and actual acreage; but a careful study of the facts, together with many years experience in these land statistics, leads me to believe that the lots will, in the aggregate, overrun the old surveys at least five per cent; and that while the officially assessed acreage of the Adirondack Park is placed here at 3,226,144 acres, the actual acreage is not far from 3,400,000 acres.

### Land Classification.

For several years there has been a constant need of some specific information as to the amount of merchantable timber left in the Adirondack Park, and the area of virgin forest that remains; also, some definite statistics as to the acreage embraced in each of the various classes of land. This becomes necessary, not only as a matter of general information regarding the industrial resources of the region, but also in order that the Department may have a proper knowledge of the various kinds of land intrusted to its care and management.

This work would have been undertaken long ago had there been anything in our forestry law providing for the appointment of competent foresters to carry it on. Fortunately, at the last session of the Legislature a law was enacted — chapter 326, Laws of 1901 — which enabled the Commission to commence this important part of its forestry work and complete it, so far as the more important details were concerned.

After a careful study of the subject it was decided that, in making the classification of the various kinds of land, it would be advantageous to classify under the same descriptive terms used by the State Comptroller in his circular letter of instructions to the town assessors; viz., forest, lumbered, waste, burned, denuded, wild meadows, improved and water. The advantage in this arrangement was that the assessment roll of each forest town, as required by law, is filed each year in this

office; that the character of the lands in each town is presumably well known to the men who make the assessments; and that, although the description of the assessors might not be accurate in all cases, it would, when supplemented by the field work and personal examination of the foresters, enable us to make a final classification that would be accurate, or approximately so in a close degree.

Foresters Bryant, Williams and Knechtel were assigned to the work. After several weeks of steady application a tentative classification, tabulated lot by lot on large blanks printed for this purpose, was obtained from the assessment rolls of 1900. With these sheets in hand they went into the forest, where they verified or amended the description of each lot. This field work occupied several months, during which the foresters worked diligently and intelligently, as may be seen from the large pile of neatly tabulated sheets now on record here. On returning to the office the areas of the lakes and ponds were obtained by tracing their outlines with a planimeter on a map. In this latter work the sheets of the United States Geological Survey were of great assistance, the large scale on which this map is made conducing to greater accuracy so far as the area of the water surfaces is concerned.

Before entering upon their field work the foresters were instructed that the following definitions of the various terms in the classification must be observed:

*Forest.* Embraces all forest lands from which no timber has been removed except white pine which on many townships had been cut forty years or more ago, at a time when the lumbermen took this species only. Also, lands which were lumbered for spruce over eighteen years ago and on which there is now a good second cutting, because the lumbermen at that time did not cut below twelve inches.

*Lumbered.* Under this head are included all lands from which the evergreens or softwoods—pine, spruce, hemlock and balsam—have been taken, but on which there is still a good forest covering of hardwood timber, the latter species generally forming over sixty-five per cent of the original growth. Some lands on which the lumbermen left the hemlock and balsam were also included in this class.

*Waste.* Includes wild lands on which there is a scattered growth of small poplars, scrubby hardwoods or stunted conifers.

*Burned.* Lands that have been burned over within a few years, and on which the timber was all killed; or ground covered with old, charred fire-slash.

*Denuded.* Sand plains; barrens; ground covered with ferns, huckleberry bushes and brier patches; abandoned farms and old clearings.

*Wild Meadows.* Grass lands, such as the Indian Plains on the South Branch of the Moose River; beaver meadows; and river flats on which wild hay is cut by residents of the vicinity.

*Improved.* Cultivated farms and inclosed pasture lands; hotel property; and village lots.

*Water.* Lakes, ponds and reservoirs.

From the recapitulation of the foresters' classification the following summary is obtained:

ADIRONDACK PARK.										ACRES.	
CLASS.	-	-	-	-	-	-	-	-	-	-	
Forest,	-	-	-	-	-	-	-	-	-	-	1,158,054
Lumbered,	-	-	-	-	-	-	-	-	-	-	1,671,139
Waste,	-	-	-	-	-	-	-	-	-	-	48,551
Burned,	-	-	-	-	-	-	-	-	-	-	43,165
Denuded,	-	-	-	-	-	-	-	-	-	-	56,682
Wild meadows,	-	-	-	-	-	-	-	-	-	-	22,529
Improved,	-	-	-	-	-	-	-	-	-	-	100,980
Water,	-	-	-	-	-	-	-	-	-	-	125,044
Total,	-	-	-	-	-	-	-	-	-	-	3,226,144

The ruled columns of the blank forms used by the foresters in making their tabulations provided for a classification by ownership, as well as character, from which we obtain this result:

OWNERSHIP.	-	-	-	-	-	-	-	-	-	-	ACRES.
State,	-	-	-	-	-	-	-	-	-	-	1,163,414
Private preserves,*	-	-	-	-	-	-	-	-	-	-	705,914
Individuals or companies,	-	-	-	-	-	-	-	-	-	-	1,356,816
Total,	-	-	-	-	-	-	-	-	-	-	3,226,144

And the footings of the descriptive columns furnish this information:

CLASS.	-	-	-	-	-	STATE ACRES.	PRIVATE PRESERVES.	INDIVIDUALS OR COMPANIES.
Forest,	-	-	-	-	-	455,415	257,186	445,453
Lumbered,	-	-	-	-	-	592,630	368,115	710,394
Waste,	-	-	-	-	-	10,275	22,483	15,793
Burned,	-	-	-	-	-	14,617	5,301	23,247
Denuded,	-	-	-	-	-	15,739	13,555	27,388
Wild meadows,	-	-	-	-	-	9,961	380	12,188
Improved,	-	-	-	-	-	4,642	6,239	90,099
Water,	-	-	-	-	-	60,135	32,655	32,254
Totals,	-	-	-	-	-	1,163,414	705,914	1,356,816

\* Not including preserves outside the Adirondack Park.

No classification has been made as yet of the 142,913 acres of Forest Preserve lands in the Adirondacks which are situated outside the park line; but this work will be undertaken and completed during the coming year.

The brief statistics given here, valuable as they are, give little idea of the amount of field work and clerical labor involved in arriving at these figures. There were 8,331 separate parcels of State and private lands which were tabulated, one by one, on the large, closely ruled sheets used in preparing and completing these records. If each lot or parcel had belonged entirely to one class the labor would have been comparatively easy. But a large proportion of the lots were of a mixed character, and hence each of them had to be divided into separate areas corresponding to the respective kinds of land embraced within its boundaries.

### Annual Product.

In connection with the foregoing statement showing the forest resources of the State it may be interesting to note the yearly product obtained. The output of sawed lumber, pulpwood, and other material for the past year cannot be given at this date; for the collecting of the statistics relating to them cannot be undertaken until the year has closed, after which considerable time and travel are necessary to obtain and compile the information in proper form for publication. And so, as is customary in our preliminary reports, we submit the statistics for the previous year — 1900 — which have not been published as yet, the final report of the Commission for that year being still in the hands of the printer.

From the written reports received at this office from each sawmill and pulpmill in the State, the logs and timber obtained in 1900 from the forests of Northern New York amounted in the aggregate as follows:

	FT., B. M.
Spruce (sawmills), - - - - -	166,614,856
Spruce (pulpmills), - - - - -	230,649,292
Hemlock, - - - - -	48,377,575
Pine, - - - - -	54,948,590
Hardwood, - - - - -	32,748,759
Total, - - - - -	<u>533,339,072</u>
Shingles, - - - - -	32,734,000
Lath, - - - - -	56,840,550

With few exceptions, the pulpmills in making their returns sent in their figures expressed in cords, as their purchases of timber are made that way, most of their

logs being cut in lengths of 4 feet. In contracting for their stock some of the pulpmills bought by the standard or market log, which is 13 feet long and 19 inches in diameter at the small end. The buyers generally estimate three markets as equivalent to a cord, and pay the same price for either. As three standard logs contain 549 feet by Doyle's rule ( $3 \times 183 = 549$ ), the 420,108 cords reported by the pulpmills were converted into feet accordingly.

The returns from the pulpmills, though correct, do not always indicate the capacity of a mill or amount of its product, for some of them are stocked in part, or wholly, from Canada. In 1900 the pulpmills of this State received 151,157 cords—equivalent to 82,985,193 feet board measure—from the Canadian Provinces.

It is interesting to note that the amount of spruce used in making paper has increased annually, until it now exceeds greatly the amount cut for lumber. In 1890 the spruce used by the pulpmills was reported at 51,966,262 feet. Last year the amount reached 230,649,292 feet.

### Product of the Catskill Forests.

Hitherto, in my annual reports, the output of the Catskill sawmills has not been included, as it was supposed that, owing to their small size and limited product, the information would have no special value. In the annual report of the Forest Commission for 1885 some statistics were submitted showing the number of mills in each of the Forest Preserve counties,\* from which it appeared that there were 90 sawmills in Ulster and Sullivan, of which 72 used water power and 18 used steam. But the water mills, which were all small affairs, were shut down most of the year, and so their product attracted little attention.

As more definite information regarding the forest products of that region seemed desirable, Mr. A. B. Strough, a special agent of this Commission, was instructed to make an exhaustive examination of the entire district embraced in the four Catskill counties, and collect all the statistics possible relating to the industries which are dependent on the forest for their supply of raw material. From the written statements furnished by the various mill owners, it appears that the lumber product of the Catskill forests for the year 1900 is as follows:

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\*At that time Delaware County had not been included in the law defining the location of the Forest Preserve.

	FT., B. M.
Spruce, - - - - -	2,730,780
Hemlock, - - - - -	18,659,026
Pine, - - - - -	9,340,448
Hardwood, - - - - -	25,876,089
Total, - - - - -	56,606,343
Shingles, - - - - -	4,871,500
Lath (pieces), - - - - -	5,158,700

Of the sawed hardwood, a good proportion is composed of chestnut and oak, species which do not enter at all into the Adirondack product, but which are abundant in the Catskills, where they are sawed largely into railroad ties.

In addition to the lumber output, the chemical mills, which manufacture wood alcohol and acetate of lime, consumed during the year 103,449 cords of four foot wood, equivalent to 56,793,501 feet. All kinds of hardwood or broad-leaved trees, large and small, are available in this industry.

In the manufacture of excelsior the mills used 4,175 cords—equivalent to 2,292,075 feet—mostly basswood and poplar. The mills engaged in this industry manufacture excelsior and nothing else.

The furniture factories reported 1,330 cords as used last year, equivalent to 730,170 feet. Most of it was hard maple used in the chair factories at Chichester and Shandaken, in Ulster county.

The two pulpmills in the Catskill district consumed 2,503 cords, or 1,374,147 feet, mostly poplar mixed with second-growth pine and basswood; not much spruce. The pulp from these mills is not used for making paper; it is dried and pulverized for use as a carbon and absorbent in the manufacture of dynamite; and, also, as a substitute for cork in making linoleum.

The combined product of the Adirondack and Catskill forests amounted in 1900 to 651,135,308 feet, or more than the entire Canadian lumber import of that year to the United States.\* As the figures may convey little or no meaning to persons who are not familiar with the lumber business, it may be well to explain, as done in a

\* The total Canadian import for 1899 was:

Logs and round timber, - - - - -	198,135,000 feet
Hewn and squared timber, - - - - -	1,593,504 "
Sawed lumber, board, plank, etc., - - - - -	423,705,000 "
	623,433,504 "

previous report, that this product would load 62,000 cars, making a train over 400 miles long.

There are no statistics showing the number of tanneries, for there are none left in the Catskills. The hemlock included here in the sawmill returns stands for logs that were cut for lumber, and not for bark. At one time the tanneries were numerous in these counties, owing to the vast amount of hemlock standing there. But this industry is now extinct in that region, the tanneries having been abandoned here and there as the supply of bark became exhausted. Some little hemlock was left standing in places, but it was so remote and inaccessible that it could not be cut with any profit. But, influenced by the present high price for this kind of lumber, the sawmill men are picking up what few lots are left, and hence the quantity — 18,659,026 feet — shown in the returns. In a few years the small amount of hemlock remaining in the Catskill region will be gone, and the species will become extinct there with the exception of what may be found in the forests of the State Preserve.

There is another industry connected with the Catskill woodlands which may be mentioned here, although it is one that is not regarded favorably from the forester's standpoint; and that is the annual cropping of the small evergreens for Christmas trees. The market demand for this young growth is enormous, although there is little profit in the business for those who are engaged in furnishing the material. Its bad effect on the future timber supply of these merchantable species is readily apparent, as the continued destruction of the young growth must result eventually in the extinction of these desirable kinds. If these woodlands were under a proper, conservative management no harm would be done; for the yearly thinnings from the entire forest would satisfy the market for Christmas trees. But under the present methods entire areas are completely stripped of the young spruces and balsams, thereby changing the future composition of the forest and converting it into a hardwood stand of less valuable timber.

The annual output of the Adirondack forests shows no diminution, the product for 1900 being largely in excess of the previous year, although not quite equal to that of 1898. Aside from the State holdings, there are now about 700,000 acres of forest land in the Adirondack Park that have not been lumbered, or from which a second cutting of spruce can now be obtained.

Each year, recently, the softwood timber on 80,000 acres or more is cut and removed by the lumbermen or pulpwood operators. This would indicate that, if the present rate of cutting continues, these industries will exhaust their supply of raw material in ten or twelve years, after which they will have to depend on the State forests or Canadian imports for a further continuance of their business. At

present the Empire State leads all others by far in the number of its pulpmills and amount of product; but if it expects to hold its supremacy in this industry it must make some prompt and intelligent provision for a future timber supply.

In discussing this question some of our lumbermen and woodpulp operators point to the great Canadian forests and the inexhaustible supply of spruce which they claim is standing there. But the Province of Ontario has already put an export duty on logs and round timber that is intended to be prohibitory; and the Province of Quebec evidently will do the same whenever the supply of spruce in New York and New England is gone. Our people then will not only have to go to Canada for their raw material, but will have to take their mills and workmen with them. The millions invested throughout New York in the great manufacturing plants belonging to the lumber, pulp and paper business will be non-productive, and these industries will be paralyzed.

### Industrial Statistics.

Aside from those engaged in our forest industries, but few people are aware how largely these industries have conduced to the commercial supremacy of the Empire State, and of the great necessity for making some prompt, intelligent provision for a future supply of the raw material on which their permanence depends.

In the year 1900 the lumber industry of this State employed 8,616 men in the sawmills and lumber camps, the total wages paid amounting to \$3,537,916.\* The total capital invested in the business amounts to \$20,236,352. The pulp and paper mills employed 9,872 men, and paid out that year \$4,958,433 in wages. New York leads all other States of the Union in the number of its paper and pulp mills, the capital invested in these plants amounting to \$37,349,390.

### Tree Planting.

The limitations imposed by the forestry clause in the State Constitution prevent the undertaking of any forestry work similar to that carried on in European countries and at some places in the United States. The Department is prohibited by law from harvesting the matured or decaying timber on the Preserve; no work of forest improvement can be done if it involves the use of the axe in thinning or pruning the woods; neither can any timber be sold or removed from the windfalls or fire-scorched areas, although the sale of such material would furnish no small revenue.

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\* Twelfth Census of the United States.



READY TO START UP THE MOUNTAIN FOR A DAY'S PLANTING.



TRAIN LOADED WITH CHRISTMAS TREES. (11,000 TREES.)

UTSFR & DELAWARE RAILROAD.



There remains, however, one important branch of silvicultural work which the Commission can undertake with a reasonable prospect of success, and which can be carried on without violating any provision of the Forestry Law. Tree planting can be done; the denuded acres of the preserve can be reforested.

Actuated by a praiseworthy desire to undertake some experimental work along this line, Mr. J. Y. McClintock, the Assistant Superintendent, accompanied by Foresters Bryant and Knechtel, began some small plantations in the Catskill Preserve during the last year. Although no appropriation had been made for the purpose, they succeeded in obtaining from the State College of Forestry a donation of several thousand seedlings which they planted, the work being done at times when they could be spared from their other duties in that region without detriment to the work on which they were regularly engaged. For information as to the details of this work you are respectfully referred to the accompanying report of the Assistant Superintendent, which gives an interesting account of the inauguration of what, it is believed, will in the future form an important branch of our Department work.

While it is not proposed at this time to undertake the reforesting of the many thousand acres of waste or denuded lands in the preserve, it seems advisable that some small portion of this area should be planted each year, and that a suitable appropriation should be made by the Legislature for such purpose. The work, if done in a judicious and conservative manner, will not necessitate any great annual expenditure, and it undoubtedly would receive the approval of every one who is interested in the forest policy of our State.

A small nursery for raising seedlings should be established at some convenient locality within the preserve, and placed in charge of one of our professional foresters. In order that a thorough knowledge may be gained of everything pertaining to the technical work involved it is recommended that the seeds used in this business should be gathered from our forests instead of purchased; and that every detail of the business, including the collection, preparation and planting of the seeds in the nursery beds, and the subsequent transplanting, be done within our own lines, not only with reference to future growth, but with the intention of acquiring all the practical and technical knowledge necessary in carrying on such work.

After making a careful estimate of the necessary expenses it is suggested that the Commission ask the Legislature to appropriate the sum of \$4,000 annually, to be devoted to the maintenance of a forest nursery, and the reforesting of the waste lands within the preserve.

## Forest Surveys and Working Plans.

Some forestry work of an expert character has also been accomplished in the way of timber measurements, forest surveys, and the preparation of working plans on Townships 5, 6 and 41, Hamilton County, an area embracing about 70,000 acres. The cost of this work was provided for by an item in the supply bill last winter, which appropriated the sum of \$3,500 "for continuing the work, and for the payment of the expenses of experts furnished by the United States Bureau of Forestry, and for estimating of standing timber and the securing of other information by them regarding the land and trees within the Forest Preserve."

Under an arrangement made with Mr. Gifford Pinchot, the forester at the head of the United States Forestry Bureau at Washington, a party of experts was detailed for this work, payment for their salaries and services being made by the general government, while the camp and traveling expenses, together with the pay of the woodsmen and camp attendants, were defrayed by the New York Commission out of the item in the supply bill just mentioned. The party, numbering 26 men in all, foresters, students and laborers, was placed under the charge of Mr. Ralph S. Hosmer, forester, and Mr. Eugene S. Bruce, lumberman, both of the United States Forestry Bureau.

The work performed by this party was similar to that done on Township 40 in 1900. Full information as to the details of what was then accomplished will be found in Bulletin No. 30, issued by the United States Department of Agriculture, a copy of which can be obtained by any one by writing to the United States Forestry Bureau at Washington. The bulletin containing the results of the investigation of Townships 5, 6 and 41 has not been published yet, as considerable time is needed for compiling and tabulating the data obtained, and making the necessary maps to accompany this report.

An idea of the actual value of the timber on some of the Adirondack tracts may be gained from the fact that it can be safely asserted that the matured timber on the tract formed by these four contiguous townships (including Township 40), the standing spruce, 14 inches in diameter or more, can be sold for over \$500,000. As the 14-inch spruce does not form over eight per cent of the forest, it is evident that its removal would inflict no injury to the timber, or impair the protective functions of these woodlands. In fact, the State has to-day on its Adirondack Preserve 1,366,245,000 feet of large spruce, with a stumpage value of over \$2,700,000; and, whenever the law will permit, this timber can be sold for that amount and removed without any injury to existing forest conditions.



H. S. WATSON

WET BOOTS.



## Land Surveying.

In addition to the technical operations involved in what is termed forest surveys, which are made for the purpose of obtaining information as to forest conditions, a large amount of work has been performed during the year in the line of land surveying, in order to ascertain or re-establish the boundaries of certain State holdings on which trespasses had been committed, or to settle disputes as to the correct location. This work has been in charge of Mr. J. Y. McClintock, Assistant Superintendent, whose experience as a civil engineer and surveyor, supplemented by several years work on Adirondack lot lines, rendered him especially competent to look after this branch of the business of the Department. A considerable part of his time was spent in surveying the boundaries of State lots in the Catskill Preserve where there had been some timber cutting on certain lots. Owing to the lack of plainly blazed lines it becomes necessary to make extensive surveys in order to re-establish the old boundaries, and thereby arrive at the extent of the timber cutting which had been done within the lines of the State property.

The survey of the John Brown farm and surrounding State property, which was undertaken by Mr. McClintock and his engineer corps of 1900, was completed this year, together with a large map showing correctly for the first time the allotment of that region as related to its topography. I cannot speak too highly of the excellent work done by Mr. McClintock and his assistants in connection with this important survey, involving as it did the correct location and boundaries of several thousand acres of State land in the vicinity of North Elba.

Another important survey was made in township 27, Franklin county, in the vicinity of Ampersand Pond, this work becoming necessary on account of the litigation of the State's title to lands in the northeast quarter of this township, and the fact that a lumber company, claiming title to a portion of this land, had made an extensive timber cutting there. This survey, and that at North Elba also, was accomplished through the co-operation and assistance of Hon. Edward A. Bond, State Engineer and Surveyor, the expenses being defrayed from an appropriation made for his Department.

It is not deemed necessary here to recount in detail the various land surveys which became necessary in the course of the Department work during the past year, all of which were placed in charge of Mr. McClintock; but attention is respectfully called to the importance and value of this part of the work devolving upon the Commission, and the necessity of a suitable appropriation by the Legislature is urged to insure its continuance.

## Forest Fires.

Among the various duties devolving upon any forestry department, however wide their scope may be as to silvicultural work or the harvesting of woodland products, there is none so important as the protection of forests from fire. It is with feelings of something more than ordinary satisfaction that the attention of the Commission is called to the fact that, while during the past year forest fires have been numerous and destructive in almost every other State in the Union, the woodlands of the Adirondack and Catskill Preserves have been remarkably exempt, and that the damage from this source during the past season has been less than in any former year on record. It is true that the season was a favorable one, but it would be unjust to the Chief Firewarden and his corps of assistants to attribute the exemption to that source in any great degree. In no previous year has there been so much intelligent and efficient work expended in organizing the force of firewardens, in making judicious appointments, in dividing the various towns into districts, and in properly locating the district firewardens.

From the reports received at this office from the various towns the Chief Firewarden has compiled the following summary :

Number of acres burned over, - - - - -	7,780
Of which the State owns, - - - - -	454
Number of days' labor fighting fire, - - - - -	1,498
Value of standing timber destroyed, - - - - -	\$2,835
Value of cordwood, logs, fences and buildings burned, - - -	\$1,145

As remarked in previous reports, the value of timber destroyed may seem disproportionately small as compared with the number of acres burned over. In explanation of this seeming discrepancy it should be stated that a large number of the fires reported occurred on waste or barren lands, on which there was no merchantable timber and but very little tree growth, the ground being covered largely with ferns, bushes, and berry patches. But the wardens are required by law to report all fires within their towns, irrespective of the amount of damage, and so these were reported as well as others, the loss in such cases being placed at a nominal figure only. The greater part of the burned areas were situated outside the Adirondack Park, less than six per cent of this burned land being owned by the State.

Of the men who were warned out to fight fire most of them received \$2 a day ; some of them less. The firewardens are allowed \$2.50 per day while engaged in

fighting fire. Hence the expense for labor was something over \$3,000, of which the State refunds one-half.

In reviewing the work of the firewardens the most encouraging feature is the very large number of incipient fires which were promptly extinguished, and which in former years would have resulted in destructive conflagrations. For instance, in the town of Johnsbury, Warren County, the firewarden, Mr. William Merrill, reported 27 fires, each of which was extinguished so promptly that no damage to the forest occurred.

Of the 130 forest towns in the Adirondack and Catskill regions, fires occurred in 71 of them. That the total damage from these fires amounts to only \$2,835 speaks well for the efficiency of the force. This matter would be better understood if one were to make a study of the numerous fires in other States, as recorded almost daily in the public press, and note the large amount of damage to forest property caused by them.

Believing that the firewardens would attain greater efficiency if they had some more definite knowledge as to their duties, a printed circular containing full instructions was sent to each one. The text of this circular is of interest to all owners of woodlands, and copies can be had on application to the office of the Commission.

While on this matter I would respectfully call the attention of your Honorable Board to the active and efficient work done by Mr. Lester S. Emmons, the Chief Firewarden. He has been busily employed during the whole year in the work of organizing the large force under his control, which, counting both town and district firewardens, numbers 617 men. Whenever the evidence would permit he has promptly instituted prosecutions and collected penalties for violations of the State Fire Law, his efforts having conduced materially to suppress the carelessness and lawlessness which hitherto have been the cause of so much evil in this respect. He has carefully examined all the bills for fighting fire as sent in by the various towns, one-half of which is a charge against the State, and as a result there are fewer items for doubtful services. He has attended to the printing and distribution of 7,000 placards relating to the use of fire in our forests. During the year he visited personally 97 towns, and in the discharge of his duties traveled 11,016 miles.

## Adirondack Deer.

From the returns made to this office by the American and National Express companies it appears that the number of deer shipped out during the hunting season of 1901 exceeded that of the previous year, the shipments between September 1 and November 15 amounting to 1,062 carcasses, 103 saddles and 121 heads. As compared with the previous year, the figures are:

YEAR.	CARCASSES.	SADDLES.	HEADS.	TOTAL.
1900, - - - - -	1,020	89	95	1,204
1901, - - - - -	1,062	103	121	1,286

Reports received from each locality indicate that for every deer shipped by express four more are killed, which are eaten in camp, consumed by the residents, or hauled out on wagons to the numerous towns and villages situated near the outskirts of the forest.

As a matter of interest to all hunters and sportsmen familiar with the region, the following statement is submitted showing the number shipped from each railroad station:

### Carcasses of Deer Shipped from Points in the Adirondack Region—Season of 1901.

#### MOHAWK AND MALONE RAILROAD.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Beaver River, N. Y., - - - - -	91	5	10
Big Moose, N. Y., - - - - -	45	3	
Brandreth Lake, N. Y., - - - - -	3	1	
Childwold, N. Y., - - - - -	8		
Clearwater, N. Y., - - - - -	53	1	1
Eagle Bay, N. Y., - - - - -	9	1	4
Floodwood, N. Y., - - - - -	19	2	
Forestport, N. Y., - - - - -	11	6	2
Fulton Chain, N. Y., - - - - -	36	4	
Hinckley, N. Y., - - - - -	2		
Horseshoe, N. Y., - - - - -	3		
Lake Placid, N. Y., - - - - -	3	- -	5
Little Rapids, N. Y., - - - - -	1		
Long Lake West, N. Y., - - - - -	37	4	1
Loon Lake, N. Y., - - - - -	10	- -	1
McKeever, N. Y., - - - - -	10	2	2



ADIRONDACK DEER



RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Minnehaha, N. Y., - - - - -	1		
Mountain View, N. Y., - - - - -	5		
Nehasane, N. Y., - - - - -	2	1	10
Onchiota, N. Y., - - - - -	1		
Otter Lake, N. Y., - - - - -	5		
Paul Smith's, N. Y., - - - - -	20	12	4
Piercefield, N. Y., - - - - -	32	2	5
Pleasant Lake, N. Y., - - - - -	1		
Piland, N. Y., - - - - -	17	-	2
Raquette Lake, N. Y., - - - - -	27	14	
Saranac Inn, N. Y., - - - - -	1	2	
Saranac Lake, N. Y., - - - - -	2	2	
Tupper Lake Junction, N. Y., - - - - -	49	2	2
White Lake Corners, N. Y., - - - - -	5	-	1
Woods Lake, N. Y., - - - - -	18		
Total, - - - - -	<u>527</u>	<u>64</u>	<u>50</u>

NEW YORK AND OTTAWA RAILROAD.

Bay Pond, N. Y., - - - - -	-	-	1
Childwold, N. Y., - - - - -	2		
Derrick, N. Y., - - - - -	15	-	1
Dickinson Centre, N. Y., - - - - -	1		
Kildare, N. Y., - - - - -	2		
Madawaska, N. Y., - - - - -	7		
Santa Clara, N. Y., - - - - -	6		
Spring Cove, N. Y., - - - - -	11		
St. Regis Falls, N. Y., - - - - -	3	-	4
Tupper Lake, N. Y., - - - - -	3	1	5
Total, - - - - -	<u>50</u>	<u>1</u>	<u>11</u>

LITTLE FALLS AND DOLGEVILLE RAILROAD.

Dolgeville, N. Y., - - - - -	8		
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NEW YORK CENTRAL AND HUDSON RIVER RAILROAD

Fonda, N. Y., - - - - -	1		
Little Falls, N. Y., - - - - -	1		
Total, - - - - -	<u>2</u>		

## FONDA, JOHNSTOWN AND GLOVERSVILLE RAILROAD.

RAILROAD STATIONS.	CARCASSES.	SADDLES.	HEADS.
Gloversville, N. Y., - - - - -	3		
Johnstown, N. Y., - - - - -	8		
Northville, N. Y., - - - - -	76	11	25
Total, - - - - -	<u>87</u>	<u>11</u>	<u>25</u>

## RUTLAND RAILROAD.

Malone, N. Y., - - - - -	3	-	5
Winthrop, N. Y., - - - - -	2		
Total, - - - - -	<u>5</u>	<u>-</u>	<u>5</u>

## ROME, WATERTOWN AND OGDENSBURG RAILROAD.

Canton, N. Y., - - - - -	4	2	1
Edwards, N. Y., - - - - -	3		
Gouverneur, N. Y., - - - - -	1		
Potsdam, N. Y., - - - - -	17		
Total, - - - - -	<u>25</u>	<u>2</u>	<u>1</u>

## UTICA AND BLACK RIVER RAILROAD.

Alder Creek, N. Y., - - - - -	3		
Benson Mines, N. Y., - - - - -	36	-	1
Boonville, N. Y., - - - - -	8		
Carthage, N. Y., - - - - -	1	-	1
Castorland, N. Y., - - - - -	5		
Glenfield, N. Y., - - - - -	24	1	
Harrisville, N. Y., - - - - -	15	5	
Jayville, N. Y., - - - - -	2		
Lowville, N. Y., - - - - -	10	3	
Lyons Falls, N. Y., - - - - -	5		
Morristown, N. Y., - - - - -	1		
Natural Bridge, N. Y., - - - - -	7		
Newton Falls, N. Y., - - - - -	63	3	4
Oswegatchie, N. Y., - - - - -	18	2	
Port Leyden, N. Y., - - - - -	5	1	

RAILROAD STATIONS.	CARCASSES.	SADDLES.	HEADS.
Prospect, N. Y., - - - - -	22	- -	1
Remsen, N. Y., - - - - -	3		
Total, - - - - -	228	15	7

DELAWARE AND HUDSON RAILROAD.

Chubbs Dock, N. Y., - - - - -	1		
Crown Point, N. Y., - - - - -	1		
Dresden, N. Y., - - - - -	2		
Hadley, N. Y., - - - - -	1		
Loon Lake, N. Y., - - - - -	-	-	4
Lyon Mountain, N. Y., - - - - -	1	-	1
North Creek, N. Y., - - - - -	99	10	1
Port Henry, N. Y., - - - - -	9	-	4
Riverside, N. Y., - - - - -	3	-	4
Stony Creek, N. Y., - - - - -	8	-	1
The Glen, N. Y., - - - - -	1		
Thurman, N. Y., - - - - -	1		
Ticonderoga, N. Y., - - - - -	1	-	2
Westport, N. Y., - - - - -	2	-	5
Total, - - - - -	130	10	22

RECAPITULATION.

NAME OF RAILROAD.	CARCASSES.	SADDLES.	HEADS.
Mohawk and Malone, - - - - -	527	64	50
New York and Ottawa, - - - - -	50	1	11
Little Falls and Dolgeville, - - - - -	8		
New York Central and Hudson River, - - - - -	2		
Fonda, Johnstown and Gloversville, - - - - -	87	11	25
Rutland, - - - - -	5	-	5
Rome, Watertown and Ogdensburg, - - - - -	25	2	1
Utica and Black River, - - - - -	228	15	7
Delaware and Hudson, - - - - -	130	10	22
Total, - - - - -	1,062	103	121

For the interesting information contained in the foregoing statistics the Commission is indebted to the courtesy of Mr. John L. Van Valkenburg, Superintendent of the American Express Company, and to Mr. T. N. Smith, Superintendent of the

National Express Company, under whose instructions the agents at the various railroad stations compiled from their books the figures submitted here.

As in previous years, the weights entered on the shipping bills of the express companies show that the Adirondack deer compare favorably in size with those of other hunting grounds. The deer this season, so far as observed, were larger and in better condition than usual, which may be due in some extent to the fact that 1901 was a beechnut year.

A buck was shipped from Big Moose to Charles Philmore, Remsen, N. Y., which weighed, on the scales of the station agent, 267 pounds, dressed weight. By adding one-fourth, according to the usual well-attested rule, we have  $333\frac{3}{4}$  pounds, as the live weight.

The shipments from Dolgeville included a deer that weighed, dressed, 237 pounds. This would indicate 296 pounds as the live weight, or over 300 if the carcass had dried out by hanging on the pole at camp for a few days. This deer was consigned to F. Shaad, Little Falls, N. Y.

From Mountain View a deer was shipped to J. Robb, Malone, N. Y., whose dressed weight indicated a live weight of 281 pounds or more; and the express agent's returns from North Creek include a carcass of 230 pounds dressed weight (live weight estimated at 288 pounds), which was shipped to L. Stadaro, Albany, N. Y.

Mr. Frank S. Partridge, of Oneonta, N. Y., shot a deer near Goldsmith's, in Franklin county, that weighed, according to report, 310 pounds before it was dressed. Only a part of this animal was shipped out by express.

The statistics furnished by the express companies are interesting and valuable so far as they go. But the deer which are killed and not shipped out are so much more numerous than those which are transported by rail that some definite information is also needed regarding the former. In order to legislate intelligently for the protection of this kind of game some specific statement is necessary as to when, where, and how many are killed. It would be well to ascertain also the proportion of does.

### Elk and Moose.

Through the generosity of Mr. William C. Whitney a carload of live elk was brought into the Adirondacks and liberated in Township 40, Hamilton county, on the carry leading from Raquette to Forked Lake. Early in June last I went to Mr. Whitney's Preserve, situated on October Mountain, a few miles from Lenox, Mass., and made the necessary arrangements for the shipment. Mr. Whitney has over 120 elk on his preserve, and from this number a small herd containing 5 bulls and 17

cows were set aside for shipment to the Adirondacks. As the animals were very wild, considerable difficulty was experienced in driving them into the wagon vans for transportation to the railway station, six miles distant.

When the elk were safely on board the cars, they were left in charge of Game Protectors Courtney and Winslow, who accompanied them to Raquette Lake, where the animals arrived in good condition and none the worse for their journey. The car containing them was run upon one of the railroad scows of the Raquette Lake Transportation Company and towed to the Forked Lake Carry, where the elk were turned loose into the woods.

The general character and feeding grounds of the Adirondack forests are so different from the usual habitat of these animals that their introduction is largely a matter of experiment. There have been no elk in the Adirondacks within the memory of any one now living; but, so far as heard from, these elk seem to be doing well, and will probably increase in number.

Unfortunately, the cows resemble the deer greatly in their general appearance, and so may be killed by hunters who mistake them for does. True, they differ in color and are of a much greater size; but these differences would not be apparent when the animal was standing breast high in the underbrush.

About one year ago an association of sportsmen was formed in the city of New York for the restoration of moose to the Adirondack forests, its organization being due largely to the efforts of Mr. H. V. Radford, editor of *Woods and Waters*. The association, in furtherance of its objects, prepared a bill which was introduced in the Legislature by Hon. Frank J. Price. This bill, which became a law, carried an appropriation of \$5,000 for the purchase of moose, and provided for their protection by a penalty of \$250 fine, and imprisonment of not less than three months nor more than one year. The expenditure of this appropriation having been entrusted to the Forest, Fish and Game Commission, contracts have been entered into with persons who deal in this kind of game to furnish moose at prices varying from \$100 to \$150, delivered free of freight at such railway stations within the Adirondack region as the Commission may designate.

### Litigations and Law Suits.

The most important litigation of the year was the suit of Benton Turner against the State, which was tried before the Court of Claims. When the State bought the lands in Township 21, Franklin county, situated near the north shore of the Lower

Saranac Lake, title was acquired to the land only, Mr. Turner having a timber right which included the spruce and hemlock on this property. In compliance with a numerously signed petition from the inhabitants of Saranac Lake village and vicinity, the Commission condemned the timber in order to prevent it from being cut, and tendered Mr. Turner \$50,000 in payment for the same. He refused to accept this amount and instituted a suit before the Court of Claims to recover \$126,656.25. The Attorney-General, assisted by the Hon. Merton E. Lewis, appeared for the State, and the case was tried last spring, the principal evidence on the part of the State being furnished by the officials of your department. The award granted by the court to Turner allowed him \$46,862.50, which was substantially less than the sum tendered him by the Commission for the value of his timber. He appealed from the decision, and the case has been sent back to the Court of Claims for additional evidence on certain disputed points.

A large number of suits have been commenced during the past year for the eviction of squatters, actions which became necessary in order to protect the State's title and remove any cloud from the same that might arise from a claim of adverse possession by these occupants. With few exceptions judgment was taken by default in each of these cases; but at Raquette Lake several parties who have cottages on State land, and who dispute the State's ownership to that township, have entered a defense. At this date the cases have not yet come to trial.

### Land Purchases.

Although no appropriation was made by the Legislature at its last session for the purchase of land, a large addition was made to the Forest Preserve by the conveyance of various tracts which were bought during the previous year, but which, owing to delay in perfecting title, were deeded or conveyed during the year 1901. These conveyances include 36,458 acres in the Adirondack Park, the aggregate cost of which was \$140,384.40, or \$3.85 per acre. In the Catskill region the conveyances amounted to 5,605¼ acres, costing \$12,581.31, or \$2.24 per acre.

In the appendix to the preliminary report of the Commission, January 30, 1902, will be found a list of these lands, showing in detail the name of the grantor, location of lot, number of acres conveyed, price per acre, and total amount paid. In some instances the grantor conveyed several lots of different values, the price per acre representing the average value. For instance: in the case of William Harris, who received \$6.50 per acre, it should be explained that the lands conveyed by him were appraised by the inspectors at various prices ranging from \$2 to \$14 per

acre, and hence the price noted in the schedules may not indicate the value of a particular lot. The price is properly understood only when taken in connection with all the lots conveyed by any one grantor.

### Employment of Foresters.

During the past year the expert foresters who were in the employ of the Commission have rendered efficient and valuable services. Some of them, induced by offers of a higher salary than this department could pay, owing to the limitations of the annual appropriation, have accepted positions elsewhere. One of them, Mr. H. S. Meekham, a forester and land surveyor, received an appointment under the United States Forestry Bureau. Mr. Grant B. Bruce and Mr. Ralph S. Bryant accepted positions from the United States Forestry Bureau in the Philippine Islands, and are now engaged there in forestry work. We shall lose also the valuable services of Mr. McClintock, the Assistant Superintendent, as he has recently been appointed commissioner of public works in the city of Rochester.

Yours very respectfully,

WILLIAM F. FOX,

*Superintendent of State Forests.*



A GENTLEMAN.

# Tree Planting.

[Extract from the Report of the Assistant Superintendent.]

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## Plantation No. 1.

LAST spring I was engaged, in company with Forester Bryant,\* in making an examination of lands in the Catskills preparatory to their purchase by the State.

We were deeply impressed by the burned and barren condition of some of the prominent mountain tops and slopes, which are a source of disappointment to the large and increasing number of people who come here for summer enjoyment and mountain scenery. As a result of this denudation of the mountain slopes the brooks, where the speckled trout once found a natural home, have become in places a succession of mere pools separated by the dry rocky bed of the once unfailing stream.

These unsightly areas are not due to any lack of soil or suitable forest conditions, but are the result of fires, which in the old days were often deliberately set, after the cutting down of the great stand of hemlock, from which only the bark was taken; in fact, it is a legend of the locality that the boys used to celebrate the Fourth of July and election by burning a mountain.

From a close examination of some of these burned places it appears that nature does not reclothe them directly with valuable species. Ferns, pin cherries, and trees of inferior value come up first, to be followed after a lapse of time by an unevenly distributed growth of more valuable trees. A long period of years is often necessary for the slow change of composition of the forest, and the return of valuable species.

First, poplar, with light seeds easily carried by the wind, and pin cherry, the seeds of which are probably carried by the birds, come in from a long distance.

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\*Mr. Ralph C. Bryant, F. E., the first man graduated in the N. Y. State College of Forestry, to whom the writer is indebted for assistance in making the plantation and in preparing this report.

These are comparatively short lived, and are gradually crowded out by trees of greater value and longer life. That nature can be effectively assisted in selecting is shown by the following facts:

The variety of forest growth in the Catskills is great. The variation in elevation from 1,000 to 3,000 feet above sea level, with a mild climate, affords a congenial habitat for a large number of species, the special limitation being upon those trees which seemingly thrive best in moist places. The slopes are generally steep and the valleys narrow. The following species have been noted in good development:

White pine,	<i>Pinus strobus.</i>
Norway pine,	<i>Pinus resinosa.</i>
Red spruce,	<i>Picea rubens.</i>
Hemlock,	<i>Tsuga canadensis.</i>
Balsam,	<i>Abies balsamea.</i>
Hard maple,	<i>Acer saccharum.</i>
Red maple,	<i>Acer rubrum.</i>
Mountain maple,	<i>Acer spicatum.</i>
Striped maple,	<i>Acer pennsylvanicum.</i>
Yellow birch,	<i>Betula lutea.</i>
White birch,	<i>Betula papyrifera.</i>
Black birch,	<i>Betula lenta.</i>
American beech,	<i>Fagus americana.</i>
White oak,	<i>Quercus alba.</i>
Red oak,	<i>Quercus rubra.</i>
Chestnut,	<i>Castanea dentata.</i>
Shell-bark hickory,	<i>Hicoria ovata.</i>
Mocker-nut hickory,	<i>Hicoria alba.</i>
White ash,	<i>Fraxinus americana.</i>
Black ash,	<i>Fraxinus nigra.</i>
Sycamore,	<i>Platanus occidentalis.</i>
Basswood,	<i>Tilia americana.</i>
Poplar,	<i>Populus grandidentata.</i>
Aspen,	<i>Populus tremuloides.</i>
Black cherry,	<i>Prunus serotina.</i>
Pin cherry,	<i>Prunus pennsylvanica.</i>

Hornbeam,	<i>Ostrya virginiana.</i>
American elm,	<i>Ulmus americana.</i>
Pepperidge,	<i>Nyssa sylvatica.</i>
Dogwood,	<i>Cornus florida.</i>

The ash makes a fine development. We noticed one two feet in diameter, and have been reliably informed of one 36 inches in diameter on the southerly slope of Hemlock Mountain. Of spruce, we saw one on West Kill Mountain, one of the highest peaks of the Catskills, which was 36 inches in diameter, with a short bole. A red oak 30 inches in diameter was seen on the Bryant tract, at an elevation of 2,000 feet; and a splendid second growth of this species was found on top of Timothyberg Mountain. Pines attain a large size here: we measured perfect specimens of second growth, 24 inches in diameter.

The different species are very unevenly distributed. In some of the small valleys or cloves many of them are entirely wanting, while in some places, like the beautiful West Kill Valley, nearly all are found in a thrifty condition. The mountain tops show the least variety, although upon some of them can be found most of the different kinds of trees. There is nothing which indicates that the existing older trees, or the second growth coming up, are the ones best fitted to the conditions. In fact there are many indications that nature could be easily and advantageously assisted in the early life of the forest growth needed to cover up the bare, rocky slopes.

It is commonly believed that the succession of short lived trees like the pin cherry, birch, and poplar, following ferns, fire-weeds, and blackberries, which come in after a burning, is necessary to form a soil suitable for the more important species. From an examination of many of the burned slopes we believe this to be an error, and that on almost all there is enough good soil held in the crevices between the rocks or on the rocky shelves to sustain any of the varieties of trees which will endure the climate.

Some of the trees do not appear to be able to thrive on exposed tops and slopes, because of the high winds and occasional ice storms. This is especially true of the birch and most of the hard woods, even the oaks. A splendid growth of hemlock has until within a half-century covered nearly all the Catskill slopes and the tops of many of the lower hills. It does not make as valuable timber as spruce and pine, and does not generally come up in second growth, except on small areas.

It appears probable that any wood of even age and even distribution would better withstand the effects of high winds and produce straighter trees. It is well worth while to try all the various kinds of trees which promise to succeed here.



SECOND-GROWTH WHITE PINE NEAR PHOENICIA.  
SHOWING TWO TREES IN THE FOREGROUND CLEANED OF THE LOWER BRANCHES  
BY NATURAL PROCESS.



We determined to take advantage of the opportunity afforded us to begin the experiments which will be necessary to discover the best means of re-forestation. So, although many species are available, we decided that white pine and spruce were the most readily obtainable, and upon application to Dr. B. E. Fernow, director of the New York State College of Forestry, he kindly sent us 500 white pine and 500 spruce seedlings. These were three years old, and were raised upon the experimental grounds of the college, which are situated at Axton, in Franklin County.

The seedlings, which were from 6 inches to 12 inches long, came by express, nicely packed in bundles, with damp moss and green balsam boughs around them, and appeared to be in good condition.

The history of the seedlings is given by Mr. Edward Hagger, forest manager for the New York State College of Forestry, as follows:

They are Norway spruce (*Picea excelsa*) and white pine (*Pinus strobus*) raised from seed planted in the nursery of Heins Sohne Holstenbeck, Holstein, Germany, in the spring of 1898; one year in the seed bed and two years transplanted. Shipped to Axton in the spring of 1901, and were one month in transit. Arrived in good condition and were considered extra good selected stock. They were raised in a sandy soil, almost of the character of a loamy sand.

In selecting a place to plant we had two points in mind: *First*. To secure a place which would fairly represent the average soil conditions of the mountains, and places which had been burnt, so that if our plantation grew and showed a favorable development, the result would have a bearing on the selection of other places.

*Second*. A prominent location was also desirable in order that this plantation might serve as an object lesson, and create a greater interest in the preservation of the forests in that region.

The site selected for the plantation was upon the northerly end of the top of Simpson's plateau, a spur of the Wittenburg mountain, between Woodland valley and Cross Mountain streams, having an elevation of 2,250 feet above ocean level, and 1,100 feet above the adjacent valley. It can be seen from the turnpike in the Esopus valley. It lies partly upon the flatter slope of the top and partly on the precipitous northerly slope. The slope of the whole hill is very steep, with numerous vertical ledges and narrow intervening shelves which retain the small amount of remaining soil.

It was covered originally with a thick growth of large hemlocks which were cut about fifty years ago, since which time fire has run over it repeatedly. The present imperfect covering consists of a tangle of pin cherry, hard maple, soft maple, red

oak, elderberry, poplar and blackberry bushes, mostly dead and bent over by wind and snow. In places there is no soil over the rock; in others the only covering is moss or forest duff, with roots and decayed leaves; while in spots the rich soil is several inches deep and underlaid by a few inches of sandy loam which appears to be rock decomposed "in situ." Using a pickaxe and grubhoe we thoroughly stirred up the earth, and then packed it around each seedling. In fact it was necessary in many cases to scrape up with the fingers all the soil within reach, in order to make a fitting bed for the little trees.

The plan was to space the trees six feet apart, as nearly as possible; but the difficulty in finding soil made this vary, so that 900 of the seedlings are spread over about two acres. One hundred of the spruces were placed on the flat top of the plateau about 1,000 feet farther south, on the west side of the old bark road, which is used as a trail up the Wittenburg, where the soil and second growth conditions are about the same, except that in spots it is inclined to be wet. Here were several spruce trees growing naturally four or five feet high, and looking thrifty.

The planting was done on May 1, 2 and 3, 1901. It required one whole day and part of two other days for both of us, with the aid of one man, to set out the 1,000 seedlings; equivalent to two full days for three of us. We put more work upon them than would usually be required, and it seems reasonable to estimate that under average conditions two men can set out 1,000 trees a day. As indicating in a small way perhaps the future possibilities of our little plantation we will say that we have noted in the Catskills a white pine 22 inches in diameter, 77 years old; another 20 inches, 75 years old; another 28 inches, 290 years old; and for spruce, one 1 inch, 25 years old; one 15 inches, 100 years old; one 17 inches, 100 years old; one 22 inches, 125 years old; one 24 inches, 155 years old.

### Plantation No. 2.\*

Last fall 5,000 trees were placed upon the eastern top and slope of Timothy-berg mountain, in the town of Shandaken, Ulster County. It is the usual practice to plant conifers in the spring in preference to the fall, and this is encouraged by experienced nurserymen. It seems to us that this selection comes from experience of the difficulties in shipping trees from the nurseries in warm weather and getting them into the ground before the roots have been dried out or the

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\* In making this plantation and the report of the same I was efficiently assisted by Mr. A. Knechtel, F. E., a graduate of New York State College of Forestry. Thirty residents of the vicinity helped us to set out the plants.



ARRIVAL OF SEEDLINGS.

TREES PACKED IN BASKETS AND BUNDLES.



INSPECTING STOCK.



plants have begun to heat; and also from the fact that most nursery trees are set out in cultivated land where, in the fall, the action of frost tends to throw out the seedlings, which have not begun to take hold of the ground with their roots and suckers.

The conditions of tree planting in uncultivated soil are different. The soil is less compact, is largely made up of roots and partly rotted leaves and wood, and is generally covered with a litter of leaves from the small growth, if not from the scattering large trees already standing.

It is often noticed that frost penetrates the forest floor but little distance, while upon neighboring cultivated land it goes in several feet. The advantages of fall planting in forestry work are: that it adds to the length of time available for doing the season's work; that it makes the necessary skilled labor more effective and economical; that there is less chance of the plants being killed by drought. When planted just before the usual fall rains the plants may be considered as heeled in for the winter, the earth becoming thoroughly packed around the roots and suckers so that when spring opens they are ready to enjoy the full benefit of the genial warmth and invigorating moisture. While our planting was in progress, after 3,500 trees had been set, there was a good soaking rain, and two days after the work was finished there was another rain, with some snow.

The Catskills afford such a healthful and attractive summer home to the vast population living within a few hours' ride that the district is destined to become a resort with an ever-increasing number of visitors. It is reasonable to expect that it will become literally a great park, as much larger than the celebrated new system of parks around Boston as those are larger than the little city squares formerly considered as parks. The mountain tops and steep slopes will be covered with a magnificent forest, crowding down to the narrow strips of meadow and garden reserved for fruit, vegetables and dairy products to supply the tables of the cottages, hotels and boarding houses which will line the finely improved roads skirting the delightful streams.

The forests will be restored to decorate the mountains which so beautify every view with their variety of curves and slopes; to revivify the air; to keep the cold springs full; to preserve the rushing streams through the hot summer, renewing the former conditions congenial to the trout, and refreshing all. And yet under forestry management they will furnish regular employment to many people and form the basis of permanent local manufacturing industries, and finally be a source of profit, like the forests of Europe, similarly situated, where there is a local market for all the limbs and twigs which will not bear the cost of transporting far.

The original forest which covered all of these mountains was mostly a dense growth of great hemlocks and pine, with some spruce and balsam in places, and a large variety of hardwoods. The hemlock occupied the slopes with a dense growth of large trees. The pine grew upon the flats and lower slopes, and occasionally showed their tall heads breaking the even outline of the hardwood growth on the mountain tops. A few spruce slopes were to be found, while the balsam occupied mostly the higher ground.

The conifers have been removed, with the exception of a few isolated patches. The mountains, though yet beautiful, have largely lost the pleasing color and form that the hardwoods gave. The light green of the hardwoods, with the darker shades of pine, spruce and balsam, and the deep, dark green of the hemlock has given place to the colors of the hardwoods only.

The hills have also lost, to some extent, the health-giving qualities of the soft woods, with their fragrant germ-destroying odors, the efficacy of which in curing disease is universally admitted.

The softwood groves were the habitations of the deer, the rabbit, the squirrel, the partridge and other animals where they took shelter from the blasts of winter.

The most of the hemlock was cut down for the bark alone. There are still large areas covered with old rotten trees which were peeled and left in the woods. The pine, the spruce and the balsam have been taken for their lumber with no care for the perpetuation of these species in the mountains. Small conifers, mostly balsam, are now being taken each winter in train loads from the woods to be used in the cities as Christmas trees. In 1900 thirty carloads passed through Phœnicia. To be sure, this would be a proper use of the young trees provided they were selected with regard to the benefit of the forest. Under proper forestry management thinnings are sometimes necessary. These thinnings, not only from the balsam, but from the pine and spruce, would furnish many trees for such purposes. Their removal as carried on at present, however, with no care for the good of the forest, only continues the destruction of the softwoods. Mills for dry wood pulp, excelsior mills, and mills for the manufacture of wood alcohol in addition to a large number of sawmills, make a local market for literally all the trees, large and small. The mills which manufacture dry pulp consume a large amount of young timber, mostly small pines, poplar and basswood.



VILLAGE OF PHOENICIA.  
THE HEART OF THE CATSKILLS.



ARKVILLE, DELAWARE COUNTY, N. Y.

THE WHITE SPACE ON THE MOUNTAIN SHOWS WHERE LUMBERING HAS BEGUN FOR AN ACID FACTORY. IT EXTENDS TO THE LINE OF THE STATE FOREST ON THE TOP.



The mountain south of Arkville shows a white, clean spot on the mountain side, where lumbering has just commenced for the new acid factory, which it is expected will consume about 5,000 cords per year. The existing acid factories in the Catskills will use about as much wood as will grow on 70,000 acres of well-stocked forest.

Fire has run over many of the hills time and again destroying the coniferous growth, while the hardwoods have been able to withstand in some degree its ravages. The hardwoods have now almost entire possession of the hills. They reproduce themselves much more easily than the conifers, and will hold possession unless softwood seedlings are planted, or the hardwoods thinned and conifer seeds sown.

To be sure, on the flats at the base of the hills are to be found groves of white pine (pumpkin pine). The trees seem to reproduce freely, especially wherever there is mineral soil at the surface, and, if cared for, this species would no doubt continue to be a feature of the valleys. But if it is ever again to occur in any considerable quantity on the sides and tops of the mountain it must be planted. It is only with very unusual and violent gusts of wind that the seeds are blown up the hill side. Once planted, however, the trees when they bear fruit will scatter their seeds laterally and down the slope with ease.

Then with the care of the forester, favoring the pine to the disadvantage of the hardwoods, groves of this valuable species may again clothe the hill sides. And what is true of the white pine in this respect is true also of the other conifers that we have planted.

A large number of the people who visit the Catskills come by the Ulster and Delaware Railroad up the valley of the Esopus Creek from the Hudson River to Phoenicia, where there is a junction with the railroad extending into the valley of the Schoharie. This place is literally in the heart of the Catskills. It is situated at the foot of the westerly end of a lofty and irregular ridge, the southerly slope of which is skirted by the Esopus Creek along which runs the railroad, and a splendid improved State road, one of the finest rides in the State, extending from Kingston about forty miles through the mountains. This ridge is called Tremper mountain on the westerly end, and Timothyberg mountain on the east end. A site was selected for a plantation upon the southerly slope of the easterly end of Timothyberg mountain. From this mountain has been taken hemlock, basswood, chestnut and poplar, and it was lumbered for oak bark twenty-five years ago. Fire burned over it in 1881 and again in 1888, since which time there has been no further burning. On the same lot, but on the north slope.

of the mountain, there is a forest standing having the following composition per acre :

- 34 ash from 5 inches to 10 inches.
- 28 beech from 5 inches to 18 inches.
- 12 birch from 6 inches to 18 inches.
- 10 hemlock from 8 inches to 16 inches.
- 56 basswood from 6 inches to 20 inches.
- 28 chestnut from 6 inches to 10 inches.
- 30 maple from 6 inches to 28 inches.
- 4 oak from 8 inches to 14 inches.
- 8 hornbeam from 4 inches to 10 inches.

Upon the top of the mountain beyond our plantation there is a forest having the following composition per acre :

- 5 beech from 2 inches to 4 inches.
- 18 birch from 6 inches to 15 inches.
- 38 hemlock from 6 inches to 30 inches.
- 3 maple from 5 inches to 8 inches.
- 47 red oak from 8 inches to 24 inches.

A number of oak stumps mark the places where valuable trees once stood. Mr. H. B. Hudler, supervisor of the town of Shandaken, stated that in 1862 he carried out a contract with J. H. Simpson for removing 400 cords of hemlock bark from the upper west slope of Timothyberg mountain, and at that time nearly all the original and exceedingly dense growth of hemlock which covered the mountain had been taken off.

A grove was planted upon the extreme top, and another at the bottom, with a narrow strip connecting the two, planted up the slope. The grove on top of the mountain is about 2,300 feet above the ocean, and about 1,200 feet higher than the lower grove, so that the plantation as it grows will become a sightly object to people traveling on the railroad and on the State highway.

That the plantation will be an object of interest, and will help to increase the interest of the inhabitants in the improvement of the forests, is shown by the fact that the people in Phoenicia and along the State road to Mount Pleasant expressed commendation of the experiment; and we were assisted in the work by a large number of citizens who gave their services without charge.

The seedlings included 1,200 white pine, 1,800 Norway spruce, and 2,000 Scotch pine. They were three years old and raised from seed in the nursery of the New York State College of Forestry at Axton, in Franklin County, and were secured from Dr. B. E. Fernow, director of the college. They were shipped from Tupper Lake on Saturday, October 5th, and arrived by express on the 7th, in fine condition, packed in German baskets and bundles, and inclosed in damp moss.

The selection of the white pine needs no explanation. It is well known, however, that the white pine without a mixture of some other species will not clean itself; that is, the lower branches as they die will not break off easily, and the lumber resulting will be full of knots. If some other species, and especially a species which grows more slowly than the pine, be mixed with it, the tops as they are blown by the wind will strike against the dead branches of the pine and break them off.

The Norway spruce was selected, not only for this purpose, but for its own qualities as a timber tree. Its wood is as good as that of our spruce. It has been planted extensively in this country as an ornamental tree, and has thriven under many conditions of soil and climate. It has an advantage in the matter of reproduction as its cones are large and the seeds many.

The Scotch pine for lumber will take the place of the hemlock. It is a hard pine, and like the hard pines will be suitable for rough lumber. It is a fast growing tree, while the hemlock grows very slowly. It is not exacting as to mineral substance, accommodating itself to any description of soil from shifting sand to clay. In Europe it thrives under any condition of moisture from very dry soil to swampy ground. In Great Britain it ascends the mountains to 2,200 feet, while in the Alps it reaches an altitude of 6,000 feet.

The seedlings were planted between October 8th to 14th, inclusive. Holes were made with pickaxes and grubhoes, and each plant was carefully placed in its hole and packed about with the fingers. The plantation extends from the foot of the mountain to the top, a distance of about one mile and a quarter. The adjacent rows of trees were generally of different species, the arrangement being more definitely shown in the accompanying sketch map.

The trees were generally spaced from six to eight feet apart, although parts of the two groves were placed closer. The soil varied in character from a rich black loam, with somewhat clayey subsoil at the lower end, to a thin earth consisting of decomposed rock on the top of the mountain. On the intervening slope the only soil was in the fissures of the rock, in some places yellow decomposed rock, and in

others simply charred duff, moss, and small roots. The rock formation consists of shales in thin layers, the surface being covered with flat, angular fragments. We found it possible to plant the trees even upon the apparently bare rocky slopes by digging down among the rocks and collecting with the hands enough of what appeared to be mostly ashes. Immediately below the surface these slopes seem to retain moisture; and, if a tree can once get started, there appears to be sustenance for it in the crevices which the roots can reach. No doubt some of the trees will die from lack of good soil conditions; and it should be stated that before the planting was completed we noticed that the trees in one of the baskets had begun to heat. It was only the Scotch pine, however, and not more than 500 of these were so affected. The surface of the ground is now generally shaded by a thrifty, thick, small growth of chestnut, oak, witch-hazel, birch, sumach, huckleberries, and ferns, with many other species represented.

J. Y. McCLINTOCK,  
*Assistant Superintendent of Forests.*



DEAD TREES.



A FISHING INCIDENT.



## The St. Lawrence Reservation.

SINCE the last report, several improvements intended to make this reservation easier of access to the public and better suited to the general requirements of visitors, have been completed.

The dock at Lotus Island is now in excellent condition, having been permanently repaired according to plans prepared by Deputy State Engineer Judson, at an expense safely within the original estimate.

At a comparatively small expense, three acres of land have been added to the reservation at Burnham's Point. This addition gives room for very desirable sites for camping. The State Engineer is preparing plans for a dock at this point, which construction is considered desirable, as this is the only place where there is no landing, and the location is a highly popular resort with the public. A small appropriation will be required for this improvement, and application has been made for the same.

A roadway has been built from the public highway down to the park grounds, thus giving the first real entrance to the reservation. This is a convenience which will be appreciated by every person visiting the park, and already has been the subject of favorable comment.

The pavilions, which were completed late last season, did not have a full trial in operation by which their popularity might adequately be judged; but their constant use during the past season has amply demonstrated the value which the public places upon them, and has shown that the expense incurred in their erection was an excellent investment on the part of the State.

The experience of the past season has also shown that some provision should be made for the care of the grounds. Thousands of people visit this reservation each summer, and the slight expense required to police it properly will be amply repaid by the increased convenience experienced by the public. The very large number of visitors on the reservation during the past summer is ample proof of the growing popularity of the reservation, and the favorable comments made on its present condition is sufficient proof that the people appreciate what has already been done here.

# Report of the Chief Game Protector.

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## To the Forest, Fish and Game Commission:

**M**Y report for the year might properly include a detailed account of many actions brought and many suits won in the interest of the State, of thousands of letters written in explanation of mooted questions about the Game Law, or of statements of many raids made upon persistent violators of the law in various parts of the State. These details would, however, be cumbersome, and the results show for themselves to an extent that would seem to make such a review unnecessary.

The work of this department is increasing steadily, and the money turned into the State Treasury shows for itself in the monthly reports.

The notable events of the past year were the suits brought against the Arctic Refrigerator Company, which stands practically convicted of having game out of season in its possession amounting in value to many thousands of dollars. It is suggested that if game is found in the close season outside of warehouses where a record is had of the same, or illegally possessed, a law should be enacted declaring that when a seizure is made, after the game has served its purpose as evidence, it should be turned over to some charitable institution instead of being allowed to go to waste, thereby benefiting some one without laying any one liable, and last but not least giving the officer making the seizure something definite under which to act.

Several large trespass cases have also been prosecuted during the year, notably that of the Moose River Lumber Company, which is still pending.

Very many smaller cases, mentioned collectively in the accompanying detailed report, attest the vigilance of the department. I submit them with the other matters for your consideration, and make the recommendations hereafter stated.

During the year the protectors seized and destroyed many nets and devices that were being illegally operated. The total of the individual seizures was 803 fyke nets, 443 trap nets, 416 gill nets, 76 squat nets, 20 seines, 335 set lines, 7 spears, 16 eel



H. S. WATSON

RAIL BIRD SHOOTING.



weirs, 8 wire nets and 2,637 tip-ups. The total number of illegal devices destroyed was 4,761, which represented a total money value of \$25,820.

Actions were begun against 348 persons. Of these 317 were convicted or judgments taken, and the total sum imposed as fines and penalties amounted to \$9,856.75. Of this amount the sum of \$8,526.70 was collected and deposited with the State Treasurer as the law provides. The remaining \$1,330.05 was retained by attorneys, justices and constables in cases where their fees were deducted before remitting to this department. There were also fines imposed to the amount of \$938 where no recovery was had, and the persons upon whom these fines were imposed served time either in penitentiaries or jails, one day for each dollar, which amounted to 938 days served. The remaining 38 cases resulted as follows: 19 acquitted, either by court or jury; 6 cases on appeal; 4 actions withdrawn, and 2 where there was insufficient evidence to hold the accused.

Too much cannot be said in favor of the law of 1899, which prohibited for a term of years the hounding of deer. It was an undisputed fact that, with the advantages of numerous railroads penetrating the Adirondacks about that time and the many people becoming interested in hunting, the deer of the State would surely become exterminated. The Legislature of 1901 should be commended for its legislation along this line, as a law was enacted which forbids for all time the hounding of deer. There is not a question, from the best information obtainable, but that deer have increased in the last five years fully fifty per cent, and they can be found in abundance through the main woods, and also in all the little detached parcels of forest land in every county adjoining the Adirondacks. If this law can remain on the statute books together with the act of 1888, which limited the number one could kill or transport, there is no prospect of the deer becoming exterminated, although the advantages of reaching nearly every portion of the Adirondacks are much greater. With the increase yearly in the number of people who are desirous of hunting, it might be well to shorten the season, making the close season October 31st instead of November 15th. The past two years have shown that more deer are killed during the last ten days of the open season than in the two months prior to that, on account of the snow which facilitates still hunting ten fold.

I would respectfully suggest that while it is not advisable to make too many alterations in our Game Law, for fear of confusing the public mind, it would be both advisable and expedient that the following changes in the law as it now stands should be made during the present session of the Legislature:

1. Increasing the force of protectors to fifty as against the present thirty-eight. Several localities are now practically without any protection and too remote from

the location of the present protector whose expense account is insufficient to permit him to travel any distance beyond his immediate locality. This is true of all that territory lying east of the Hudson River from Lake Champlain to Long Island Sound, which embraces six counties. On account of the increased acreage of forest land and the reservations made for lumbering, much time also will be required to prevent the inadvertent cutting of timber outside of that reserved, to say nothing of the constant necessity for checking the general tendency of many people to plunder on the State land wherever an opportunity presents.

2. Continuing the present close season for deer in the counties of Delaware, Ulster, Greene and Sullivan absolutely for a term of years, or, if this is not possible, then not allowing more than two weeks open season in these counties. The State has stocked this territory with deer at a considerable expense, and the results of the work have been highly gratifying. The continuation of the present close season, as suggested, will materially aid the work and be beneficial to everybody concerned.

3. Amending section 36 of the present law so as to place in the hands of the Commission the granting of certificates to take birds for scientific purposes, instead of the matter being as at present in the hands of "any society of natural history incorporated in the State or by the Regents of the University." The reason for this suggestion is that the Commission can readily ascertain through the protectors in their several localities the exact standing and the full object of persons making application, which would prevent an abuse of the law that might very easily arise under the present system.

4. Establishing a system of licensing guides, thereby placing upon the list of those available to the public a much more competent class of men as compared with the many inexperienced so-called guides of the present day, who are not familiar enough with the woods to render efficient service.

5. Enacting a law charging a license fee to non-residents for the privilege of hunting in this State, thereby in a measure reserving the game to the citizens of the State who are paying a large amount annually to propagate and protect it. This proposition may meet with some objection from a few hotel keepers, but it is no more than justice to the taxpayers who are called upon to pay a license in nearly every State into which they may go to hunt. It is particularly true of Canada where many of our citizens who go hunting are compelled to pay a large license fee for that privilege. The revenue derived from this source and from the licensing of guides should be placed at the disposal of the Commission to further aid in carrying on the work of protection.

6. Prohibiting the sale of woodcock, grouse and quail killed within this State,



H. S. WATSON

DUCK SHOOTING.



and compelling dealers who are handling any game from outside the State during the open season to keep a record and be ready at all times when a proper demand is made to furnish an invoice of all game received or sold.

7. Repealing all supervisor laws on Long Island relating to fish and shellfish. The Legislature should enact laws for that locality as it does for other parts of the State. By reason of the fact that the supervisors have been legislating independently since 1849, their laws have become confused, and in recent years to my certain knowledge they have not conformed to the State law. There is no question but that a majority of their present laws are in such a confused condition that they cannot be enforced, notwithstanding the fact that this department is called upon frequently to prosecute under those laws. Several years ago the Legislature empowered all the boards of supervisors throughout the State to pass laws further restricting the taking of fish and game. Each county availed itself of this, and matters became so mixed up that, in 1895, the Legislature at the request of the general public repealed the law, except as to the power given to the counties of Long Island in relation to the taking of fish and shellfish from salt water.

J. WARREN POND,

*Chief Protector.*



CURIOSITY—WHAT IS THAT?

# Report of the General Foreman of Hatcheries.

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## To the Forest, Fish and Game Commission:

HEREWITH present my report for the year ending September 30, 1901, showing the number of fish distributed by the Commission, the number of each kind of fish and the size, from which hatchery and hatching station distributed and where the fish were planted.

There were 1,631 applications received by the Commission — of these 1,259 were granted for various amounts each, 173 were rejected, and 179 carried over to be filled in the current year. Included in the rejected applications are 92 for black bass, 27 for pickerel, 4 for bullheads, 4 for rock bass and 3 for catfish.

With the exception of a very small number of black bass that are usually taken out of the Erie Canal when it is drawn off in the fall, the Commission has none of these varieties for distribution. The remainder of the applications were rejected for various reasons. Many of them were duplicates of applications already granted, and in some cases the waters were not suitable for the fish for which application was made. A few of the applications were withdrawn.

Your attention is called to the large number of fingerlings and yearling fish that have been distributed during the past season, which exceeds by far any previous distribution of these sizes ever made by the Commission.

In order to obtain some information as to the result of the Commission's work in planting fingerlings and yearlings, at the close of the season about fifty circular letters were sent out which read as follows:

“Since 1896 the Commission has been rearing and distributing to the public waters of the State, yearling and fingerling fish, as well as large numbers of fry. Some of these fish have been planted in your section of the State upon applications made by yourself and others. I would like very much to learn the result of the efforts of the Commission in stocking various waters, and if you will kindly write



BASS FISHING.

LANDING A DOUBLE.



me a letter advising me of what the result has been in your section, the Commission would appreciate it. Thanking you in advance for any information you can give, I remain .. .. ."

In response to this circular letter between thirty and forty answers were received, and with scarcely an exception the replies were most gratifying, showing results beyond all expectations.

In almost every instance where fingerlings and yearlings had been planted the fishing has very materially improved, and in many instances the fishing for the past season had been better than ever before. As you will note from the tabulated report, a very large number of fish have been sent to the Adirondacks and Catskills, aside from those reared at the three Adirondack hatcheries, all of which were planted in Adirondack waters.

The question is very frequently asked of the Commission and its employees, "What is meant by fingerlings and yearlings?" In answer, it may not be out of place to quote a clause in the Superintendent's report of 1897:

"In referring to fingerlings it may not be out of place to explain the term a little by giving the age and length. At about four to five months we commence calling the young trout fingerlings, and continue to designate them as such until they are from eleven to twelve months old, when we call them yearlings up to eighteen months old, when they are classed as eighteen months or two-year-old fish. The average length of a brook, brown or rainbow trout four months old is about two inches. At eight or nine months old they will average three inches, and at one year old five inches. These figures are exceeded at some hatching stations in the State. Lake trout grow faster than the other species, and at twelve months old will average six inches long. Fish at the same age are not always the same size. Sometimes the larger ones are capable of swallowing the smaller ones of the same hatch."

To the above it might be added that brook trout, like lake trout and brown trout commence hatching about the first of January, and rainbow and black spotted trout hatch out in the spring months. All of the above are called fingerlings between the first of July and the first of January, after which they are called yearlings.

As a greater part of the applications made to the Commission are for fingerlings and yearling fish, it is suggested that additions be made where practicable at the various hatcheries to enable us to rear a greater number of fingerlings and yearlings. It is apparent that the increase in applications, for fingerlings particularly, is going to be very much greater than any possible increase in the facilities of the Commission

On account of an insufficient appropriation some necessary repairs and improvements were not made during the past season, and these should be made during the coming season.

As the Commission is about to build a hatchery in Delaware County, I would recommend that the hatchery at Rockland, Sullivan County, be abandoned and disposed of, if it is within the power of the Commission to dispose of it. The water is insufficient, very uncertain, and of very poor quality.

Some changes have been made at the Old Forge Hatchery, and some contemplated improvements there the coming season will, I believe, very materially increase the output at that hatchery.

Your attention is called to the recommendation to the previous Commission that an additional pipe be put in at the Adirondack Hatchery. This would necessitate an expense of some \$1,500, but would double the present capacity of the hatchery, and enable us to raise a very large number of fingerling fish.

It is recommended that the site selected last winter for a hatchery in Delaware County, near Hobart, be abandoned, for the following reasons: Insufficiency of water, danger of contamination, and lack of sufficient fall in the water.

The United States Commission, as usual, have been very liberal in their allotment of eggs to this Commission, particularly of shad, and much credit is due them for what they have done and are doing in keeping the Hudson River thoroughly stocked.

The taking of muskellunge for propagating purposes at Chautauqua Lake was carried on this year, and a very satisfactory number of eggs were taken and fry distributed. The foreman in charge of the work there was instructed to count each day the number of muskellunge taken in nets, and he reported 1,693, of which 27 had spear marks on them.

It is to be regretted that spearing through the ice is permitted in Chautauqua Lake, as it is apparent that the number of fish taken and the size of the fish are growing smaller each year. If the work is to be carried on at Chautauqua Lake some improvements should be made in the facilities for doing so.

The stocking of the larger bodies of water in the State with whitefish and pike perch is being carried on on as large a scale as the facilities of the Commission will permit. If a larger output is desirable increased facilities should be obtained, if funds are available for that purpose.

At the last session of the Legislature an appropriation of \$1,000 was made for the purpose of making exhibits of fish at the State Fair and at the Pan-American Exposition at Buffalo.

The exhibit at the State Fair, though not a large one, was a very creditable



SALMON FISHING.

NOW GIVE IT TO HIM.



exhibit, and attracted a large number of people, many of whom had never seen the different varieties of trout and game fish of the State.

The exhibit at the Pan-American Exposition was made by the United States Fish Commission, W. de C. Ravenel in charge, and was without exception the finest exhibit of the kind ever made in this country, being much better than your Commission could have made with the limited facilities at their disposal. We rendered all the assistance possible in the way of supplying the United States Commission with every variety of fish for which they asked, which necessitated an expenditure of \$241.16, leaving an unexpended balance of \$828.43 of the amount appropriated.

I regret to report that there is apparently a very large increase of carp in many waters of the State, and in many instances they have nearly ruined the fishing, principally by the condition in which they keep the water. They apparently multiply very much faster than any other fish, and it is to be regretted that they were ever introduced into the waters of this State.

In conclusion your attention is called to the very liberal courtesies extended to the Commission by the railroads of the State, particularly the New York Central and Hudson River Railroad, and Ontario and Western, the Delaware and Hudson Company, and the Buffalo, Rochester and Pittsburgh Railroad, for transportation furnished free to the State fish car and the messengers in charge of the fish, and in returning the empty fish cans.

### Pheasants.

The raising of pheasants at the Pleasant Valley Hatchery has been carried on during the past year on a limited scale, on account of our not having an appropriation for that purpose. An appropriation of \$1,000 or \$1,500 would enable us to more than double the output.

Very gratifying reports of results have been received from those to whom the birds have been sent during the past season, and it is suggested that when applications are granted, notice be sent to the persons receiving the birds that they must be liberated at once, and not kept in confinement. The birds are strong and hearty, will stand all kinds of weather, and do very much better free than when kept confined.

Many instances could be cited where large broods have been raised by birds that were liberated, and other cases where few if any birds were raised when they were kept in confinement.

Respectfully submitted,

RICHARD COTCHEFER,

*General Foreman of Hatcheries.*

# Fish Distribution.

## Summary for the Year Ending September 30, 1901.

Shad, - - - - -	19,675,000
Whitefish, - - - - -	32,250,000
Pike, - - - - -	46,900,000
Muskellunge, - - - - -	4,520,000
Frost fish, - - - - -	4,900,000
Shrimp, - - - - -	158,000
Ciscoes, - - - - -	100,000
Tom cods, - - - - -	35,000,000
Bullheads, - - - - -	50
Perch, - - - - -	4,500
Bass, - - - - -	1,500
Lake trout fingerlings, - - - - -	399,210
Lake trout yearlings, - - - - -	46,450
Rainbow trout fingerlings, - - - - -	132,325
Rainbow trout yearlings, - - - - -	109,975
Brown trout fingerlings, - - - - -	131,600
Brown trout yearlings, - - - - -	102,475
Brook trout fingerlings, - - - - -	351,500
Brook trout yearlings, - - - - -	65,368
Lake trout fry, - - - - -	2,405,000
Rainbow trout fry, - - - - -	20,000
Brown trout fry, - - - - -	1,187,000
Brook trout fry, - - - - -	2,262,000
Scotch sea trout yearlings, - - - - -	1,700
Red throat trout, 1 year old, - - - - -	13,350
Steel head salmon, 2 years, - - - - -	12
Red throat fingerlings, - - - - -	22,000
Lake trout, 4 years old, - - - - -	12
Rainbow trout, 2-5 years, - - - - -	76
Brown trout, 2-5 years, - - - - -	507
Brook trout, 2-5 years, - - - - -	646
Total, - - - - -	150,760,256



QUAIL SHOOTING.



# Report of the Superintendent of Shellfisheries.

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To the Forest, Fish and Game Commission :

I HAVE the honor to present a report of the business of the Shellfish Department, which, under the general supervision of the Shellfish Commissioner and of the Commission, has been assigned to my management as superintendent of shellfisheries.

The hydrographic surveys and the preparation of maps of lands under water, initiated by Hon. Eugene Blackford in 1887, and continued to the present time, have, during the past year, been carried forward by Charles Wyeth, C. E., surveyor of oyster lands, under my direction. Mr. Wyeth has been connected with this department for eleven years past, and his work, which calls for the exercise of more than ordinary skill and precision, has been performed in the most satisfactory manner.

The records of this office show a constantly increasing business. During the year 137 applications for lands under water for shellfish cultivation have been received, and after due advertisement the lands applied for have been leased to the highest bidder, as provided by law. A total of 2,467 acres has thus been added to the lands heretofore granted by the State for shellfish culture. The grants made during the year cover lands under the waters of Long Island Sound, East River, Hempstead Harbor, Jamaica Bay and Raritan Bay.

On December 1, 1901, there were under lease 6,055 acres, and under franchise 20,005 acres, a total of 26,060 acres now in use for shellfish cultivation. Sixty-six applications, 8 being for lands in Hempstead Harbor, and 58 for lands in Manhasset Bay, covering 1,044 acres, are now pending and are not included in the above total of lands in use.

The jurisdiction of the State over lands under these waters (Hempstead Harbor and Manhasset Bay) is disputed by the town of North Hempstead, which asserts its own jurisdiction and ownership under colonial patents. Upon receiving the first applications for lands in these localities, the superintendent, under the direction of

the Commission, requested from Hon. John C. Davies, Attorney-General, written opinions concerning the questions at issue. The Attorney-General, after considering a formal remonstrance filed in support of the claim of the town, prepared opinions which in both cases asserted that jurisdiction is in the State, and that the Forest, Fish and Game Commission has authority to lease such lands for the purpose specified. In pursuance of these opinions, and of a resolution adopted by the Commission, at its meeting in the month of May, a tract of land under the waters of Hempstead Harbor was advertised, surveyed and leased to Messrs. Olson and Weber, who at once entered into possession as lessees of the State, whereupon an action of ejectment was instituted by the town for the purpose of ousting said lessees. This action is now pending but, as the people of the State were not made a party, it cannot be expected that a judgment in the proceeding will determine the real issue.

In the matter of the claim of the residents of the village of Noank, in the State of Connecticut (to which allusion was made in my last annual report) that they have from time immemorial fished for lobsters in the waters of "The Race," southwest of Fisher's Island, in the State of New York (by far the best lobster fishery of this State), and have gained by prescription a right to fish therein, a test case (the People against Morgan) was made, resulting in a decision favorable to the contention of the People. It may be added, however, that Hon. Harrison S. Moore, county judge, in his opinion stated that the question of the defendant's prescriptive right was not properly before the court. It is, therefore, probable that this issue will be again raised.

Few persons other than those actually brought into contact with it, are aware of the immense and growing proportions of the shellfish industry of the State, which, it is estimated, amounts to at least \$7,000,000 per annum, in seed oysters, marketed oysters, clams and lobsters. The justly celebrated oysters from Blue Point, Jamaica Bay (Rockaways), East River and other Long Island localities are eagerly sought by consumers and always command a ready market. Little Neck clams also are in constant demand, all of which means business, work and money for those engaged in the cultivation, handling and exportation of these valued shellfish. The principal export trade is with England, though quantities are shipped to the continent of Europe, and a recent demand has sprung up in the West Indies. A shipment of oysters to Santiago in October brought \$20.80 per barrel.

An increased trade is occasioning a constant betterment of facilities; many small sailing craft are rapidly being replaced by steamers and others are being remodeled



POUND FISHING.

EMPTYING THE POUND.



and fitted with modern motive power. From comparatively small beginnings the urgent necessities of the rapidly expanding industry of shellfish cultivation led, a few years ago, to the adoption by the State of a system of control of lands under the public waters suitable for the business; a system which includes a unification of laws; an elaborate plan of surveys, based upon the triangulations of the United States Coast Survey; the establishment of numerous intermediate coast signals and the preparation of necessary and carefully prepared maps and charts, together with grants of leases and franchises under well-defined boundaries. Thus has the older plan of control by localities, so palpably inadequate, been outgrown.

The obsolete local plan contemplated a right to the farmer or citizen whose lands happened to be adjacent to or near a bay or sound, to take a small piece of land under water, in size ranging from a fraction of an acre to three acres, upon which he might dredge or rake a few bushels of shellfish for domestic consumption, or upon which the bayman owning a small boat could dredge the natural growth oysters for market. The laws of a given locality were sure to differ from those of every other locality, the point of greatest resemblance being that these rights were confined to residents of the particular town or community.

In one large bay the land granted to an individual was limited to three acres at an annual rental of five dollars per acre, while in another bay the limit was five acres at three dollars per acre, an effort always being made to increase the revenues of the town or community by the income from these grants, while nothing was done by the town to protect its lessees in their rights. No hydrographic surveys were made. Lessees fixed their own stakes or buoys marking the boundaries of the lots. These marks being constantly removed by tides, ice and storms led to contentions between adjacent owners. Larceny of planted shellfish was a crime almost impossible of punishment, property lines being uncertain and the visible marks unreliable. Under that expensive system doubtful or experimental ground was not taken. Extensive growers requiring grounds in different localities suitable for different stages of shellfish growth were obliged to use subterfuge and employ men resident in each locality to rent grounds as though for their individual use, when in fact they were to be used by the larger planters.

Under the local system efficient means for destroying the enemies of the shellfish, involving the use of steamers, was out of the question. Under the present system of State control the planters may obtain sufficient lands; employ capital to advantage; combat the natural enemies of the shellfish and have the benefit of proper surveys and boundaries, the lines being accurately fixed and easily relocated when necessary.

When we consider this vast industry, so necessary to the welfare of the State, a business employing thousands of our citizens, which amounts to so great an annual sum and supplies our population with an unsurpassed food product, we cannot wonder that this better system has developed, and the experience of the past leads us to look forward to increased progress and greater improvements.

The tomcod planted in Jamaica Bay during the season of 1900 have thriven and are now to be found all over the bay. Hundreds of these fish were cast upon the beach during the severe storm which occurred on Saturday, November 30, 1901, and were gathered up by fishermen residing in the vicinity.

Under section 114 of the Forest, Fish and Game Laws, the boards of supervisors of Queens, Nassau and Suffolk Counties are given power to pass laws regulating and controlling the taking of fish and shellfish in the salt waters of such counties. This power has from time to time been availed of in these counties, resulting in the passage of numerous laws, imperfectly published and of doubtful authority. Communication is now being had with these official boards for the purpose of ascertaining which of these laws should be preserved with a view to having them embodied in the statute law of the State.

During the past summer certain newspapers have devoted considerable space to the net fisheries of Great South Bay, strongly intimating, though not actually asserting, that these fisheries are in violation of the Forest, Fish and Game Laws. It was said that the number of bluefish have annually decreased until the fishing in the bay is almost destroyed, that "Bluefishing in Great South Bay has been ruined by the net. Fifteen years ago this was the finest body of water in the world for fishing." The Superintendent has made several visits to Great South Bay for the purpose of investigating this alleged condition and has conversed with boatmen, whose livelihood depends upon taking out parties of anglers, and with residents of the locality representing both sides of the controversy. As a result it has been ascertained that the pound-nets are not placed in the main channels of the bay, that there is no obstruction or hindrance in these main channels to the entrance of fish from the ocean, that the pound-nets are placed in the minor channels and shoal waters of the bay, and that bluefishing by hook and line has not been better in any season during the past fifteen years than in the season of 1901, anglers having had no difficulty in securing well-filled baskets.

While it appeared that the nets might interfere to a certain extent with the navigation of the bay by small yachts and sailing boats, it was asserted, on the other hand, that at night, in foggy weather, the lights maintained upon the pounds were of great assistance to navigation. The question of navigation is without the

province of this Department, and these Great South Bay fisheries, upon which, to a considerable extent, our markets depend for fresh fish, are not in violation of our law.

The menhaden season of 1901 has been, it is believed, a satisfactory and profitable one. These fisheries extend along the entire length of the Atlantic Coast of the United States. In company with several gentlemen connected with the Commission, the Superintendent visited a factory of the Fisheries Company located at Promised Land, Long Island, for the purpose of ascertaining in what quantities, if any, food fish are taken in menhaden nets. We inspected, upon the wharf, a lot of fish, said to amount to 300 barrels, which had been discharged from one of the company's fishing steamers, and failed to discover any fish other than menhaden.

Respectfully submitted,

B. FRANK WOOD,

*State Superintendent of Shellfisheries.*



AFTER SOFT CLAMS.

# Financial Statement.

## Statement of Expenditures for the Fiscal Year Ending September 30, 1901.

### FORESTRY ACCOUNT.

To land purchased in Adirondacks, - - - - -	\$173,841 39	
To land purchased in Catskills, - - - - -	16,273 86	
Salaries and expenses of superintendent of forests, inspectors, clerks, etc., - - - - -	12,721 58	
Traveling expenses of Commissioners, - - - - -	458 91	
Services and expenses of attorneys, - - - - -	17,838 17	
Printing, surveying, searches and miscellaneous office expenses,	3,504 07	
Rebates paid towns, account fighting forest fires, - - -	20,183 86	
Firewarden and foresters, salaries and expenses, - - -	5,456 05	
United States expert foresters' expenses, - - - - -	3,518 91	
		\$253,796 80

### FISH PROPAGATION.

Maintenance of hatcheries and hatching stations and collection and distribution of fish and fish fry, - - - - -	\$50,463 06	
Salary and expenses of State fish culturist, - - - - -	3,940 56	
Salary and expenses of general hatchery foreman, - - -	1,303 55	
Delaware County hatchery site, - - - - -	500 00	
		56,207 17

### FISH AND GAME PROTECTION.

Salaries and expenses of 35 protectors and clerk, - - - -	\$38,500 03	
Moieties paid complainants from fines recovered, - - -	3,161 30	
Justice, constable and witness fees, - - - - -	1,699 36	
Attorney fees and expenses, - - - - -	5,283 86	
Surveying, measuring timber, boat expenses, etc., - - -	2,478 83	
		51,123 38

Forward, \$361,127 35

SHELLFISH DEPARTMENT.

	Brought forward, \$361,127 35
Salary and expenses of superintendent of shellfisheries, - - -	\$1,097 89
Salary and expenses of oyster protector, cashier and clerk, -	6,670 55
Office expenses, rent, etc., - - - - - - - - -	2,656 92
	10,425 36

MISCELLANEOUS.

Commissioners' salaries and expenses, - - - - -	\$11,487 81
Assistant secretary and clerks, - - - - -	6,940 00
State reservation St. Lawrence River, - - - - -	4,165 35
Office expenses, printing, stationery, etc., - - - - -	5,841 17
State fair and Pan-American exhibit, - - - - -	241 16
Printing extra copies game law, - - - - -	225 00
Salmon River fishways, - - - - -	450 00
Wild moose and elk transportation, - - - - -	153 90
	29,504 39
	\$401,057 10



IN OCTOBER.



IMMIGRANTS AT SEA.

# The St. Lawrence Reservation or International Park.

BY ARTHUR B. STROUGH.

**D**URING the year 1883, and for a great many years previous, nets were used for catching fish in the waters of the St. Lawrence River in the State of New York. It was illegal to take fish in that manner; but no attention was paid to the law, and no officer was there to enforce its provisions. All kinds of fish were taken in this manner, mostly Black Bass and Wall-eyed Pike, as they were by far the most valuable. Sportsmen were continually dragging their baited hooks on the nets, and any one that has ever had such an experience is conscious of the fact that the inclination to use profane language at such a time is almost irresistible.

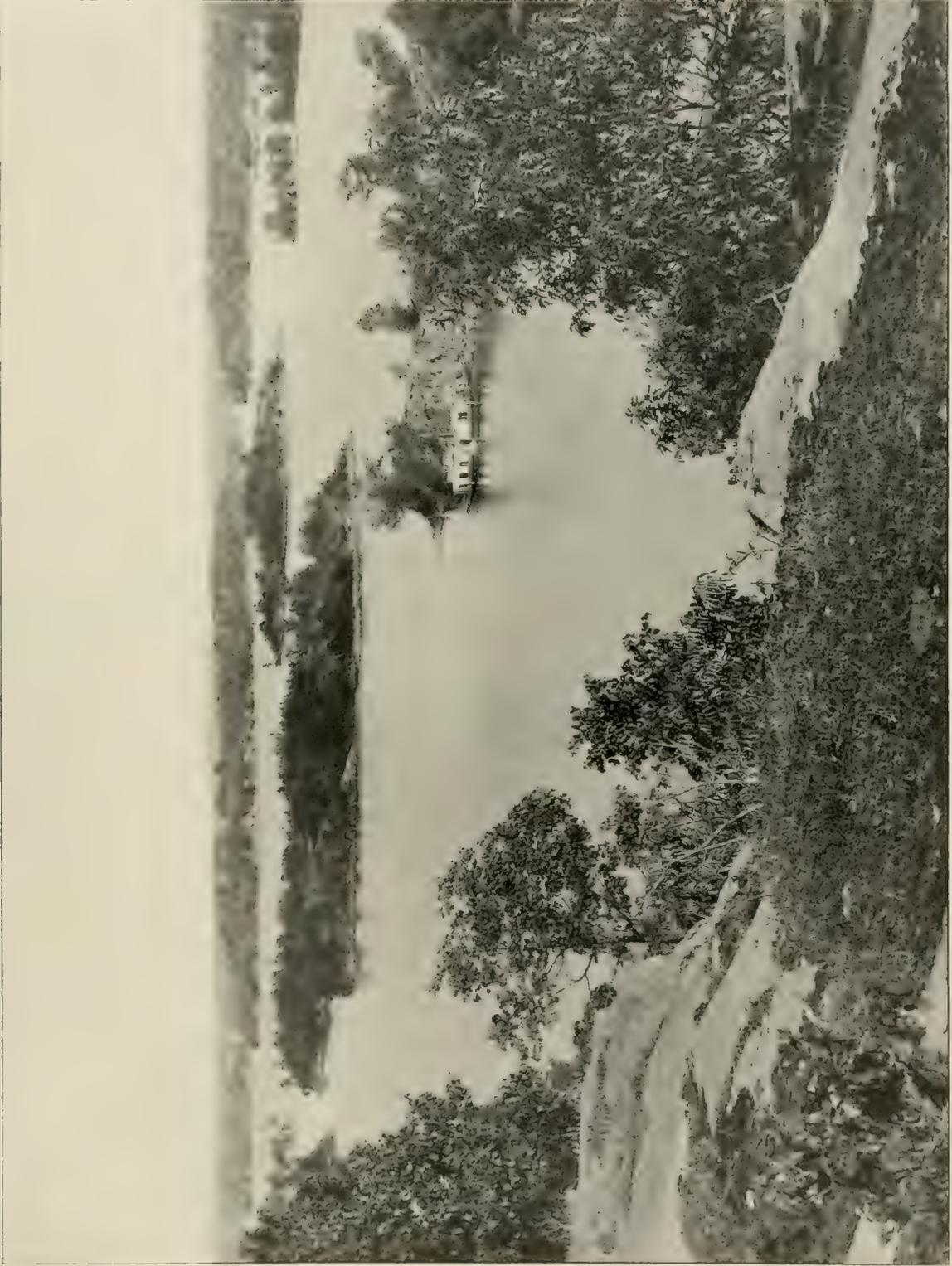
Comparing notes at the end of a day's outing on the river, a number of sportsmen who had poor success in landing fish, and undesirable results in catching nets, resolved, orally, to rid the river of the illegal devices used by lawless fishermen. Raids were planned, steamboats chartered, and guides employed, with the result that hundreds of nets were taken from the water and burned. At the close of the season, after considerable discussion, an organization for continuing the work of clearing the river of illegal fish nets, and for the promotion of such means as would advance the interests and pleasures of tourists among the Thousand Islands, was incorporated under the title of "The Anglers' Association of the St. Lawrence River." This Association petitioned the Governor of New York to appoint a game protector at the Thousand Islands, a request which was complied with. Several members of the Association placed their private yachts at the disposal of the protector, whereupon an active, aggressive and effective warfare was made upon the net fishermen, resulting in the destruction of most of the obnoxious nets. As a further result a large number of the men employed in netting adopted other vocations, and the game fishing soon showed signs of improvement.

Although the main object of the Association seemed to be accomplished, strong social connections had been formed in the meanwhile, and the other work, the

development of the Thousand Islands as a pleasure resort, was taken up earnestly. Thus the organization was kept intact as a protection to the sporting interests of the Thousand Islands. Some of the members of the Association were Canadians, who were not without influence with the Dominion Government. Originally the Indians owned all the islands of the St. Lawrence River, on both sides of the national line. The State of New York, however, acquired title to all islands south of the national boundary more than a hundred years ago, and this title has passed down through various owners to the present occupants. The timber was cut off for building purposes or fuel prior to 1850, and such of the islands as were large enough and of suitable soil were cleared up for farming purposes.

Sometime in the sixties this locality commenced to develop as a summer resort. The attraction that first acted as a magnet to draw people of leisure from their city homes to this place was the fishing with hook and line, popularly known as "angling." The first visitors made their homes at such hostelries as a rural farming community usually provides, where the fare was of the quality generally found at country hotels. There were two hotels at Clayton and one at Alexandria Bay; but their patronage was a mixed one, made up of commercial travelers, farmers, etc. The sportsmen soon found the climate highly beneficial to health; the water, purified in Nature's own laboratory, of unexcelled quality and transparency, and, to the user of the contaminated water of the city, a tonic of alterative quality. Thus, from being simply a favorite place for sportsmen, it became a health resort. To accommodate the constantly increasing numbers that flocked there to take advantage of its natural attractions, hotels were erected at conveniently located places until the patronage each summer included many thousands.

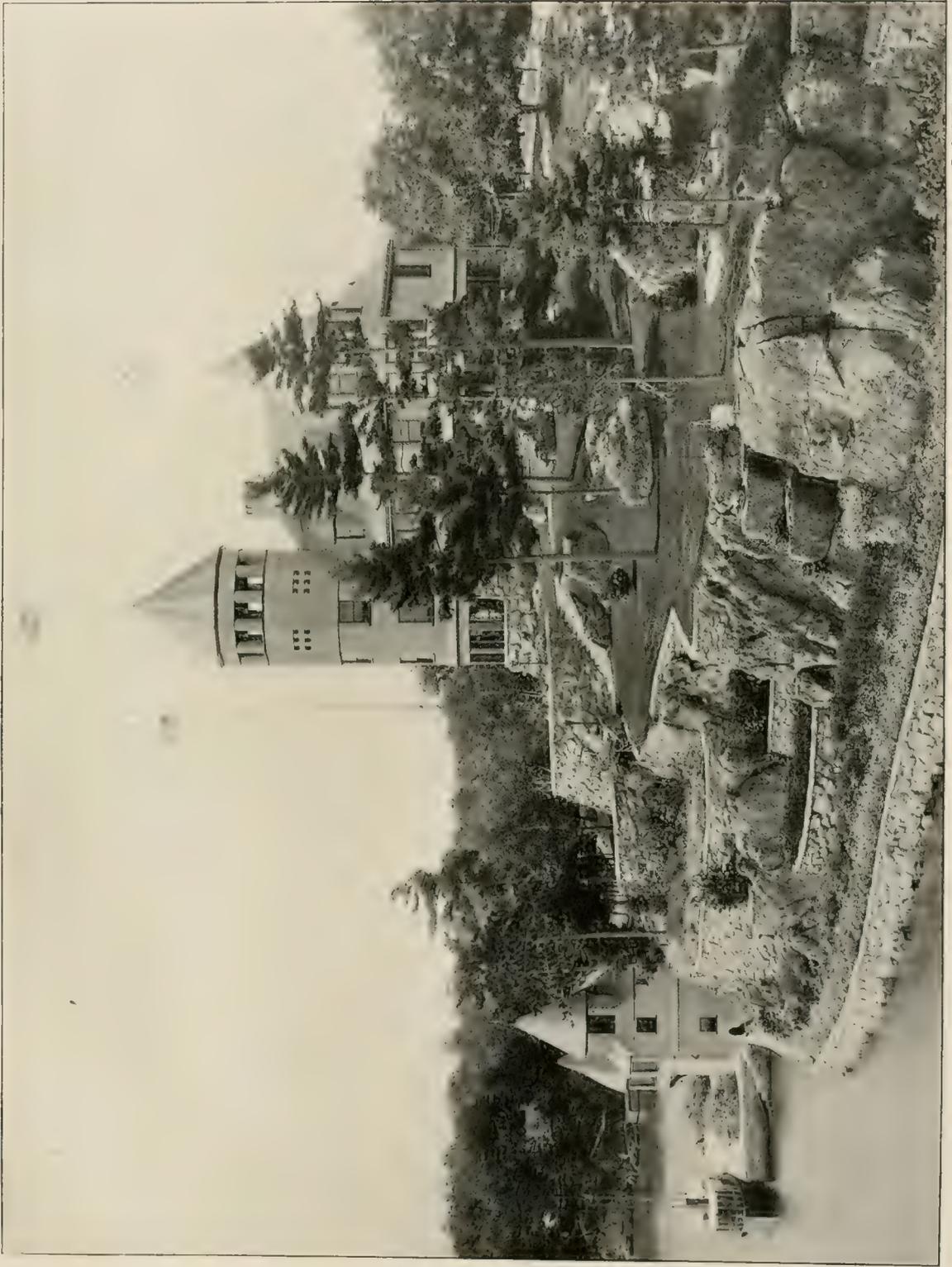
As usual in such cases, in company with the sportsman and health seeker, finally came the pleasure seeker, and then, of course, larger, more pretentious, and more attractive hotels were erected. Now, there is such a variety of hotels and boarding houses, with various rates, that all classes of society may readily be accommodated. Following the usual course of development at resorts of this kind, many of the patrons of the hotels that made a vacation at the Thousand Islands an annual matter, soon desired places of abode of a more private character than can usually be obtained at a public house. Many such people, desiring facilities for entertaining friends and guests, each purchased an attractive island or a point of land of a few acres and erected a cottage or villa suitable to the individual needs of the person, in many cases at an expense which would not be possible to any other than the multi-millionaires of these modern times. Not content with providing palatial residences, comfortable and roomy grounds have been made from unsightly areas;



LOOKING EAST FROM SMOKE ISLAND.

G. O. MCINTYRE, PHOTO.





G. O. MCINTYRE, PHOTO.

ON WELLS ISLAND.



rocks have been blasted away in places, or artificially arranged in others ; castles and outbuildings have been built and artificial ruins erected, imitating, or at least recalling, the sightly, interesting and historic places in foreign lands. Artists and architects have been called into service, and sometimes it seems as though an attempt was made to outdo all previous efforts in beautifying the surroundings of private cottages.

Of course, but a few places have been ornamented with a view to gratifying the eye of the traveling public ; but, while building and beautifying for themselves, they have incidentally created a fairyland which cannot be kept from the view of the passing tourist ; for the water which flows at the very doors of the private cottages is a public highway, and all that desire may enjoy the outward attractions provided by the fastidious residents for self and guests. While many islands and points of land have been occupied in this manner, and improved for exclusive private use, those not desirous of living apart from others, or not having the means to maintain such elaborate villas, have developed villages, locally called parks, which, in most instances, are laid out symmetrically in avenues or streets, with many of the conveniences of city life — post office, telegraph and telephone service, running water in each cottage, and an efficient sewerage system. At these places may be found a general store, meat market, and the ubiquitous dealer in Indian baskets or souvenirs of local interest. At these parks nearly as much variety of architecture may be observed as in a city, eliminating, however, the tenements of the laboring class, and, also, the marble residence of the man of means. The population of some of these parks embraces many thousands.

Few people remain long at this resort without taking advantage of the excellent fishing. No fishing picnic is considered complete without landing at some shady place, where the party indulges in a specially prepared fish dinner cooked by the guide, or "oarsman" as he is locally called. A man is not considered a competent guide unless he can properly prepare an outdoor dinner, including fish which are caught during the forenoon. To prepare such a meal a fire is built, fuel being generally found in some nearby woodland in sufficient quantities for that purpose.

Now, one of the results of these outdoor dinners was the littering of the grounds nearby with the refuse of the meal, including in many instances broken glass, entrails of fish, and remnants of vegetables. The owners of the places where landings were made sometimes objected to the practice of preparing dinners on their premises, not so much at being annoyed by trespassers as at having their groves endangered by fire and their grounds left in an unsightly condition. In some

instances notices forbidding such trespassing were posted, and, occasionally, a dinner party was driven off the grounds.

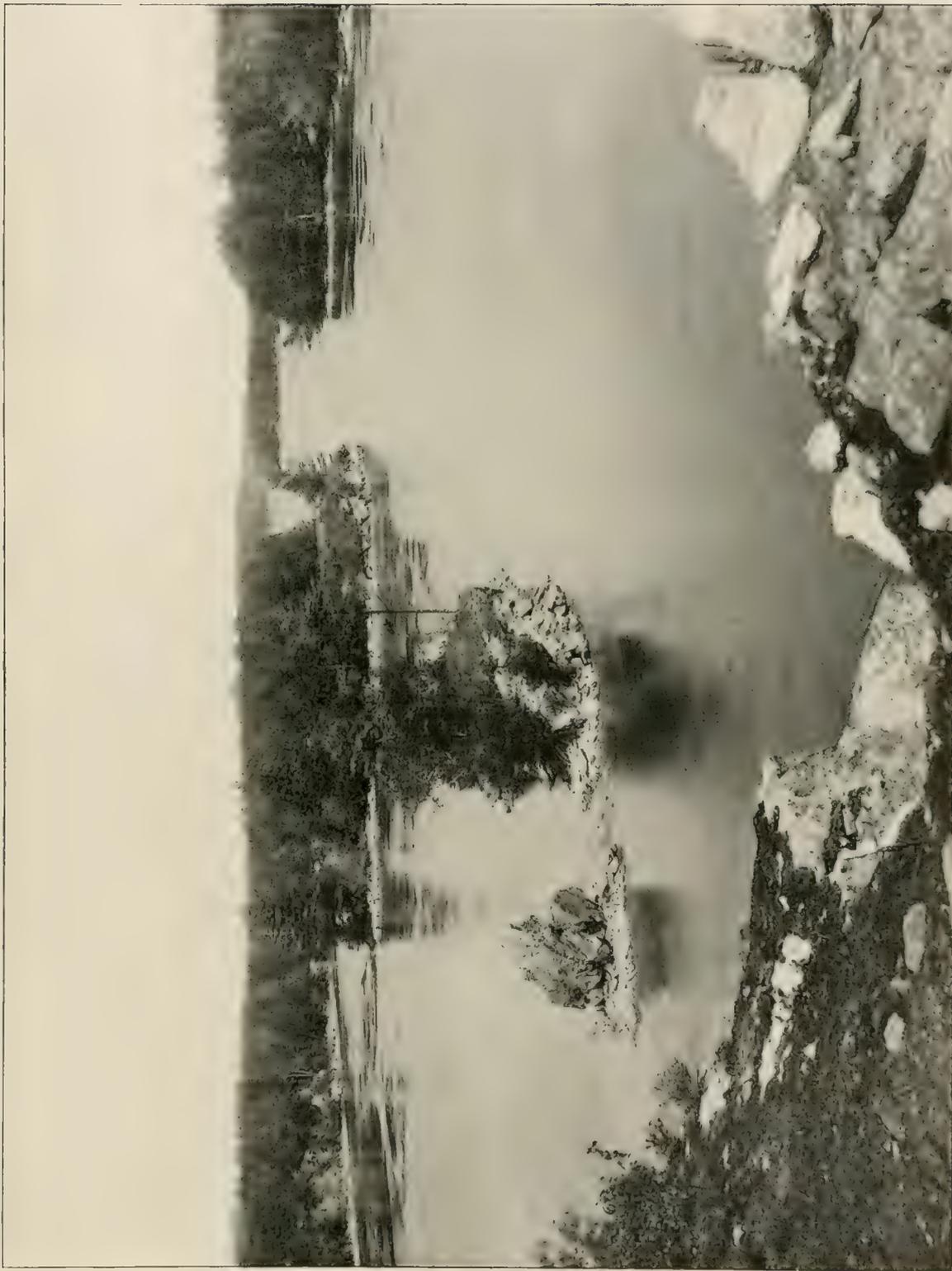
The summer population of this vicinity has increased rapidly during the last ten years. The number of parties partaking of outdoor meals as a matter of course increased in proportion; and in solving the question of providing suitable free places for dining, where fires for cooking meals might be lawfully kindled, the Anglers' Association has taken the initiative. In connection with co-workers in Canada an effort was made to establish small public parks for the free use of all who desired to camp out, or to build a fire in order to enjoy a characteristic out-of-door fish dinner.

In this connection it is proper to note that the seasons established by law, during which game fish might be taken, were not uniform on both sides of the national boundary, which, by the way, divides about equally the islands between the State of New York and the Province of Ontario. A Legislative Commission from New York, in company with members of the Anglers' Association, some of whom resided in Canada, visited Ottawa and conferred with the Dominion Government in relation to forming an International Park of the Thousand Islands and creating uniform fish and game laws for the same.

Nearly all of the islands of the Canadian side at that time were in a state of nature, although many years ago much of the merchantable timber was stolen from the same and rafted down the river to Quebec.

The Canadian Government, owing to an ancient agreement with their Indians, did not dispose of the title to their islands, although some of the larger ones were occupied by agriculturists. At some time during the eighties a new arrangement with the Indians was made, under which the Dominion Government proceeded to dispose of the islands. Many were purchased for building sites by persons who have erected or are erecting cottages of ornate design and further embellishing their property with beautiful boat houses and outbuildings. Development of the resort in this manner, however, is not nearly as far advanced as on the New York side of the river.

As a result of the mission to Ottawa, the Dominion Government set aside, or withdrew from sale, a number of its desirable islands, and the same are to be always open to the free use of the public for camping, dining, and picnic purposes. Uniform fish and game laws have not as yet been enacted, but the close seasons for fish and fowl have been brought nearer together than they were formerly. A license fee of \$5 was at one time exacted of our people when fishing on the Canadian side of the river; but this obnoxious restriction was suspended as a concession or move-



G. O. 310 IN LYBE, PHOTO.

LOST CHANNEL — CANADIAN ISLANDS.



ment towards international comity. Carrying out in part the ideas advanced by the mission to Ottawa, the Legislature of New York, in 1896, enacted the following law :

CHAPTER 802 OF THE LAWS OF 1896.

AN ACT for the establishment of a State reservation upon and along the Saint Lawrence river in the State of New York.

*The People of the State of New York, represented in Senate and Assembly, do enact as follows :*

SECTION 1. All that part of the river Saint Lawrence, lying and being within the State of New York, with the islands therein, is hereby constituted an international park which shall be known as "The State Reservation on the Saint Lawrence."

Section 2. The said state reservation on the Saint Lawrence shall be under the control and management of the board of fisheries, game and forest, who shall have the power to make and enforce ordinances, by-laws, rules and regulations for the management of the property of the state within the borders of said reservation and for the orderly transaction of business not inconsistent with the laws of the state ; to designate one of the present fish and game protectors as a superintendent, who shall be subject to the order of said board, who shall have the authority of a fisheries and game protector and of a police constable in criminal cases within the limits of the state reservation.

Section 3. It shall be the duty of the said board of fisheries, game and forest to report to the next legislature of this state what laws, in their opinion, should be enacted for the government and control of said state reservation, so as to make the same the most useful to the people of the state as a part of an international park upon the Saint Lawrence river, comprising the whole of said river.

Section 4. This act shall take effect immediately.

Thus an International Park was established, although as regards the American islands it was on paper only. The State of New York did not own a foot of land and could only reciprocate the action of our Canadian friends by purchasing in the usual manner islands or points of land suitable for public purposes. The Fisheries, Game and Forest Commission, in pursuance of the law quoted, visited the St. Lawrence River, and, after making a careful study of the matter, urged "the propriety of providing small pieces of land at convenient places to be owned by the state and to be kept free for the public use, and to provide boat landings, camping and

picnic sites." The Legislature, in 1897, accordingly appropriated \$30,000 for the "purchase of islands, points of land on the main shore, or on islands within such reservation" and for "building wharves, piers and necessary buildings on the lands so acquired, and for otherwise maintaining and improving the lands of the state within such reservation." The succeeding Legislature made an additional appropriation of \$10,000 for the same purposes. With these funds there were procured for the Reservation or International Park nine parcels of land, seven of which are in Jefferson County and two in the County of St. Lawrence.

Describing briefly these park lands in the order in which they may be found, commencing at the upper end of the group of islands, there will first be noted BURNHAM POINT, about three miles from the village of Cape Vincent on the main shore. This attractive place contains 7.37 acres of land, on which is a pretty grove. It has no docks, but it is connected with the public highway by a road, and the place is much used by the people of Cape Vincent and surrounding country as a picnic ground.

The next piece of State land is CEDAR POINT, sometimes called Percy's Point, having been owned a great many years by a Mr. Percy, from whom it was purchased. It contains 13.09 acres and is also located on the main shore about midway between the thriving villages of Clayton and Cape Vincent. A large part of this point is covered with a thrifty grove of trees of various species. The State land includes a lane to the highway. The point had been a favorite place for camping and dining ever since the development of the Thousand Islands as a resort for sportsmen. The river at these two places is more exposed to wind than at most other points; and, as Cedar Point is partly formed by a cove or inlet, easily entered when the winds were high, it was a favorite place for dinner with many parties fishing up stream from the hotels at Clayton and below. As the place is easily reached from the highway it is used extensively by residents of the surrounding country and nearby villages for camping, fishing, and general picnic purposes.

Proceeding down the river the next State parking is what is now known as CANOE POINT. The American Canoe Association occupied this place several years in succession as a meeting place, and hence its present name. It is also known as Delany Point. It is situated at the lower end of Grindstone Island. It contains 70 acres, and consists of three points of land locally known as "Picnic," "Squaw," and "Canoe Points." Picnic Point is the most popular place for dinner parties. It has been used for that purpose constantly during the fishing season for more than thirty years. Squaw Point is covered by an attractive grove, both that place and Canoe Point providing excellent places for tenting. Canoe Point is well wooded on



A. B. STROUGH, PHOTO.

CANOE POINT — PUBLIC PAVILION.



A. B. STROUGH, PHOTO.

TYPE OF PRIVATE YACHT IN USE BY COTTAGERS ON THE ST. LAWRENCE.





A. B. STROUGH, PHOTO.

ON WATTERSON POINT—STATE RESERVATION.



A. B. STROUGH, PHOTO.

A TOURIST STEAMER.



the northwest shore. On this part of the reservation is what is known as "Big Hill," one of the highest, if not the highest, point in the Thousand Islands. It is cleared of trees at the summit, where the view, east, north and west, is worth going many miles to enjoy. The shore line of this property, including the three points, is at least two miles in length.

Next in order is WATTERSON POINT, an attractive, shady, and convenient place for dining and camping, on the north side of Wells Island. It is in close proximity to the most beautiful of the justly celebrated Canadian island scenery. It contains 6.15 acres of land, is the smallest of the reservation lands, and has water on three sides.

On this same island, located on the shore of a land-locked sheet of water, known as Lake Waterloo, is DEWOLF POINT. In this piece of State reservation land there are 10.11 acres of ground. It was purchased for the accommodation of the fishing parties that leave the large hotels at Alexandria Bay in the morning for a day's outing at Lake Waterloo.

Going down the river to a point nearly due north of, and about two miles distant from, Alexandria Bay, is MARY ISLAND. This attractive place, containing 12.50 acres, is separated from Wells Island by a very narrow strip or passage of water, just large enough to allow the passage of a fishing skiff, as the boats in general use there are called. It is said that at one time, not many years ago, Mary Island was a part of Wells Island. This place is well shaded and has been a favorite resort for Sunday school picnics for a number of years. In its vicinity, on the New York side, are some of the finest of the summer residences or cottages belonging to prominent city people.

Next in order proceeding down the river is KRING POINT. It was bought from a man by the name of Kring, who owned it many years, and whose name was connected with it, as is customary at the Thousand Islands. It is a part of the main shore and partly surrounds Goose Bay. It contains 34.35 acres of land and is next in size and importance to the reservation which includes Canoe, Squaw and Picnic Points. It has considerable shade, and is used very extensively by boating parties from Alexandria Bay and the numerous populated islands and parks in that locality. It has a long shore line, and frequently during the open season a dozen or more fishing parties may be seen occupying desirable places for dining in the open air.

A few miles farther down the river is CEDAR ISLAND, lying in front of Chippewa Bay. The State Reservation here, containing 10.11 acres of land, occupies about one-half of the island. The balance of the island is used for hotel and summer

cottage purposes. In the immediate vicinity, in and about Chippewa Bay, are many islands, large and small, on a number of which cottages have been erected within the last few years. The reservation land at this place is well shaded, and is a popular outing place.

The next and last piece of State park land is found at LOTUS ISLAND, below Ogdensburg, in one of the famous rapids of the St. Lawrence River. The State owns 20 acres of land here—about one-half of the island. The waters at this part of the river, being constantly in motion, are a favorite place for Black Bass, and they are much sought for here. This reservation is used continually by sportsmen and picnic parties. The island is well shaded, and the part outside the State holding is occupied by cottagers. One building and a steamboat wharf is on the portion purchased for park purposes.

In addition to providing these several places for public use, a tasty open pavilion has been erected on each reservation except Lotus Island. On Canoe Point there are two such structures— one on Canoe Point proper, the other on Picnic Point.

In these pavilions there are tables and benches for the accommodation of picnic parties who may desire to take their meals there. If a fishing party is caught out in a storm, as is sometimes the case, the pavilions are a great convenience, as the fishermen can eat and have good shelter while waiting for the storm to subside. At convenient places stone fireplaces have been constructed, with a specially designed iron top and front on which meals may be cooked expeditiously and without endangering the surrounding groves. When fires for preparing meals are built between small heaps of stones a forest fire is sometimes started which does great damage. These fireplaces have proved very popular with guides and campers, and are used very generally during the open season. Sufficient fallen timber or dead wood may usually be found for cooking purposes, although some guides take a supply of fuel with their other materials when starting out for a day's fishing. Portable tables and benches for seats are also placed near each fireplace. These are in general use, although each guide has a small folding table as a part of his professional outfit. But the folding tables which can be carried in a fishing skiff are very small, and hence they are not used when park tables can be obtained.

At each of the park places, excepting Burnham Point, docks of sufficient size with a proper depth of water have been constructed for the use of parties landing from steam yachts. These, also, are a great convenience for steamers to lie at while parties are fishing in the neighborhood. In addition to the yacht docks, small landings of proper size and height have been constructed for the use of parties coming in fishing skiffs. These small docks are also used by guides for landing their



A. E. STROUGH, PHOTO.

CEDAR POINT—STATE RESERVATION.



A. E. STROUGH, PHOTO.

KRING POINT—STATE RESERVATION.



boats while their parties are at dinner, being much more convenient for that purpose than the rocky shore or gravelly beach. Many small buoys have been placed on shoals in waters navigated by yachts and launches. The constantly increasing population, and the desire for better transportation facilities by cottage owners, have caused the use of steam yachts and launches, with which all parts of the river and bays are navigated. The National Government does not place buoys on any of the shoals that are not near the main routes of travel, and therefore it was thought best to place small buoys on some of the shoals in parts of the river frequented by launches, but which were out of the main steamboat channel. One of the regular game protectors, as required by the law creating the park, was detailed as superintendent, and much of the work of building and maintaining the fireplaces and buoys is done by him.

In a codification of the New York Forest, Fish and Game Law, in 1900, the act creating this Reservation or International Park was repealed and in place thereof, in that part of the codification relating to public parks in charge of the Forest, Fish and Game Commission, was placed a section, as follows:

Section 218. *Saint Lawrence Reservation.*—All that part of the river Saint Lawrence lying and being within the state, with the islands therein, and such lands along the shore thereof as are now owned by or shall hereafter be acquired by the state, is hereby constituted an international park which shall be known as the "Saint Lawrence reservation."

The elevation of this Thousand Island region at some prehistoric time was much higher than now. It is probable that, instead of being an island and water region, it was a valley or rather a low but rocky depression in the mountain system extending from the present Adirondack plateau to a similar upland wilderness in Canada. The line of ridges even now extends across a comparatively level and fertile stretch of country in the counties of St. Lawrence and Jefferson. The land on each side of this rough territory is of entirely different character from the island and rocky region, as even a casual examination plainly shows. A surprisingly similar formation in the land on the Canadian side of the river adjacent to the Thousand Islands is observable.

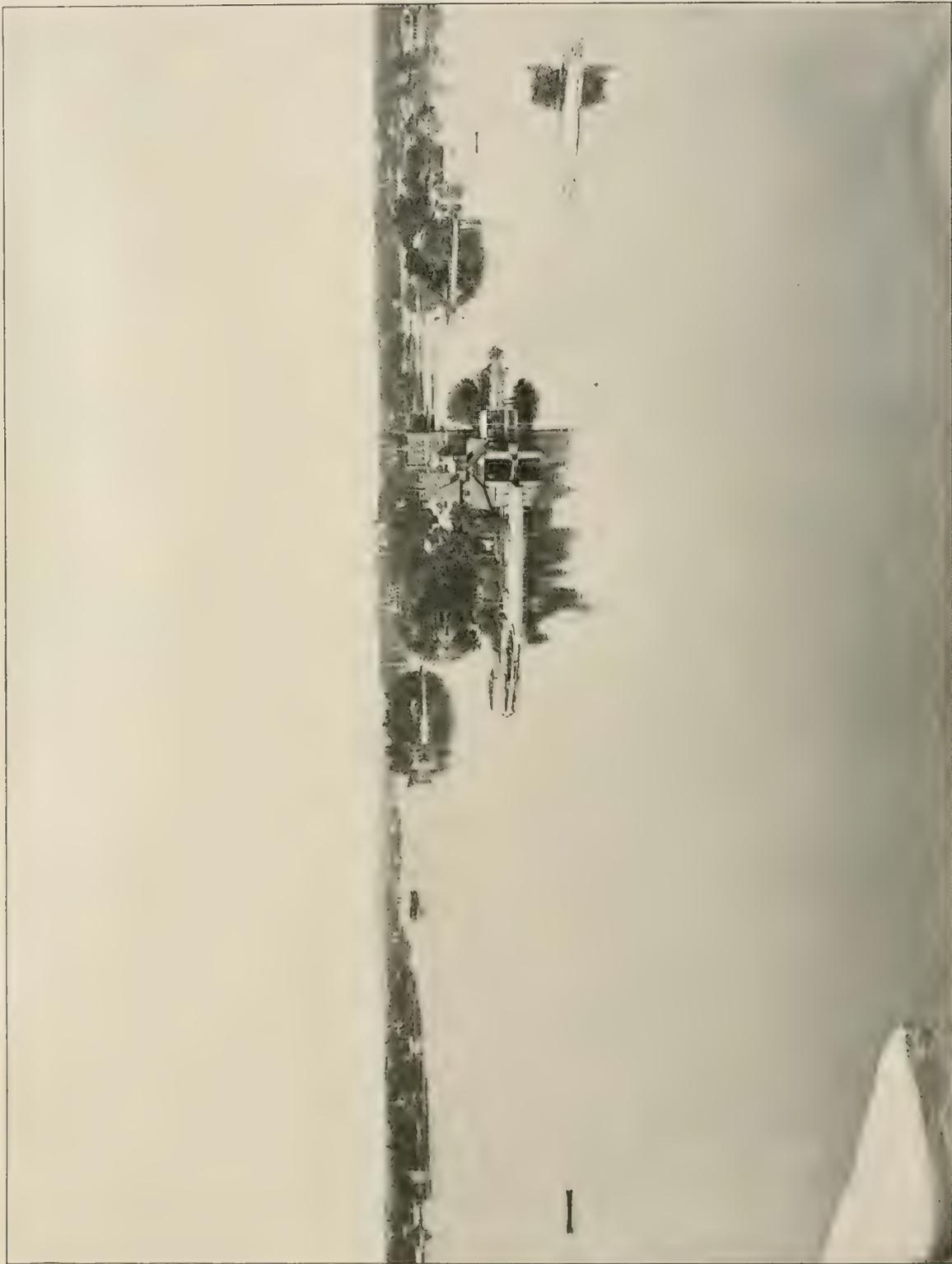
When this ridge of rocky, mountainous formation was at its maximum height, many thousand years ago perhaps, it was a part of the shore line of Lake Ontario, which then emptied into the ocean by way of the Mohawk and Hudson River Valleys. Interesting evidences of a great prehistoric waterfall are noticeable at Little Falls, in the Mohawk Valley. In the progress of the earth's changes this eastern shore of the then Lake Ontario sank gradually until the waters of that great

lake commenced to flow over the barrier. Before the present level was reached the lake had ceased discharging its water by way of the Mohawk Valley, and discharged by way of the St. Lawrence Valley. Thus, it will be observed, this section before flooding was of a character similar to that of the Adirondack region—rocky, ridgy, and of a generally hilly and broken character.

When finally flooded, the waters, flowing out and down between hills and ridges, carried with it most of the loose material, and formed what are locally called “channels.” Two of these are of sufficient size and depth to permit navigation by vessels of very large size, and form now a part of the water route for freight from Chicago to Montreal and European ports. The passage along the south side of the river is called for convenience the American Channel; the other one, north of the main body of islands, is called the Canadian Channel. The former hills and ridges became islands, and the rocks that were covered by water are our present shoals.

At the foot of Lake Ontario, and at the head of the river, is the town of Cape Vincent, in New York, and the city of Kingston, in Canada. Between these two places at the west, and the village of Brockville in Canada at the east, are situated most of the Thousand Islands. At the west end the river is fifteen miles across while at Brockville it is one mile from shore to shore. This body of water is sometimes spoken of as the Lake of the Thousand Islands. How many of these islands there may be is a question continually propounded by tourists. Although said to be one thousand in number, some claim to have counted nineteen hundred of them. Now, the exact number of the islands cannot be stated with any degree of accuracy. There are rocks that are mere isolated points projecting above the surface of the water for only a few inches. Technically, these may be called islands. There are other areas of rock and soil only large enough to form a landing place for fishing skiffs. These, also, may be called islands. Many of them are below the surface of the water—weeks at a time—when the river is at its highest; and, on the other hand, the tops of many rocky shoals are out of the water for months when the river is low. Hence, while it is probable that there are not more than a thousand of the islands when the river is high, there may be two thousand of them when the river is low.

Anent the rise and fall of the St. Lawrence it is noted that the distance between high and low-water mark is about three and a half feet. An interesting fact in this connection is that the seasons seem to have very little, if any, effect on the height of the water. During flood times of all the streams emptying into Lake Ontario from the north and south, and into the St. Lawrence, that river is as liable to be near its low-water mark as otherwise; and sometimes during protracted local



G. O. MCINTYRE, PHOTO.

LOOKING SOUTHWEST FROM HART ISLAND.



droughts the river is near its highest. The water there is usually at its highest stage some time during the months of June and July; and at its lowest, some time during December or January. In some years it seems to vary more than in others; and it is believed that the flood conditions of the great basin draining into the upper lakes and eventually reaching the St. Lawrence have more effect on the height of water there than local floods and droughts. It has been observed that a gale of wind from the west on Lake Ontario raises the water in the river nearly a foot; while on the other hand a strong northeast wind on the lake lowers the water in the river correspondingly.

There is an excellent variety and good supply of fish in these waters. First of all in the estimation of the sportsman is the Small Mouth Black Bass (*Micropterus dolomieu*). It is not intended here to offer any dissertation on fish; but it seems proper to mention that many sportsmen consider the Black Bass of the clear, cold running water of the Thousand Islands the gamiest fish of its size that swims. As they spawn during the latter part of May and in June, depending on the temperature of the water, fishing for them is not allowed here until the tenth of June, when, generally, the most of them, or at least the older ones, have spawned. The weather here, as at other places of the same latitude, is two or three weeks earlier in some years than in others, and the temperature of the water is affected materially by that of the atmosphere. If the water reaches the temperature of 65° by the middle of May, Black Bass will be found on or about the gravel beds and shoals, where they make their nests. If the water is not that warm until in June, bass will not spawn until that time. This much is said in relation to this species of fish as it is a question discussed continually by the guides, sportsmen and law makers.

The Large Mouth Black Bass (*Micropterus salmoides* Lacép.) also inhabits these waters. They are not often found in the main part of the river, but may be found in shallow bays and grassy bottom tributaries. They grow to greater size than the Small Mouth Black Bass, are a coarser fish, and not considered desirable here.

The next fish that we note as being a denizen of this water is the Wall-Eyed Pike or Pike-Perch (*Stizostedion vitreum* Mitch.). This fish is quite as plentiful as the Black Bass, although but few of them are taken. They stay in deep water, thirty-feet or thereabout, and hence, on a lower level than the bass and other game fish. To catch them one must fish in the current where the water is deep, and usually near the head of some shoal or island. As they must be sought for in water below the level of other species, rarely will any fish other than Wall-Eyed Pike be landed. Their habits are much the same as those of the Small Mouth Black Bass, which belongs to a nearly related family. The waters of the Thousand Islands region

have shoal and gravelly bottom for the most part, over which the water is continually in motion, thus forming a natural breeding ground for such fish, and many believe that the most of the Bass and Wall-Eyed Pike caught in Lake Ontario are bred here.

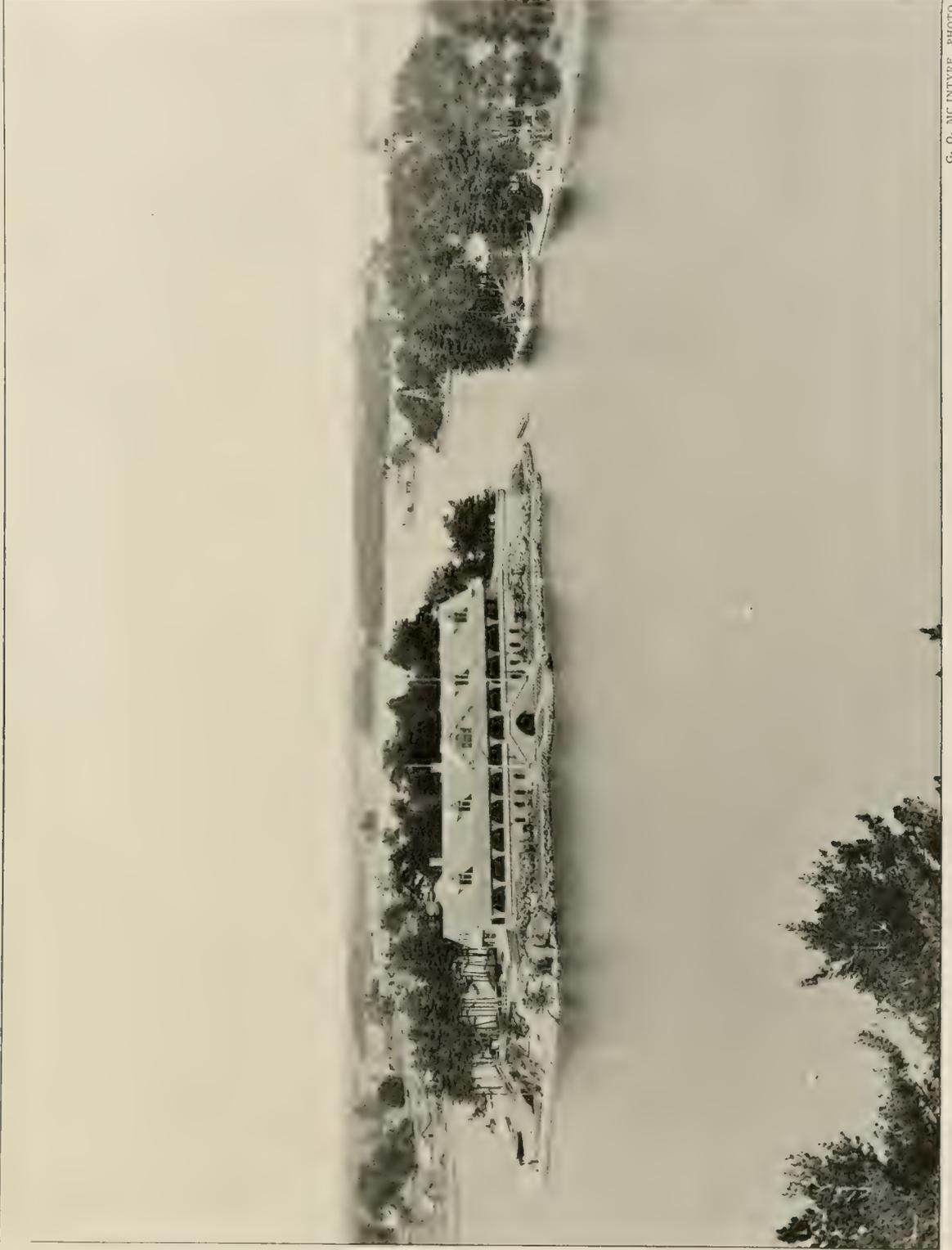
The Yellow Perch (*Perca flavescens* Mitch.) is found here also. In many localities they are considered valuable game fish, and, in most places, desirable for food. They are so numerous and so easily caught here that most sportsmen consider them of no account. The fishermen usually return them to the water, using language that would not look well in print.

The Pike proper (*Lucius lucius* Linn.) sometimes called Great Northern Pike—locally and erroneously called Pickerel—are here in countless numbers, although many sportsmen do not like to catch them. Still there are but few who are not pleased when they land one of these strong, beautifully marked denizens of this clear cold river. Their spots are peculiarly distinct here, as is the case with most fish grown in transparent running water. Many are taken that weigh from five to ten pounds; and, occasionally, a fifteen pounder is landed.

The next fish to be noted is the Mascalonge (*Lucius masquinongy* Mitch.). They are plentiful here, but not many are caught. The only fish that attains a greater size in this locality is the Sturgeon. The average weight of the latter seems to be about twenty-five pounds. A few years ago one was brought in that weighed fifty-six pounds. During the last four or five years some Mascalonge have been taken that weighed ten to fifteen pounds, and it seems probable that the catching of these smaller ones is due to the extensive plants of fry from the State Hatchery made since 1895. It is only occasionally that Mascalonge are fished for exclusively; usually if caught at all it is when fishing for Bass or Pike.

In addition to the above-mentioned game fishes are to be found the following food and coarse fish, viz.: Bullheads, Catfish, Eels, Suckers, Sunfish, Sturgeon, Rock Bass, Alewife, Dogfish, Gar Pike, and some other small species of little value. These fish have increased rapidly since the use of nets was prohibited; and it is a question whether some means for keeping them down will not have to be devised if the angling for game fish is to be maintained to any satisfactory extent. Minnows, such as usually inhabit northern fresh waters, are also found here. The clear, cold running water is peculiarly prolific of live fish food, such as is required by Bass, Pike and Mascalonge. The late Hon. A. N. Cheney, State Fish Culturist, visited the place a few years ago and reported that a surprising amount of fish food was to be found on every hand.

It is not entirely the fishing that first made the region famous among sportsmen,



G. O. MCINTYRE, PHOTO

THOUSAND ISLAND YACHT CLUB HOUSE.



as many were going there in the fall of each year to hunt ducks. The following kinds are found here, viz.: Redhead, Black, Wood Duck, Black Coot, Whistler, American Widgeon, Broad Bill, Sprig Tail, Sheldrake, Goosander, Hooded Merganser, Shoveler, Bufflehead, Old-Squaw, Mallard, Canvas Back, and Blue and Green Wing Teal. Duck hunting is probably not as good as it was fifty years ago, because the birds were allowed to be taken during the breeding season. A recent law protects them during the spring and summer months, and as a result the number found now is considerably greater. The sportsman will also find in this region Grouse, Woodcock, Plover, Canada Geese, Loons, Gulls, Divers, Curlew, Cranes, Kingfishers, Bittern and Snipe.

The St. Lawrence River has been a favorite route of travel for seventy-five years. Long before the building of the railroads through northern New York a large through passenger traffic had grown up between Montreal and Ogdensburg at the east, and Lewiston at the west. Large side-wheel steamers, rivaling in size even the modern steamers of Lake Ontario, were built and they did a lucrative business. Many of them were constructed at Clayton, and the old residents of that town relate with pride various incidents connected with the construction and operation of these large, palatial boats. There were two lines—one American, the other Canadian. Some of the steamers of the Canadian line are still in service, although new and larger ones have recently been put on the route for the lake and island part of the travel. The steamers of the American line were, some of them, sold to the National Government for transport service during the Civil War, and the others were dismantled upon the building of railroads. Succeeding the American line, in part, came the Northern Transportation Company, operating about thirty steamers between Ogdensburg and Chicago, stopping at Clayton and Alexandria Bay for passengers and wood. They were propellers of convenient size, seaworthy, and made a daily line during the open season, nearly as reliable in the hour of arrival and departure as a railroad service. However, the building of the railroad to Cape Vincent, and later to Clayton, brings the matter of tourist travel nearer to the times and subject of which we write.

At first one small steamer accommodated the tourist travel from the railroad, and nearly all of the arrivals were at Cape Vincent. Some time after the building of the line to Clayton the connection down the river from Cape Vincent was discontinued, and now the principal part of the arrivals for the many hotels, parks and cottages are at Clayton, a line of half a dozen steamers being required to meet all the trains at that railroad terminus. Some people find it more convenient to go to the Islands by way of Morristown and Ogdensburg; some go to Charlotte or to Oswego.

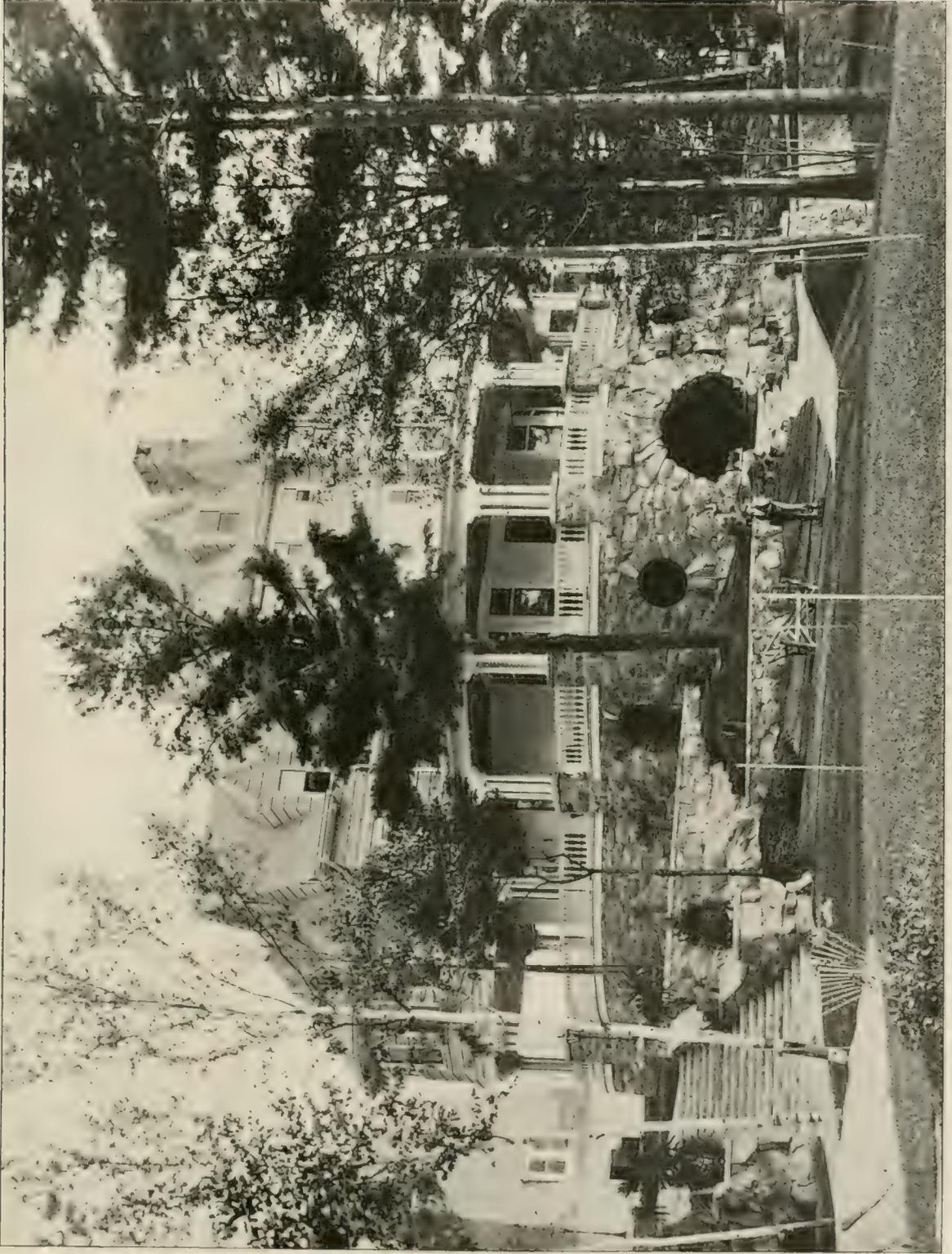
and thence by steamer through Lake Ontario to the Islands, while the Canadians go by steamer from Toronto, Kingston, Gananoque and Brockville.

Inquiry is often made as to the best way in which to see the Islands. Some of those who make this inquiry intend staying there but a day or so, being on a tour of perhaps the whole northeastern United States and Canada. It seems as though such a person were living this life altogether too fast; but if the trick of doing this resort in one day seems necessary, one of the specially constructed excursion steamers or observation yachts, which make a regular business of traversing the Islands for sight-seers, may be taken at any of the principal hotels. A fascinating ride of nearly fifty miles through the intricate water passages of both the American and Canadian Islands will unfold to the traveler a very good, but altogether too brief, vision of this fairyland. There are three steamers employed almost exclusively on these excursions. If the trip is made in the forenoon it is probable that the route will be up the American and down the Canadian side of the Islands. A trip is usually made in the afternoon in the opposite direction by one of the boats, and every one should make this trip, even if they have no time for anything more. The passages between the Islands will not be the same ones traveled in the morning. In this manner a variety of scenery, a combination of nature and art in buildings and landscape views that rival any scenes of foreign travel, will be unfolded to the eye.

In the evening a ride should be taken on some one of the steamers which carry a powerful searchlight and pass through both the principal channels. Nearly all the larger villas and their grounds will be found illuminated in an artistic and unique manner, while the natural beauties of the islands and shores are brought in full view by the expert manipulator of the searchlight. These three sight-seeing rides may be made in one day, and there is no other way of learning so much of the Thousand Islands in so short a time. But all who can should stay longer; for not less than a week should be devoted to this interesting locality.

Most people who go there will want to fish for a few days, or at least enjoy one of the famous out-of-door fish dinners. A side trip to the interesting old city of Kingston, in Canada, should not be missed. The ancient fortifications, the shops and the penitentiary, are points of particular interest. The beauties of the several populous parks can be realized only by going to each. If one is a camera expert some delightful opportunities for views of villas and island scenery, combinations of unique architecture, land and water, are to be had everywhere.

One of the most interesting sights of the place is the variety of water craft passing almost continually to and fro. The substantial cottager usually has a pri-



G. O. MCINTYRE, PHOTO.

SUMMER RESIDENCE ON ONE OF THE ISLANDS.





G. O. MCINTYRE, PHOTO.

IN CAMP AT THE THOUSAND ISLANDS.



vate steam yacht, these boats varying in size and cost according to the needs or bank account of the islander. While they are not usually of sea-going size, some represent an investment of a hundred thousand dollars. Many of the occupants of the smaller but substantial cottages have naphtha launches fitted out with elegant roomy cabins, and some have sailing yachts. One can see here sailing craft of all sizes, from the famous St. Lawrence fishing skiff, rigged with a sail, to cabined yachts that tour the Great Lakes. Regattas are held each season, in which the rivalry and interest is as keen as among salt water yachtsmen. A few years ago a small type of boat, about twenty-five feet long with two bat-wing sails, carrying a crew of five, called the St. Lawrence racer, developed a speed unequalled by any sail boat of its length on record. Then, again, there are the large freight steamers carrying grain from Chicago to Ogdensburg, great hulks with cargoes that will fill half a dozen freight trains; and, increasing the variety and interest, occasionally is seen an old-fashioned picturesque lake schooner with three masts, fore and aft rigged, or some old-fashioned barges—belated specimens of a rapidly passing style of fresh water architecture.

The better class hotels, being conducted for the higher class of tourists and pleasure seekers, provide entertainment of as high order as is found at any summer or winter resort. Fine orchestras are provided, and usually the manager arranges a series of hops or other social functions for the pleasure of his guests. In many instances the occupants of the neighboring cottages are welcomed at such entertainments.

There is much social intercourse between the summer residents, with many private and semi-private picnics, or other affairs of local interest occurring in which the yachts and house boats of the cottagers are brought into use. Family friendships and alliances are frequently created, which in many instances continue in the city homes of the people. Matrimonial affairs, sometimes of romantic interest, are contracted. The searchlight of a passing excursion steamer many times, almost every night, reveals to the tourist a glimpse of lovers whiling away the evening hours along the shores or swinging in hammocks. A person of literary inclinations will find abundant material on which to base fascinating stories of a romantic character.

If the tourist is interested in historical matter, much will be found in this locality that will occupy his or her time. It was the early through highway of discovery for the pioneer *voyageurs* of the French before the English occupation, and having been the national frontier between two nations in three wars, and a favorite location with the Indians, historic places and incidents are many. It is claimed, also, that a

station on the underground railway of the Abolitionists was located on one of these islands.

The air of this region is pure, clear, humid and at all times invigorating, forming one of the attractions and sources of pleasure to the tourist just from the heated, noisome atmosphere of an overcrowded city. As soon as the sun lowers in the west the temperature drops, and be the day ever so hot the evening is cool, the atmosphere tonic. People from inland places who are suffering from insomnia, generally experience little or no trouble in obtaining refreshing sleep with its resultant health and strength.

Other matters of interest, of which no mention is made here, will occupy much of the time of the tourist. A week soon passes, and still there are many places to see, many pleasures to enjoy. The visitor who is not pressed for time, but is intent on rest and recreation only, will linger in this charming region, finding with each day some new pleasure and attraction. The traveler leaves it regretting that he cannot make a longer stay, but cherishing the pleasant hope that he may visit it again.



ST. LAWRENCE RIVER STEAMER.

# Chestnut Culture in the Northeastern United States.

BY E. A. STERLING.

CONTINENTAL EUROPE, by reason of its long-established civilization, density of population, and development of its natural resources, is able to teach a much needed lesson in conservation to the wasteful young nations, among which the United States is a fair sample. Especially in the development of the various branches of forestry, most of the old world countries have taken marked precedence over us; and everywhere abroad a more complete utilization of all major and minor forest products is found, together with a more careful provision for the future needs of the people, than in this country.

## Chestnut Culture Abroad.

As it is the chestnut with which we are now concerned we must look to Italy, Spain, and parts of France for our lesson, as there will be found the highest development of this branch of forestry, or horticulture, whichever it deserves to be called.

In Italy the chestnut has long been of great commercial value, ranking in many parts with the grape and olive as a source of revenue, but more often serving as a cheap and nutritious food supply to the poor peasant than as an article of commerce. Wherever found in the countries bordering the Mediterranean, whether growing naturally or in cultivated orchards, the chestnut is highly prized, both on account of its finely flavored nuts and its valuable wood.

In the uses of the chestnut the Italians are connoisseurs, and from them we have much to learn as to the methods used in preparing it for food. Their ability to dry and preserve the nuts so that they retain all of their original flavor and sweetness, without becoming dry and unpalatable, is an unpracticed art with us, but one which necessity will soon compel us to acquire if the nuts continue to grow in popular favor. On the streets of many foreign cities the nuts are sold by street vendors the year around, as peanuts are in American cities, while among the com-

mon people the bread made from chestnut flour is a staple article of diet. The nuts, too, are often cooked as a vegetable, made into a soup or prepared as a pudding, and when candied have a ready sale as an article of confectionery.

The wood finds ready sale for a variety of purposes, as in this country. The bark yields tannin, the coppice makes first-class vine stakes, while the large tree trunks furnish wood material of various kinds, suitable wherever durability is desired. It is asserted that there are chestnut trees on the slopes of Mt. *Ætna* which bore fruit when Homer was a boy.

### The Chestnut in America.

Turning to our own country and our own State we find the chestnut occupying relatively a much less important position than abroad, the reason, perhaps, being in the fact that because of the greater diversity of valuable tree species there is less need of giving especial attention to any one. Another reason may be found in the certainty that the chestnut is not yet fully appreciated, nor its many virtues and capabilities fully known. Among the broad-leaved trees it is hard to find its equal. It is a rapid grower on soils of good or medium quality, forms a vigorous coppice (root sprouts), yields a wood which, because of the tannic acid it contains, is very durable in contact with the ground, and is very valuable for fuel, fence-posts, cross-ties, telegraph poles and interior house furnishing, while last, and perhaps most important, it yields a fruit in the form of a very valuable nut.

Until quite recently the nut has not been accorded anything like its true value; it has been considered as a luxury rather than as a valuable food product or article of commerce. In clearing away the virgin forest the chestnut, along with the walnut and hickory, has sometimes been left in the pasture lots and fence corners for the sake of the wholesome crop of nuts which were sure to result. Trees, too, have been planted near gateways and along roadsides for the sake of both shade and fruit; but anything like the systematic planting of chestnut orchards on a commercial scale has not been extensively attempted until within the last decade.

The nuts which were produced on the native trees scattered through the pasture lands and along the edge of the wood lots were not generally looked upon by the farmer as possessing any value worthy of his attention. The squirrels and the children were usually the ones most interested, and it was often a question as to whom fell the greater share. The squirrels, with an eye to the future, and a knowledge that the chestnut is a valuable article of diet, assiduously stored away large quantities of nuts where they would serve as a granary during the midwinter star-

vation period. The children, on the other hand, being assured of a winter food supply from other sources, gathered the chestnuts partly for pleasure, and, in part, to obtain pin money. Pleasure and profit were thus well combined, because for a merry band of young people to wander through the autumn woods in search of nuts was a pleasure which cannot be readily appreciated by the dwellers in urban communities. The nuts thus collected, which were not dried and kept as winter companions for the apples and cider, were usually sold to the local storekeepers who forwarded them to city commission merchants, whence they found their way to the city markets. Occasionally when nuts were plentiful, agents traveled through the country districts and bought them in large quantities for shipment to the centers of consumption.

Of late there has been an increasing interest in the growing and marketing of both exotic and native nuts, and active steps have been taken to improve existing varieties and introduce new ones. By thus insuring a steady supply of first-class nuts new uses for them have been found, and growers are now reasonably assured of a steady and growing demand for the fruit product of the chestnut tree.

## The American Chestnut.

*Castanea dentata*, Marsh.

The generic name *Castanea* was probably derived from *Kastanea*, a city in Pontius, Asia Minor, where the chestnut is a native, or from the town of *Castanea* in Thessaly where it is believed it was first brought into Europe. Some botanists affirm that the European chestnut is indigenous to the British Isles and the continent of Europe; but most authorities agree that it was introduced into Greece from Asia Minor, thence carried to Italy by the Romans, whence it was disseminated throughout Southern and Western Europe. Its introduction took place so long ago that chestnut trees have been growing apparently wild in Spain, Italy, France, and Great Britain for centuries.

The history of the European chestnut has been noted somewhat carefully because it is a question whether the American nut is worthy of a place as a distinct species, or is only a variety of the European. From a purely botanical standpoint there is little difference between the two, yet the pomological variations are so marked that certain authorities give the American nut specific rank on this basis alone. De Candolle, Asa Gray, Apgar and Loudon hold to the opinion that the American chestnut is but a variety of the sweet chestnut of Europe. Prof. Sargent and Mr. Sudworth, on the other hand, prefer to dignify our chestnut as a distinct species. The most

striking characteristics which distinguish the native from foreign chestnuts are found in its taller, straighter trunk, less rounded crown, thinner, smoother and more pendent leaves, and smaller, but, invariably, sweeter nuts. The differences in all cases are slight; hence, in this discussion we shall be as patriotic as possible, and follow the nomenclature of the school which regards our chestnut as a distinct species.

The specific name *dentata* was determined by Mr. Sudworth to be the earliest name identifiable with it, and by this it is generally designated. The Indians of New York State called the chestnut "O-heh-yah-tah," which meant prickly bur.

*Castanea* is distinguished by its broad spreading habit when grown in the open; its long, sharp-pointed, coarsely serrate bright green leaves; and its wealth of creamy-tinted, fragrant catkins, which burst into bloom in midsummer and give color to the landscape long after the apple and cherry trees have scattered their petals to the winds, or the red maples have matured their keys and the elms their samaras.

The staminate flowers are borne in the axils of the alternate leaves, on cylindrical catkins six to eight inches in length, which appear only after the leaves are nearly grown in June. The male flowers proper appear in 3 to 7 flowered cymes in the axils of minute bracts on the rachis of the pendent ament. The pollen is abundant and fragrant, and is liberated readily, so that wind fertilization is easily effected.

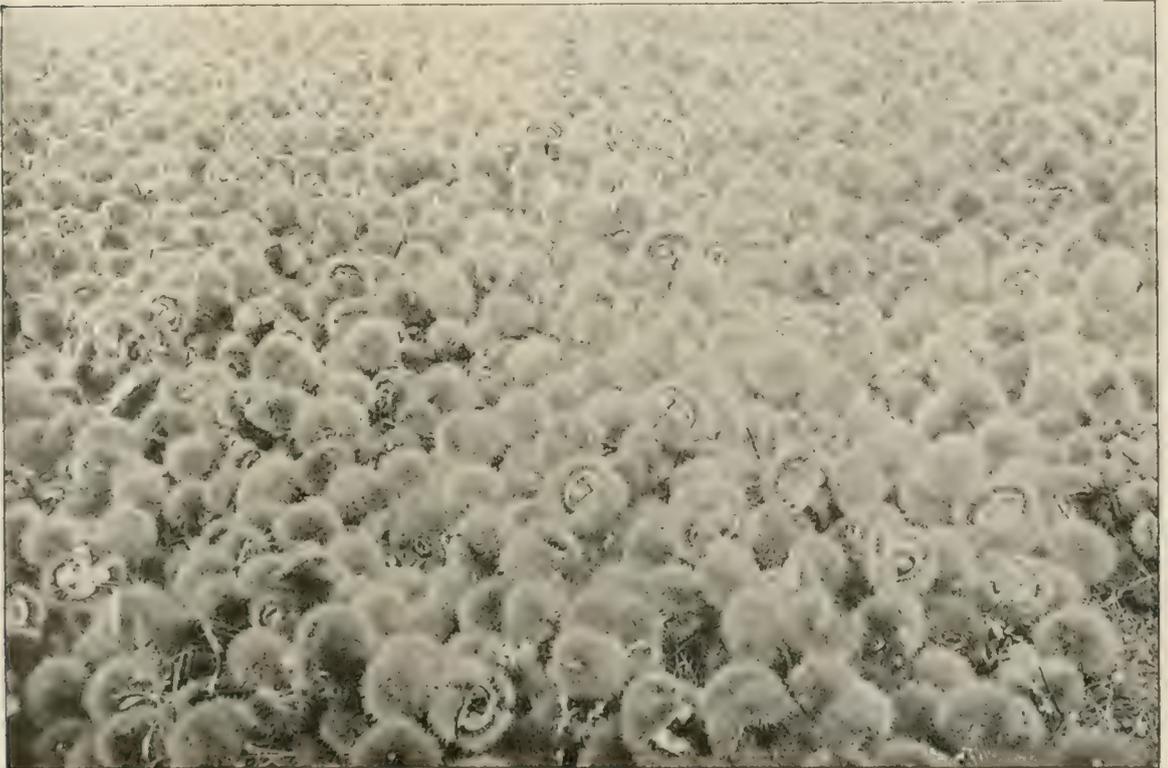
The pistillate flowers appear singly or in groups of two or three within a short-stemmed involucre of closely imbricated green bracts, in the axil of a bract borne on the base of the erect pistillate ament. This involucre grows rapidly and eventually develops into the bur which incloses the nuts. At the time of blooming the female (pistillate) flowers, including their burs, are about half an inch long, and are borne on stiff spikes that grow from the axils of the leaves of the newly-formed shoots. Usually only 3-4 flowers at the base of the spike produce fruit. The lower part only of the shoot supporting the immature burs becomes woody, as the portion beyond shrivels and drops off, leaving the burs at maturity as a terminal cluster. Botanically the fruit is a hard prickly cupule (bur) which splits at maturity into four valves.

Just what the bur of the chestnut is has puzzled botanists not inconsiderably, and remains yet an undecided question. It is thought to be a whorl of metamorphosed bracts.

The chestnut is strictly monoecious, yet in most individuals the staminate catkins mature before the pistillate, thus making cross fertilization a necessity. Why



STAMINATE AND PISTILLATE FLOWERS OF THE PARAGON CHESTNUT.



CHESTNUT BURS SPREAD ON THE GROUND TO DRY.



this provision is necessary in trees which produce perfect flowers of both sexes on one individual is a problem for the evolutionist; while to the arboriculturist the fact is significant only in that it shows him that his chestnut trees should be grown in groups and not singly in order to secure a full crop of nuts. In growing the various native and exotic varieties many advocate a mixing of varieties as well as of individuals.

Few long-lived trees equal, and none surpass, the chestnut in rapidity of growth and ease of propagation under ordinary conditions. In New Jersey\* a chestnut tree is recorded which had a diameter of 60 inches at the age of 70 years, and which in one year increased its diameter by 1 inch. In the same State several trees 35 years old ranged from 24 up to 34 inches in diameter, with a height of 40-50 feet. The rate of growth is governed to a great extent by the nature of the soil, the thinner soils being less favorable to rapid tree growth than the deeper red sandstone lands. The above figures are remarkable, for the average growth of the chestnut is probably not over one-half as rapid. A diameter of 8 inches at 20 years and 12 at 30 is what may be reasonably expected as fair. Coppicé should give trees of a size suitable for cross-ties and telegraph poles in 25 to 35 years, and large enough for posts in 15 to 20 years.

Our native chestnut is broadly distributed throughout the Eastern United States, and is found at varying elevations from sea level in Massachusetts, to 4,500 feet in the mountains of North Carolina. It occurs also on soils of very diversified nature, from almost pure siliceous sand to coarse, gravelly soil or shale, or even on limestone; on the latter, however, it is found only when the strata of the underlying rock is tilted. In general the dry rocky land of the glacial drift is preferable to the richer, more compact alluvial soil of low lands. The soil best suited for its growth is a retentive clay containing some sand. The tree does not require a rich soil.

In its more definite geographical distribution the chestnut is found from Southern Maine southward through New England; most abundant in the valley of the Merrimac River south of Concord, and in the Connecticut valley as far north as Windsor, Vt.; common in Massachusetts, Rhode Island and Connecticut, and along the coast as far south as Delaware, except where exposed to the direct winds from the sea. In Canada it is common in the Province of Ontario. In the Middle States it is common in New Jersey, Pennsylvania, Southern New York and parts of Maryland, and southward it is found all along the Alleghany Mountains to Alabama, and westward to Michigan, Indiana and Tennessee.

The chestnut tree attains its greatest development in Western North Carolina

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New Jersey Geological Survey. Report on Forests. 1900.

and Eastern Tennessee, where specimens 13 feet in diameter and 120 feet high have been found. This size, however, is exceptional. The average size at maturity in regions of favorable growth is a height of 60 to 80 feet, with an average diameter of 5 feet, although much larger specimens not infrequently occur. Near the northern limit of its range, which is about 44° latitude in the United States, the tree is decidedly smaller and sprouts less readily from the stump than farther south.

During the tertiary period *Castanea* flourished from Greenland and Alaska, and traces of it are found in the miocene rocks of Oregon and Colorado.

In New York the chestnut is plentiful throughout the valley of the upper Hudson, in Saratoga, Warren and Washington Counties, and along the slopes of the foothills belonging to the Catskill uplift. It has not been observed anywhere on the northern Adirondack plateau, and is scattered only sparsely throughout the western portion of the State. In the Adirondack region it is too cold for the chestnut to mature its annual shoots, but in the western part of the State its sparseness is due rather to unfavorable soil conditions than to climatic variances, the rich alluvial soil of Western New York being little suited to its best development. The tree attains its best development in that part of the State between the Delaware River and the Catskills, along the glacial hills which are a continuation of the Kittatinny Mountains and the northern "Jersey Highlands," a country famous for its oak and chestnut. This region, although well settled and cleared, is dotted by many large wood lots, and here lie most of the New York "chestnut hillsides," in which, because of their small value for other purposes, lie the opportunities for the profitable chestnut culture to be described later. In Saratoga and adjoining counties there also exist splendid possibilities for chestnut orcharding.

Within the limits of its range the chestnut occurs either singly or in scattered groups or groves, usually most abundant on the high, gravelly, well-drained land of hillsides and ridges, seldom growing in pure stands, but usually mixed with oaks or other hardwood trees. It has been stated on good authority that the "chestnut is almost unknown on red shale land;" but in Central Pennsylvania it is certainly found growing well on almost typical red shale soil.

Groups of young seedlings are found only in the pasture lands or open forest, where there is plenty of light, since, as the chestnut when young is essentially a light-needing species, it cannot grow in the lower story of a high, dense canopied forest. The mature tree is moderately shade enduring. The chestnut is further handicapped in its struggle with more tolerant species, by its characteristic trait of not unfolding its leaves until most other trees are in full foliage, thus giving the earlier trees something of a monopoly of the available light and space.

Forest, park, or pasture-grown trees differ widely in general form and habit. The tree of the woods, because of its crowding neighbors, soon loses its lower branches and is stimulated to thrust its crown upwards towards the light, where it remains supported by a long slender trunk, which is the form most desired for telegraph poles, cross-ties, and the general uses of the lumberman. In fact it is a natural characteristic of the chestnut when grown in mixtures to shed its lower branches quickly, and develop a smooth, straight bole. When grown from stump sprouts several of these tall, tapering trunks are often found with their bases touching or even united, and all the product of one stump.

Started in the open and given plenty of room in which to spread itself in all directions, the chestnut devolves from its tall slender habit and forms a tree noted for its short stable trunk and broad spreading crown. Upon a short trunk, 4 to 8 feet in diameter, is often supported a crown from 40 to 60 feet high, with a spread of branches equaling, or often surpassing, the tree in height. Many of these spreading pasture trees rank among the most magnificent specimens of arboreal growth which are found in the Eastern States, and to a man who has spent his childhood in the freedom of the country the sight or recollection of these "spreading chestnut trees" will awaken in his mind many happy memories and associations of those blithesome, unappreciated boyhood days of long ago.

The exact extent to which the native chestnut has been improved by cultivation and extended beyond its natural range by artificial propagation is rather hard to determine. Certain it is, however, that experiments along this line have not been very comprehensive, nor the results sufficiently encouraging to warrant their continuance. American horticulturists and nurserymen are not slow to follow up a line of work which promises even mediocre returns; hence, the mere fact that our chestnut has received little attention from them is in itself proof that its cultivation as a shade or nut-bearing tree is not exceedingly profitable. This refers only to the wild native chestnut, and not to the improved or acclimated foreign varieties.

In the South nothing has been done further than utilizing for timber the magnificent chestnut trees of the Appalachian Mountains. In the North and West half-hearted attempts, with fair success, have been made to extend its range in the suitable soil of mountains and hillsides just beyond the range of natural growth. When carried too far north the new shoots fail to ripen before they are nipped by the early autumn frosts. On stiff alluvial soils the trees make a fair growth, but are short-lived and fail to produce fruit abundantly. It is thought that the presence of lime or alkali in much of the prairie soil is responsible for the poor growth. On very rich soil the growth is too vigorous and the tree is liable to be unproductive

and winterkill. More potent than extremes of heat and cold as sources of injury to the chestnut are hot dry winds, and in its susceptibility to them is found, perhaps, the principal reason why it will not thrive on the western plains and prairies.

In New York the region of growth can be extended northward towards the St. Lawrence Valley between the western edge of the Adirondack Mountains and Lake Ontario, and westward to the boundary of the State. The region of most favorable growth is from the southern boundaries of Herkimer, Hamilton and Warren counties in the Southern Adirondacks, southward to Pennsylvania and New Jersey. In the southeastern corner of the State the chestnut is decidedly at home and can be grown successfully in almost any part. The western half of the State, because of its lower elevation and less favorable soil, does not offer such a promising field for planting or grafting operations; yet even here the rough hillsides offer opportunities which should not be slighted.

The chestnut is reported as growing well under cultivation as far north as Saco, Maine; in Central Vermont; westward to Michigan, where plantations have been made by the Lake Shore and Michigan Southern Railroad along its right of way; and at several points in Wisconsin. In most of the Central and Southern States attempts to grow the chestnut have proved unsuccessful.

Despite the fact that our native chestnut does not possess the qualities which make it pre-eminently desirable from a pomological standpoint, it should not be overlooked that as a forest timber tree, to be grown as such, it takes high rank. The wood for railroad ties is considered almost the equal of white oak, and about five per cent of the ties used are of chestnut, while for fence posts and telegraph poles it has no eastern rival except the white cedar. Its rapid growth and tendency to reproduce by coppice makes it an exceptionally valuable tree for these uses. It reproduces readily from seed as well as coppices. The seeds, immediately after they ripen in the fall, may be planted in the places where the trees are to grow permanently, or they may be layered in damp sand during the winter for nursery planting in the spring. If planted in a nursery the trees should be transplanted at the end of the first year to the permanent plantation. Planted in mixtures with the white pine and red pine the chestnut is a most excellent species to use in reforesting the waste lands of Southern New England and New York.

To summarize, under the head of the "American Chestnut" it may be said that on the whole the attempt to improve its quality by cultivation, and its range by planting or transplanting, have proved unprofitable. The nuts produced are too small, and the time required for a tree to come into bearing too long to induce a hustling American to grow it for the nuts alone. Its greatest value for nut culture

lies in its root sprouts, which furnish most excellent "stocks" upon which to graft the most desirable European varieties. As a shade and timber tree, or source of nuts for home or local consumption, it will always hold an esteemed place with the American farmer; but the horticulturist or orchardist who wishes to produce nuts on a large scale must turn to the larger, more rapid growing European and Japanese varieties, or greatly improve the native nuts if success is to be assured.

With commendable and characteristic American energy horticulturists long ago began experiments with imported chestnut seedlings and nuts, so that now, at the time when conditions seem ripe for extensive commercial planting of nut-bearing trees, there will be no need in choosing varieties or in growing scions or seedlings, as the nurserymen have the problem well worked out, and can supply the increasing demand for the best Japanese and European chestnut trees which have been produced up to date. The complete history of the introduction of exotic chestnuts in America is a long one, and can only be briefly summarized here.

### The European Chestnuts.

It would be neither safe nor advisable to attempt to give the exact date at which seedlings or nuts of the European chestnut, or "Spanish Chestnut," as it was popularly called, were first planted in American soil. Certain it is, however, that the introduction took place nearly a century ago, and that imported trees have been bearing fruit in this country for over fifty years. It was in the region around Philadelphia, Pa., Wilmington, Del., and Trenton, N. J., that the first general introduction took place, and from here has occurred the eventual dissemination of the different varieties to other parts of the country.

The initial introduction of foreign nuts was not, as would be expected, the work of horticulturists who wished to propagate them for economic purposes, but the result of efforts made by wealthy individuals to secure rare and interesting trees adapted for planting on their new world estates. To the French "Marrons" is accorded the credit of being among the first to introduce the European chestnut. Irenee Dupont, the founder of the now famous powder mills bearing his name, was a recipient as early as 1802 of chestnut seed and young trees from France. Most of the seed failed to grow, but records show that a few trees became established in his garden, and flourished for years, no doubt serving as a center of distribution for the surrounding country.

Although the non-professional tree growers took precedence as to point of time, it was the nurserymen who inaugurated the first systematic work of introducing and

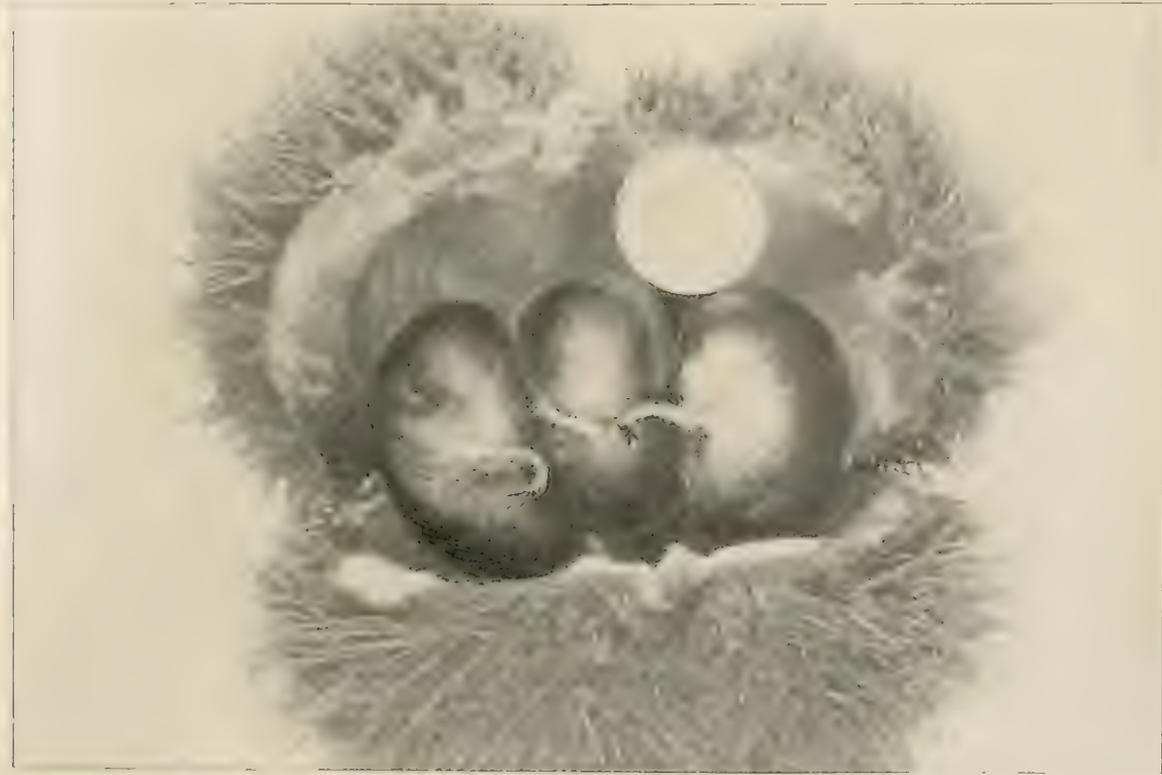
improving foreign varieties of chestnuts. Most of these men lived and carried on their experiments within a radius of fifty miles of Philadelphia. For some years there was a mania for importing trees and nuts, and each importer expected to find the one tree which would be par excellent for this country; but the failure on the part of most of the imports to withstand the change of climate eventually curbed the interest and checked the importation.

The chestnut will not grow true to seed, but often it varies only slightly; hence, selected nuts of both foreign and native varieties were frequently planted in the hope of securing from the seedlings a nut in which large size and good quality would be combined, and which at the same time would be able to endure the vicissitudes of our climate. In most cases the attempts resulted in failure, although in a few instances desirable trees were secured. The same was true with the many imported seedlings. The greater number of the imported trees proved frost-tender, and otherwise unsuited for their new environment. Of the large number planted probably not over one in a hundred has been retained as possessing desirable characteristics. Good quality rather than quantity in the acclimated varieties seems the most difficult to obtain. Trees which bear large sized nuts in abundance are many, but few of them produce a finely flavored nut. The European nuts are usually less bitter and astringent than the Japanese; but neither of them can approach the small native nut in sweetness and delicacy of flavor. The nurserymen have still before them the task of producing by judicious selection and crossing a large nut of fine quality.

A large number of European varieties are listed by nurserymen, but the experience of practical growers indicates that only a small proportion of these are worthy of propagation. The best are:

#### PARAGON.

Undoubtedly the best variety for general planting produced up to date. The original tree, according to Thomas Meehan, was grown by W. L. Shaffer, of Germantown, Pa., from a nut produced on one of the old Spanish trees growing in a Philadelphia garden. H. M. Engle, of Marietta, Pa., was the first to discover its exceptional value, and by him it was first grown extensively and introduced to the public. It is the variety now exclusively grown by Mr. C. K. Sober, of Lewisburg, Pa., who owns a promising grove of 300 acres near Shamokin, Pa. The nuts are large, three-fourths of an inch in circumference, and somewhat pubescent. One average specimen will cover a silver dollar, while thirty-two selected nuts will weigh one pound. The tree is hardy within the range of the native chestnut, ripening moderately early in Central Pennsylvania about October 1, comes into bearing very



PARAGON CHESTNUTS — NATURAL SIZE.

THE FIVE CENT NICKEL COIN IS SHOWN FOR COMPARISON.



NATIVE.

PARAGON.



young, and is exceedingly prolific. In fact, the young trees are such heavy bearers that it is almost a drawback to their value, as they will exhaust their vitality and die, or lose their vigor of growth if unrestrained.

Paragon grafts take exceedingly well in American stocks, and have been known to grow well when grafted upon red oak sprouts. While not free from insect attacks the Paragon is much less affected by the weevil than are other varieties.

A not serious reduction of its many good qualities is the tendency of the burs to remain closed and fall to the ground with the nuts still retained. They open readily, however, if spread in the sun; hence the only detriment is a slightly additional cost in harvesting. It saves, on the other hand, however, the loss and difficulty occasioned by picking the nuts from the grass and debris beneath the trees. For planting in this State the Paragon can be safely recommended above all others.

#### NUMBO.

Bur medium; nut large, bright, slightly pubescent and of excellent quality. It is extensively grown, and is deserving of second place in the list of valuable varieties. Its greatest fault is that it is not sufficiently prolific.

The original Numbo seedling is a vigorous tree still growing on the nursery grounds of Mr. S. C. Moon, at Morrisville, Pa. At present it is a tree with a diameter of about three feet, and a rounded symmetrical crown with a spread of branches of about 60 feet. The history of the Numbo, as given by Mr. S. C. Moon, is that it is one of the seedlings imported from France or England by his father, Mahlon Moon, about 1850. Of a large number imported, both at this time and later, this tree turned out to be the best one of the few good ones which were retained. Many scions have been taken from it, and the Numbo is now known and grown in various parts of the Middle States. It is not a Japanese seedling, as many suppose, nor is Numbo a Japanese word; but is rather an abbreviation of the name *Magnum Bonum*, which the elder Moon first applied to the variety.

#### RIDGELY.

Bur medium, nut smaller than Paragon and less pubescent at tip. The skin is astringent, but the flavor of the nut is good. The tree is hardy and a very prolific bearer. The original seedling was sprouted by Irénée Dupont, Wilmington, Del., and sent to Henry M. Ridgely about 1822. Because of its hardiness it is worthy of experimental propagation in New York State. It bears a very large nut, bright in color, and of attractive appearance. It is a very heavy producer and is among the

earliest to ripen. Because of its beauty and earliness it brings a high price in the market, and should be grown in quantities sufficient to supply the early demand.

### The Japanese Chestnuts.

The Japanese chestnuts are of more recent introduction than the European; but from the limited experience with them it seems certain that they are a valuable acquisition. The limits of the range to which they are adapted is uncertain; it seems probable that their distribution may comprise the area covered by the American chestnut. Judge Andrew J. Coe carried on experiments some years ago, near Meriden, Conn., which seem to show that Japanese varieties are hardy in this part of New England. In low land where frosts were very severe he grafted several newly imported varieties upon native stocks, and found that they not only made a close union and rapid growth, but were uninjured and bore well after frosts of unusual severity.

Compared with the American and European varieties the Japanese chestnut is a smaller tree,—a semi-dwarf, with a compact crown, slender branches and small buds, apparently, though not actually opposite. The leaves are long, narrow, usually pointed, with sharp teeth and a white tomentum underneath. At a short distance the tree is quite peach-like in appearance. The burs are small, thin, with large nuts, free from pubescence; but the meat is covered with a bitter skin, which should be removed before eating. Are very early to ripen. The nuts are of poor flavor when raw, but excellent when cooked. The foliage is comparatively free from the common leaf fungi, making the tree very desirable for ornamental planting. Will probably succeed better south than north.

The wood is rather slow growing, but Japanese scions have a close affinity for American stocks, and hence take well when grafted. It has been asserted that because of this affinity they are more desirable for grafting on American stocks than the trees of European derivation. This has been found to be an unjust criticism when comparing the two, because the best European varieties, of which the Paragon and Numbo are fair samples, take readily on American wood.

In New York the grafting of Japanese chestnuts on native stocks has been reported as successful in Washington and Yates Counties. In Rockland County both whip grafting and budding have given fair results.

The first introductions were the outcome of efforts made by several nurserymen to find and naturalize valuable Japanese seedlings. The climatic conditions of parts of Japan are not widely different from those of the Eastern United States, and as

other trees and shrubs had been introduced successfully, it was inferred that the chestnut could be added to the list. The first recorded importations were by Mr. L. B. Parsons, of Flushing, N. Y., in 1876. These trees received very little care, but, nevertheless, grew and soon came into bearing. In 1882 the late William Parry, of Parry, N. J., began their importation on a large scale, and has done much toward improving and disseminating the best varieties. Probably no one has done more to arouse interest in chestnut culture and put it on a commercial basis than Mr. Parry. For years he was engaged in importing chestnuts, propagating new varieties and improving the old, and several valuable varieties have originated in his nurseries. Mr. J. T. Lovett, of Little Silver, N. J., also imported trees and nuts extensively in the earlier '80s, and has produced several new varieties. He now prefers European varieties, however, and has at Emilie, Pa., a fine Paragon orchard of about 1,200 trees from four to thirteen years old.

The number of Japanese varieties offered by nurserymen is very large, but are much confused as to nomenclature, because of the distribution of seedlings under various good selling names, such as Mammoth, Giant, etc. Those recommended as of tested value are the following :

#### ALPHA.

First in importance as well as name. Originated by William Parry, of Parry, N. J. Claimed to be the earliest known variety of chestnut, and especially valuable on this account. Ripens at Parry, N. J., about September 10. Tree an upright, vigorous grower, and very productive. The original tree began to bear when three years old, and has never failed since to produce a full crop: Burs rather small, somewhat flattened; spines thick, short and stiff; nuts large, averaging two or three to the bur. Quality only fair, but it commands a high price in the market because of its early appearance.

#### RELIANCE

Another one of Parry's seedlings. Tree a semi-dwarf, low spreading and drooping. Comes into bearing remarkably early. Scions not infrequently mature fruit the first year they are set. This should not be allowed, however, as the early bearing injures the future vitality of the tree and reduces the size of the nuts. Burs medium, with three to five large nuts to the bur. Ripens from September, 20 to October 1, in New Jersey.

#### HALE.

Originated from seed imported in 1886 by Luther Burbank. Now grown by J. H. Hale. Tree low, of spreading habit, with narrow pointed leaves of a very

glossy dark green color. Burs with thin peppery shell, each normally containing three nuts of medium size and rich brown color. Is very prolific, and, from experiments of Hon. Andrew J. Coe, in Connecticut, very hardy.

#### PARRY.

One of the best productions of the Parry nurseries. It is the original "Parry's giant," also called "Japan giant." Tree large for a Japanese chestnut, open, spreading, very prolific and an early bearer. Burs very large, containing usually one, sometimes three nuts. Nuts largest known, sometimes two inches across; ridged; bright mahogany color, and of fair quality. If exceptionally large nuts are desired this is the variety to plant.

To attempt a close discrimination based on the general qualities of the Japanese and European varieties of chestnuts is rather difficult because both groups have many good qualities, and each, unfortunately, several bad ones. For each, too, can be found men who earnestly advocate the propagation of their favorite group to the exclusion of the other; hence, to favor one is to produce enmity. The difficulty is that few growers have experimented with more than a few varieties of each group, and they are inclined to make sweeping assertions on a limited experience.

If the general characteristics of each group, as far as known, be listed and compared the balance of favor would give the Japan nuts first place. If, however, the two or three best and most widely grown varieties of each be compared, the imports from the far East are immediately reduced to second place. The experience of practical growers corroborates this view, and men who were once heavy importers of Japanese seedlings are now planting only European trees in their commercial orchards. When the Oriental varieties were first introduced it was thought they would be the money makers in either groves or orchards; but to-day it is hard to find them grown on a large scale.

As an ornamental tree the Japanese chestnut is of undoubted value because of its freedom from disfiguring fungi and insects, and its large beautiful nuts. From the purely financial standpoint, however, as well as for horticultural reasons, the more enduring, better flavored European varieties are to be recommended for extensive propagation in New York and the Northern States. It is advisable, nevertheless, for all growers to experiment to some extent with varieties of uncertain value, so that they may find the ones best suited to their local conditions.

## Systems of Management.

Two distinctive methods of chestnut culture are in vogue in the Eastern United States. The one is the method of grafting young native chestnut coppice (sprouts) with the scions of Japanese, European, or native varieties, and depending on the roots of the old stump, and the new roots which are developed, to afford nourishment and give the necessary mechanical support. Where the natural stump sprouts are thus grafted the resulting growth is called a "chestnut grove."

The other method is to grow young plants from seed, graft them in the nursery when two or three years old and the following year set them in orchard rows in cleared or cultivated ground. When nursery seedlings are cultivated in this way they are described as a "chestnut orchard."

The propagation of chestnuts in groves by the grafting of numerous young sprouts is decidedly the most advisable, both from an economic and purely horticultural standpoint, in a country where native trees are at all common. If only a partial stand of sprouts can be obtained, they should be encouraged and grafted, and seedlings planted in the blank spaces between, other species of course being cut out.

The grafted sprouts by virtue of the old established root system are furnished an abundant supply of nourishment and make a surprisingly rapid growth, often bearing fruit profusely when only three or four years old. One little Paragon graft in Mr. Sober's grove matured 56 large burs when only two years old. Trees three to five years old bear several pints of nuts annually, while their crop when more than five years old may be counted in quarts. Paragon grafts when ten to twelve years old produce on an average a half a bushel or more of nuts. With a chestnut grove there is, too, less liability of failure in obtaining a full stand of trees, as the loss attendant upon transplanting is eliminated, while the great number of sprouts which spring up in a newly cut-over chestnut forest gives an abundance of stocks upon which to graft the scions. With experienced men there is little loss in the grafting process, and under favorable circumstances ninety per cent of the grafts may be expected to take. By grafting a large number of sprouts per acre there is sure to be left, after deducting for all probable loss, a thick stand, which may be thinned as conditions require, thus keeping the ground continually covered, and production, even at the outset, at its maximum. The newly grafted sprouts which are removed to make room for others furnish a fine supply of new scions, if cut in the late fall or winter.

The trees which are ultimately to cover the ground and produce the fruit should

not be allowed to mature burs while less than five or six years old; but since the original stand is to be thinned eventually, it is possible to mark, at an early date, those intended for removal, and allow them to fruit while young, thus securing early returns without working permanent injury to the grove.

Financially the chestnut grove is to be preferred to the orchard for several reasons. First, the cost of cutting off the old stand and grafting the sprouts does not greatly exceed the expense of producing seedlings and grafting them in the nursery, and, in addition, the chestnut timber removed is usually of considerable value for fuel, poles or railroad ties. Secondly, the ground which produces the sprouts is usually of little value for agricultural purposes, being mostly rough waste land; while in setting a chestnut orchard land is required which would be of considerable value for general agricultural purposes. Thus the cost of the first investment is in favor of the chestnut grove rather than the orchard; hence, from the latter it would be necessary to realize a greater income in order to pay interest on the large capital tied up in the more expensive land. As a third condition there is an appreciable loss in time—and, hence, in revenue—in the chestnut orchard; because seedlings, especially when retarded by an early graft, do not come into bearing nearly as early as do the grafted sprouts. A vigorous stump sprout will be a tree eight to twelve feet in height when five to seven years old, and will produce several quarts of nuts annually. A grafted seedling does not attain this size, nor bear to the same extent until eight to twelve years old. The seedling, however, has the advantage of longer life and less liability of deterioration.

With the rough, idle chestnut hillsides and flats of New York, as well as other States, it is a question of raising chestnuts or waiting through a long period of years for the timber to mature. Even then the most desirable timber trees will not grow unless planted, so great is the power of worthless species to crowd out the more valuable ones. On the fertile soil of the plains or uplands where most of the chestnut orchards are located, it is a question of raising chestnuts, pears, apples or other common fruit; hence the loss in case the chestnuts fail is much greater. In the latter case chestnut culture becomes merely a branch of horticulture, to be governed by much the same rules as apply to apple and pear orchards. When the sprouts on a worthless old hillside are grafted and made to produce a valuable crop of nuts, as well as timber, the work is surely entitled to a place as a branch of forestry, since the essential elements of a tree forest are all present, and are preserved rather than disturbed. In addition it is an important step towards the solution of the great problem of reclaiming the worthless waste lands which at present are a menace to the surrounding forests, and which show a lack of the Yankee ingenuity that has



A YOUNG CHESTNUT "GROVE."

TREES SIX YEARS OLD. PARAGONS GRAFTED ON NATIVE SPROUTS.



DISTANT VIEW OF ONE OF MR. SOBER'S CHESTNUT GROVES.







GENERAL VIEW IN THE "GROVE" OF THE ALBION CHESTNUT COMPANY.

THE TREES ARE NINE YEARS OLD, MOSTLY NUMBOS.



A CHESTNUT "ORCHARD."

solved the problem of "complete utilization" in nearly every branch of commercial activity, except forestry.

The chestnut orchard, it is true, often has the advantage of location, accessibility to market, freedom from underbrush, and lessened danger from fire, while as an additional advantage the purely artificial orchard may be started in a region where the chestnut is not indigenous. To the man, however, who is after the largest returns in the shortest time, the chestnut grove, produced by grafting the coppice sprouts in the natural chestnut forest, provides the most. A combination of the two may perhaps be profitably effected under certain conditions.

### The Chestnut Orchard.

Although chestnut orcharding in its extreme form is not considered as profitable as the grove system, yet the method of procedure is here briefly outlined for the benefit of those who wish to grow chestnuts and yet do not have the native sprouts upon which to start their scions.

The first step is the starting of the seedlings in the nursery. These may be grown from native or imported nuts, it being immaterial which so long as vigorous seedlings are produced. The seeds (nuts) may be planted in the fall or spring in nursery rows four or five inches apart in the row and covered one to two inches deep. Fall planting is advisable if the nuts can be protected from mice and squirrels. If planting is delayed until spring the nuts should be kept over winter, layered in damp sand. In one year they should have attained a height of six to twelve inches, and in two years stand two to three feet high. The third spring they should be grafted while yet in the nursery rows, and the following spring transferred to the orchard rows. Tongue or whip grafting is the most successful method. Budding, grafting one year olds at the collar, and root grafting as done with apple trees, have all been tried, but with little success. As a variation on the above, the two or three-year-old seedlings are sometimes first transplanted to the orchard rows and then grafted. This, however, results in a loss of time because the trees must be allowed to get their root system firmly established before setting the scions, otherwise they will not have sufficient vitality to withstand the shock of both grafting and transplanting.

The trees are usually set thirty feet apart each way; but with the smaller Japanese varieties they may be set as close as twenty feet. In the New Jersey orchards the ground is kept cultivated for some years, during which crops of corn or potatoes are raised between the rows. Mr. R. Williams, of Riverton, N. J., tried the

experiment of setting native seedlings, four to six feet high, in rows twenty feet apart, cutting back the limbs to the two-year-old growth, and inserting scions of Japanese varieties. The plan is not advisable because it makes the crown too high and heavy to be safely supported by the long slender trunk.

No case is known where grafted seedlings have been set in brush land. The first cost would be somewhat greater; but there seems no evident reason why such treatment would not be successful. If seedlings will thrive equally well in cultivated or brush land, one of the objections to chestnut orcharding would be removed. The long time element remains, however, an unchanging disadvantage in such management.

### The Chestnut Grove.

Given a mixed stand of coppice chestnut and oak and other hardwoods, to transform into a nut-bearing grove of improved exotic varieties. The system applied in the best groves of Pennsylvania and New Jersey is practically as follows:

In the late fall or winter all trees and brush are removed from the area under management, care being taken to cut the chestnut near the ground and leave smooth stumps. From these stumps there will spring up during the following summer a vigorous growth of sprouts, usually several around each stump, which in one year reach a height of four to six feet, and a diameter from one-fourth to three-fourths of an inch at two feet from the ground. Experience has shown that sprouts of this size are the best for grafting; hence it follows that the second spring after the timber is cut off grafting operations may begin.

Grafting may be commenced when the buds first start; but it is better to wait a little later, until the sap flows freely. May is the best month in which to graft, although it may be commenced as early as the middle of April. The tongue or whip graft is the method which should be exclusively used. Budding, cleft (wedge) grafting, prong grafting, crown grafting and many other methods have been tried, but experience has shown that they are in general impracticable. The cleft or wedge graft can be set in stocks of a size up to several inches, and usually succeeds to the extent of making a union; but it seldom heals smoothly, and usually leaves an opening between the scions which becomes a source of infection and point of structural weakness to the whole tree. With the small sprouts and the whip graft the union is seldom discernible after a few years.

The scions should be cut early and kept dormant in a cellar or ice house until the buds on the stocks are well swollen in the spring. It should be remembered



SPROUTS BEFORE GRAFTING.

THE PLACE WHERE THE SPROUT IS GRASPED BY THE FINGERS SHOWS THE HEIGHT AT WHICH IT SHOULD BE CUT OFF AND THE SCION INSERTED.



THE "WHIP" OR "TONGUE" GRAFT.





GRAFTS FOURTEEN DAYS OLD.

SHOWS METHOD OF WRAPPING WITH MUSLIN.



that the sap of the chestnut does not start as early as that of apples, pears and other succulent fruit, and hence grafting should be done later.

The stump sprouts should be cut off and the scions inserted some three to four feet from the ground, so as to keep the heads low. Where there is a circle of sprouts around a stump the ones which start nearest the ground should always be chosen, because they root in more firmly and are less liable to damage by the wind. In a group of sprouts, such as spring from one stump, only one or two are grafted; but the rest are left during the first year as a protection to the young grafts. Where sprouts are plentiful grafts should be put in every 12 to 15 feet or from 200 to 400 per acre, care being taken to leave no open spots or any unnecessary grouping. As the trees grow and expand the poor and crowded specimens should be removed to make room for the better trees. If small seedlings appear they should also be grafted.

Many mistakes have been made in grafting, and as it is a most important phase of chestnut growing, in fact, the basis of success, too much care cannot be given to this part of the work. If well done ninety per cent of the grafts should live. An experienced man should set 250 scions per day, and do it well. In whip or tongue grafting the stock and scion should be of as nearly the same diameter as possible, and the cut on each long and smooth and made with a thin, very sharp knife. Each should then be cut vertically so as to leave a wedge-shaped piece on the face of each cut, so that the tongue of the scion may be forced firmly into the cleft of the stock. The union should be exact, so that the inner side of the bark on each will coincide at least on one side. The joint should be thoroughly waxed, and as a further precaution wrapped tightly with waxed muslin. The muslin holds everything firm, thus hastening the union of the cambium layers. It excludes air from the cracks in the wax caused by the expanding sprout, and gives a mechanical support which prevents breakage of the joint by the wind. The yearly growth of grafts when thus treated is quite remarkable. When two months old they are often two to three feet in length, while it is recorded that one specimen grew in one year a linear distance of 54 feet, counting the main axis and all the lateral branches. The writer measured one graft which had been inserted 14 days and found it to be ten inches long. The first year's growth is inclined to assume a fan-shaped form, and not make a well-rounded crown; hence it has been found advantageous to cut back the first year's growth in the fall so that only a stub three to four inches long, containing two to three buds, remains. The following year these buds will grow into a well-rounded head.

An interesting fact is that many of the European chestnuts will grow equally

well if grafted upon oak sprouts or seedlings. In France and England the chestnut has been grafted upon the English oak (*Quercus robur*) for years. In this country the U. S. Division of Pomology found by experiments that several varieties of European chestnuts, including the Paragon, Numbo and Ridgely, grow well on our chestnut oak (*Quercus prinus*). In Central Pennsylvania the Paragon has been seen grafted upon red oak (*Quercus rubra*) with evident success. This adaptability of the chestnut to thrive on oak stocks materially increases its range and possibilities.

It is essential that a good grafting wax be used if success is to be attained. An excellent wax is the following from an original formula by Mr. C. K. Sober, Lewisburg, Pa.: Resin, 2 pounds; beeswax, 2 pounds; beef tallow,  $\frac{1}{2}$  pound. The whole to be melted together and worked into a wax upon cooling.

Another wax recommended by the U. S. Division of Pomology for nut trees is: Linseed oil or tallow, 1 pound; resin, 6 pounds; beeswax, 1 pound. Melt all the ingredients together, pour into water to cool, and knead into balls of convenient size.

As to species it is hard to say anything definite, because local conditions so greatly affect species and the final results. The Numbo, Paragon and various Japanese varieties take well on American stocks. From the experience of the practical men in the business, and from personal observation, it seems, however, safe to recommend the Paragon as the best for general propagation in chestnut groves. With whichever variety is chosen for the main crop, trees of another variety should be mixed in so that cross-pollinization may be effected, although there is some uncertainty as to whether this is absolutely essential.

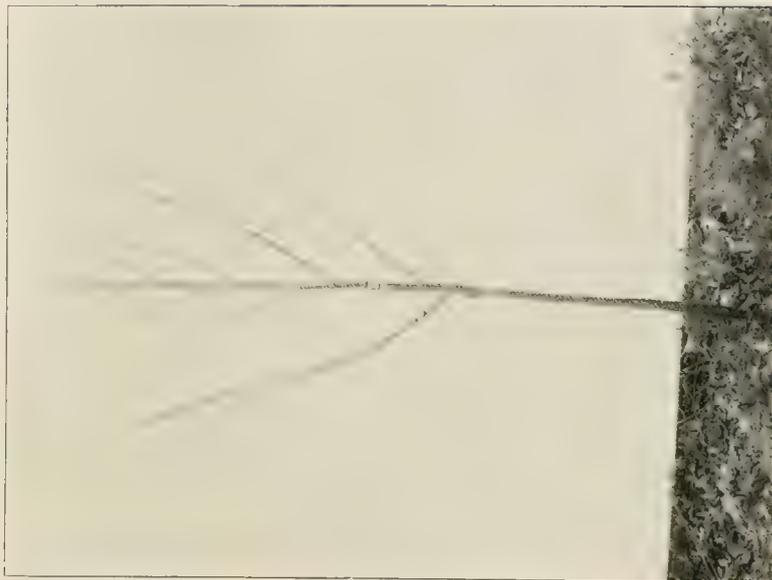
## Harvesting.

With the exception of the Paragon the imported chestnuts have burs which open when the nuts are ripe, allowing them to fall to the ground, where they may be collected. It may be mentioned here that the frost performs no direct function in ripening the nuts, although there exists a widespread notion to the contrary. The process of ripening is gradual, and is usually finished before frosts occur. The part the frost really plays is in checking the growth of the tree, and thus causing the withdrawal of the sap from the twigs and burs. This reduction in moisture results in a shrinkage in parts of the bur; the outer, thinner, and more exposed portion dries more rapidly than the thicker inner part around and at the base of the nuts. It is this unequal shrinkage which causes the involucre to open. A long rain, followed by drying weather, is often equally effective in opening the burs.



THE BEST METHOD.

THE JUNCTION OF THE STOCK AND SCION IS WRAPPED  
WITH WAXED MUSLIN.



TREE GRAFTED LAST SPRING (1902).

THE TAPES SHOW WHERE TO CUT IT BACK.





A "WHIP GRAFT" 21 YEARS OLD.  
THE PROPER METHOD OF GRAFTING.



THE "WEDGE GRAFT."  
A WRONG METHOD.



In the case of the Paragon the burs must be picked from the trees by hand, or, by waiting, they may be gathered from underneath the trees, as the closed burs soon fall. Ripeness is indicated by the yellow color of the bur, and a slight cracking open at the end, disclosing the nut within. The collected burs if spread in the sun a few days will open fully, and liberate the nuts.

### Care of the Crop.

Having secured a crop of nuts the next step is their proper care and disposition. Those sold immediately need no special care, and from present indications prompt sale of a large crop will not be difficult. There is a growing demand for large, sweet chestnuts, especially in the Middle West, and dealers are usually on hand to buy up the crop even before it is harvested. Prices for the best nuts range from five to twelve dollars per bushel. On the streets of Philadelphia, Paragon nuts sell readily at forty cents per quart.

If not immediately disposed of the nuts should be subjected to some treatment to prevent their getting hard and being destroyed by weevils. Probably the best treatment is the scalding method. By this plan a quantity of nuts are put in a tub, or other water-tight receptacle, and covered with boiling water. If stirred for a few minutes the wormy, and otherwise defective ones, will come to the surface and may be removed and destroyed. The good nuts in the bottom should be allowed to remain for ten minutes, so that all eggs and larvæ may be killed, then removed and dried. Nuts thus treated will not get flinty hard when subsequently dried for winter use. Another plan is to put the nuts in cold storage as soon as harvested, removing them only as required for market. Those which are to be planted the following year should be treated with carbon bi-sulphide to destroy all insect life, and then layered in sand during the winter.

### Uses.

Mention has already been made of the extensive use of chestnuts in many foreign countries, notably France, Spain, Italy, Korea and Japan. In all of these countries the chestnut is considered, not as a luxury, but as a staple article of diet, to be prepared and used as such. It is said that Paris alone consumes twenty million pounds of Marrons (table or desert chestnuts) annually, while the consumption of nuts and meal in France as a whole is so great that, despite the enormous production within her own territory, several million dollars worth of nuts are

imported from Italy and Turkey yearly. Nor is the consumption confined to the peasant classes, who use the flour almost exclusively for bread; but chestnuts roasted, steamed, puréed, as a dressing for meats, and as vegetables, are served extensively on the tables of the rich.

In this country the variety of food stuffs is so great, and their production so easy, that necessity has never taught us the value of nuts as food. The great grain fields of the West are looked upon as the one legitimate source of the "staff of life," yet the fact remains that chestnut flour makes an equally palatable and a more nutritious bread. The chestnut when raw is not easy to digest; but in cooking the starch grains are broken up, making them readily digestible. Prejudice, coupled with ignorance and lack of appreciation of its good qualities, are the factors which to-day retard the adoption of the chestnut as one of our staple articles of diet.

In chemical composition and relative food value, the chestnut differs widely from other nuts, since it contains a large percentage of the carbohydrates, especially starch, and less proteine matter and oils. In this respect it quite closely resembles wheat flour. Since the carbohydrates are the chief source of the energy used in maintaining the vital processes of the body, it follows that the chestnut, by reason of its high percentage of these carbohydrates and the comparatively small amount of nitrogenous matter, is a better balanced and more nutritious food than other nuts, or even many of the cereals.

It may be that when the wheat lands become less productive and the margin of profit lower that men will turn to the idle, untilled woodlands of the East and utilize them for the production of nuts as a substitute for cereals. A change in our bread-making material, if ever made, will come slowly, since public taste and long-established customs are slow to alter, and new introductions are looked upon with distrust. The growing realization that the fine white bread in use at present is lacking in nutriment, and is injurious to the digestive organs, and the general crusade against it by physicians and health food advocates, will, however, rapidly turn public attention to new cereals or substitutes for them.

An acre of land will grow 35 bushels of wheat in a year if properly cultivated. A like area of chestnut trees will produce many times as many bushels of equally nutritious food yearly for an indefinite period, and require no outlay for cultivation, replanting or fertilization. More than this, the spring frosts, beating rains and summer droughts, which are a constant menace to a wheat crop, work no injury upon the chestnut tree or its fruit. Why then is wheat grown on millions of acres, while we fail to produce even enough chestnuts to supply the now limited demand, and allow Southern Europe to exact large tribute from us annually for the nuts we



FROM THIS TREE 300 YOUNG BURS WERE PICKED; 200 WERE LEFT ON THE TREE TO MATURE.



A NORMAL YIELD.



import for consumption in their raw, unwholesome form. With the exception of the occasional Thanksgiving turkey stuffed with chestnut dressing, chestnuts in their many appetizing cooked forms seldom appear on the bill of fare of the American people; and yet housewives are constantly complaining of the lack of variety in the foods obtainable. Why not try chestnuts? Mrs. Rorer gives several excellent recipes which any cook can follow or enlarge upon at will. If given a fair trial the chestnut cannot fail to commend itself for general table use, and when once generally introduced new uses for it will be found, and its permanent place among our valuable food products assured.

### Insects.

Enemies in the form of fire, thieves, or wind may be fought and controlled, either wholly or in part; but when we consider the insect pests in their relation to chestnut culture, a more serious problem presents itself. Insects are so subtle in their workings, so mysterious in their many forms, and present such vast numbers, that man with his limited powers must stand more or less powerless in the event of their extended ravages.

The chestnut as a tree is not seriously injured in either leaves or trunk by any form of boring or defoliating insect; but unfortunately the nuts furnish a breeding place and food supply to a very destructive larva known as the "chestnut weevil." So great has been the destruction wrought by this weevil in parts of the country, especially in the South, and on the more susceptible varieties, that many growers have ceased the commercial propagation of the nuts because of the annual reduction of profits by the ravages of the weevil. It must be admitted that the tribute of one-half to three-fourths of the crop, which weevils sometimes levy, is decidedly discouraging; but these extreme cases are usually the result of unwise choice of species, or an unfavorable location of the grove or orchard. Improved varieties suffer most in or near native chestnut forests. Japanese varieties suffer less than European, and of the latter the Paragon is least affected. Insect pests on apple, peach and other fruit trees have been controlled, and it seems reasonable to suppose that if chestnut culture assumes sufficient proportions, remedial measures will be found for the chestnut weevil.

At present the danger of an annual diminution of profits from wormy nuts is the one drawback to extensive culture of improved chestnuts, especially on cut-over chestnut land. The control of this pest is a question of vital interest to growers and entomologists, and upon its proper solution depends, to a great extent, the ultimate success of chestnut culture on waste land. With the Paragon and other

varieties which are least susceptible, the margin of profit left after the worms destroy a considerable portion of the crop is sufficiently high to induce many to invest in the business, even when possessed of the certain knowledge of this annual loss. If this damage by weevils can be decreased or made nil, the profits, which even now are high, will of course increase in like proportion.

The whole question of damage by weevils is at present something of a lottery at best, since not only orchards and groves but individual trees of the same variety are infested in widely varying degrees, and to a different extent each season. One plantation may be seriously injured during a season, while another a few miles away remains exempt; or one portion may be affected and the remainder left uninjured. The same is true of individual trees, although there are varieties, as the Cooper, which seems a special prey for the weevil at all times and places.

The chestnut weevil is of the beetle family of insects, and is one of the several species of *Curculio* which infest nuts. The genus *Balaninus*, to which it belongs, includes seven species, all of which are nut weevils; but only two, viz., *B. caryatrypes* and *B. rectus*, work serious injury to the chestnut. It is the larval form of the insect which works within the chestnut and renders it unfit for use. The larva or grub is footless, white or cream colored, with a red or yellowish head, and a cylindrical body about half an inch long. The larvæ of *B. rectus* are of smaller size than those of *B. caryatrypes*. The adults are yellowish in color with rusty lines and spots on the wing covers, and are characterized by their extremely long and slender snout or beak. Their powers of flight are rather limited. In the male beetle the beak is about the length of the body; in the female it is twice as long as the body. The function of the beak is to pierce the immature burs and nuts and prepare a place for the reception of the eggs.

The life history of the insect, briefly stated, is as follows: The winged beetles appear about the time, or soon after, the trees begin to bloom; but egg laying is delayed until the staminate catkins drop, and the young burs are of considerable size. Then with their long beaks the beetles pierce a hole through the thick bur and into the tender nut itself and excavate a tiny cavity, in which the female deposits from one to four eggs. The tiny wound in the nut soon heals over completely, thus effectively protecting the eggs and grubs within. Eggs are often laid in different parts of the same nut; hence we frequently find the mature nuts harboring several grubs, sometimes as high as fifteen or twenty. As soon as the eggs are laid the winged beetles die, there being only one brood each season. The eggs hatch in a few days and the larvæ live and work within the growing nuts, reaching maturity about the time, or a little after, of the autumn ripening and falling of the



CHESTNUT WEEVIL — NATURAL SIZE.  
IMMATURE BUR.



CHESTNUT WEEVIL (*Colemanus carpathicus* Bohemann).  
THE LONG BEAK INDICATES THE FEMALE.



nuts. The time required by the larvæ to reach maturity is not fixed, but is governed by the time of ripening of the nut, which acts as host. In different varieties the grubs are always full grown when the nuts mature, even though the varieties ripen many weeks apart. The full grown larvæ bore out through the shell and enter the ground soon after the nuts fall, where they change into a pupa state, in which condition they remain dormant all winter. In the spring, after another transformation, they emerge in the adult beetle form, thus completing their cycle of existence, and are ready to perform the one function for which they were created, the reproduction of the species.

The full control of this weevil pest is as yet an unattained result. As with many other pests of this kind preventive measures, rather than remedial ones, are most effective. The one plan which aims to reduce the injury after it is done, is the scalding method already described under instructions for the care of the crop. This method, if immediately carried into effect upon the maturing of the nuts, makes most of the crop available for market, and kills all insect life in the gathered nuts, thus reducing the number which would prey on next year's crop, and saving a second resorting of the nuts before marketing. If left a few days without scalding, a basket of nuts often shows twice as many wormy ones as when set away, since many larvæ mature and leave within that time. The holes in the shells are always made from the inside by emerging larvæ. Sound nuts never become infested when mixed with wormy ones, because the larvæ pass the pupa state and winter in the ground, not in the nuts.

The preventive measures which may be practiced are many and are all good, since anything which reduces the number of insects will lessen the injury done during the subsequent year. To keep large flocks of guinea hens, turkeys and game chickens foraging among the trees is an excellent plan, as the number of adult insects and larvæ they will destroy is enormous. In order to prevent the larvæ from escaping into the ground the nuts and burs should be gathered the moment they are ripe, and immediately sorted and the defective ones destroyed; or, if left unsorted, they should be thrown into tight bins or boxes to prevent the escape of the larvæ. Even the immature burs which fall early should be gathered and burned, and every precaution taken to destroy all existing larvæ. The Paragon burs which are picked and dried in the sun should be burned as soon as the nuts are extracted. It has been suggested that the curculio be shook from the trees into sheets, as is done with the plum curculio; but this would prove practicable only where the orchard or grove is small. A better method is to plant throughout the plantation varieties, like the Cooper, which are especially sought by the weevil, and destroy all

burs which form on them. Whenever possible the orchard should be located some distance from native chestnut woods, or, if a grove, all the trees should be cut off and grafted. Some means should also be taken to trap the winged beetles during the egg-laying period. As far as known no attempts have been made to spray the young burs with a solution which would kill or drive away the adult beetles. It is worthy of experiment. The various treatments just enumerated can be applied most advantageously in the chestnut orchard. The chestnut grove, however, if kept clean and free from underbrush also responds readily to treatments which help to reduce the beetles.

### The Coppice Forest.

To those not sufficiently interested, or not so situated as to make the growing of chestnut trees for their nuts advisable, there still remains a profitable and interesting field of operations in the growing of the native tree for timber or fuel. This work may be loosely conducted or made intensive as desired.

Two systems present themselves. The one easiest of control and offering the quickest returns is the "coppice system." Under this system the forest is cut over clean with a rotation of about thirty years, the time depending on the use to which the timber is to be put. From the stumps thus left a new growth of sprouts spring up which are the basis of the new crop. The cutting should be done in the fall or winter, when the vital functions of the tree are at a low ebb and most of the sap is withdrawn from trunk and limbs. The stumps should be cut low and smooth. The sprouts which result from this system of forest management are very rapid in growth, and will furnish poles, posts and cross-ties in twenty to thirty years. The forest when once started may be left to itself; but it can be greatly improved by making thinnings and improvement cuttings, while the material thus removed can be utilized for fuel. This involves the removal of defective and crowded trees, and likewise those of other species which are of little value, or are around the more valuable trees.

The other system which may be recommended is that of "coppice with standards." This system is essentially the same as the one just described, except that in addition to the sprouts a number of seedling trees are left, or, if needs be, planted. These seedlings are not to be cut when the sprouts mature, but are left through two or three rotations of twenty or thirty years, so that they may attain a size suitable for lumber. The number left per acre may vary from 30 to 50.

### Summary.

Our native chestnut, although of unsurpassed flavor, is not desirable for general culture because of the small sized nut, irregular and non-prolific bearing, damage by weevils, and long time required to come into fruit. As a timber tree it is of recognized value and responds readily to several systems of forest management. Many varieties of chestnuts have been introduced from Europe and Japan, but of the large number imported but few have been found which are suited to our climate or possess commendable characters. Those retained are a valuable acquisition, and in size, productivity and rapidity of growth, are far superior to our native chestnuts for cultivated plantations. The Paragon, Numbo, and Ridgely of the European, and the Alpha, Reliance, and Parry of the Japanese varieties, are the most valuable.

Two general systems of chestnut culture are practiced, designated respectively as the "chestnut orchard" and the "chestnut grove." The first is composed of grafted seedlings set in orchard rows on cleared, usually improved, land. It offers advantages of location, ease of cultural control, and greater freedom from insect pests; but in general it is too expensive. The other system is an attempt to utilize waste forest land for the production of nuts. By this system a natural forest, in which the native chestnut is the predominant tree, is cut over, and the following year the one-year-old sprouts which spring up from the stumps are grafted to improved varieties. The Paragon stands first in general favor. In this system of culture the whip or tongue method of grafting has proved most successful. Returns from a grafted grove are early and the income large if no detrimental element enters. Insects and fire are the worst enemies, the former being the most injurious and hardest to control.

The American people have not yet learned the full value of chestnuts; but it seems probable that with a larger supply and an improved quality there will come a better appreciation of their food value, and a greater demand. In many European countries the chestnut has long been recognized as a cheap and nutritious food, and as such is extensively used. Chestnut culture in the United States is truly in its infancy as yet; but interest is rapidly being awakened, and in the near future a rapid advancement of the industry may be expected. If followed for pleasure, few branches of arboriculture possess greater fascination or offer a broader field for experimental work. If conducted as a business enterprise for profit only, there is offered a reasonably safe investment with quicker and higher returns than are assured by any system of forest management, while but few branches of horticulture are equally profitable.

In conclusion full credit must be accorded to the several men who aided the writer so materially in his investigations of the latest methods of chestnut culture, and without whose assistance the data and photographs herewith presented could not have been obtained. To Mr. Coleman K. Sober, Lewisburg, Pa., and Mr. Samuel C. Moon, Mooresville, Pa., especial thanks are due for their hospitality and valuable information regarding methods of grafting and general care of chestnut groves and orchards. From Prof. Nelson F. Davis, Bucknell University, many timely notes have been received, and by him many of the accompanying illustrations have been obtained and contributed. To nurserymen and horticulturists generally, who verbally and by correspondence have contributed to this article, the thanks of both the Commission and the writer are extended.



JESSUP COL., NO. 290.

CHESTNUT (*CASTANEA VULGARIS*).

# Economic Value of Birds to the State.

BY FRANK M. CHAPMAN

ASSOCIATE CURATOR OF MAMMALOGY AND ORNITHOLOGY IN THE  
AMERICAN MUSEUM OF NATURAL HISTORY.

## The Bird and the State.

THE bird is the property of the State. From this fundamental conception of the bird's legal status there can be no logical ground for dissent. If a certain species of bird is conclusively proven to be injurious to the agricultural or other interests of the State, no one would deny the State's right to destroy that species. If, on the contrary, a species is shown to be beneficial, then the State has an equal right to protect it. Indeed, we may go further and say it is not only the right, but the duty of the State to give to its birds the treatment they deserve. Here is the great Commonwealth of New York with agricultural and forestry industries which annually yield products valued at \$266,000,000. In the closest relation to the welfare of these industries stands a group of animals represented by some 350 species and millions of individuals. Obviously, then, it is the first duty of the State to learn definitely in what way or ways the presence of these incalculably abundant creatures affects its crops and forests.

If they are harmful how are they to be destroyed? If they are valuable how are they to be preserved? In short, the State should take all necessary steps to appraise its vast possessions in bird-life.

The government at Washington realizes the importance of this subject and in 1886 it established, in the Department of Agriculture, a Division of Economic Ornithology and Mammalogy, with the object of learning accurately the economic relations of birds and mammals to man. Illinois, Wisconsin, Nebraska, Pennsylvania, Massachusetts and New Hampshire, among the States, have made investigations with the same end in view. Now the South is awakening to the vital importance of this practical side of natural history research. At the Annual Session of the Texas Farmers' Congress, held at College Station, Texas, July 17, 1902, Professor H. P. Attwater, a prominent ornithologist in the State, was invited to make an address on "The Relation of Birds to the Farmer." In commenting on this address *The State*,

a newspaper of Meridian, Miss., says: "Bird protection is going to be made an economic issue in every Southern State before many days, and the army of sentimental advocates will be reinforced by the utilitarians, who, while caring nothing for the beauty of the feathered songster or the music he makes, are very much alive to his usefulness in exterminating insects that kill crops, and are determined to stay the hand of the snarer and wanton bird-killer before it is too late and the insects have taken possession of the land. \* \* \* Wherever common sense prevails this cause will find advocates, and *The State* would like to see Bird Protection made an issue in Mississippi politics."

No "issue," however, can be successfully promoted unless the facts involved rest on the firm, incontrovertible foundation established by exact research. The Forest, Fish and Game Commission of New York State, in calling the attention of the citizens of the State to the economic importance of birds, desires to present, therefore, the results of the investigations of economic ornithologists into the food habits of our birds. But before giving in detail the studies of these specialists it will be well to outline in a general way how birds may be valuable or injurious to man.

### What the Bird Does for the State.

Birds are of value to the State chiefly through the services they render in (1) eating harmful insects, their eggs and larvæ; (2) in eating the seeds of noxious weeds; (3) in devouring field mice and other small mammals which injure crops; (4) in acting as scavengers. The appended outline of the bird's relation to the forester, fruit-grower, farmer, and citizen will enable us to appreciate its economic importance.

#### THE BIRD AND THE FORESTER.

The agriculturist, in producing an artificial condition in the plant world, creates also an unnatural state of affairs among the insects that find a new food in the outcome of his husbandry and among the birds that prey upon these insects. But between birds and forests there exist what may be termed primeval, economic relations. Certain forest trees have their natural insect foes to which they furnish food and shelter; and these insects, in turn, have their *natural* enemies among the birds to which the trees also give a home. Here, then, we have an undisturbed set of economic relations: (1) the tree; (2) the insect which lives in the tree, preys upon it, and may assist in the fertilization of its blossoms; (3) the bird which also finds a home in the tree and, feeding upon insects, prevents their undue increase. Hence, it follows that the existence of each one of these forms of life is dependent

upon the existence of the other. Birds are not only essential to the welfare of the tree, but the tree is necessary to the life of the bird. Consequently, there has been established what is termed "a balance of life" wherein there is the most delicate adjustment between the tree, the insect, the bird and the sum total of the conditions which go to make up their environment. The more trees, the greater the number of insects, and, hence, an increase not only in food supply for the birds, but an increase in the number of nesting-sites.

Destroy the trees and the insect finds new food in the crops of the farmer, but the birds, although food is still abundant, lose their home when the tree falls, and, lacking the nesting-sites and protection from their enemies once found in its spreading branches, they soon perish.

What we may call artificial forest conditions are to be found in parks, squares, village streets, and in our gardens. Here forest trees may find a suitable soil, but birds are often less abundant in such localities than in the forest, and consequently the trees growing in them are notably less healthy than forest trees. It is in these semi-domesticated trees that a scourge of injurious insects most often occurs, occasionally to be followed by a marked increase of their bird enemies, which are attracted by the unusual abundance of food. Such an instance is recorded in *Bird-Lore* for October, 1899, by Caroline G. Soule, who writes:

"Last year, at Brandon, Vermont, the tent-caterpillars were so abundant as to be a serious injury and annoyance. They lay in close rows, making wide bands on the tree trunks. They spun down from the upper branches and fell upon the unfortunate passers-by. They crawled through the grass in such numbers that it seemed to move in a mass as one looked down upon it. Under these circumstances, birds might be expected to do strange things — and they did.

"The pair of Downy Woodpeckers which lived near us were frequently seen on the ground picking up the crawling tent-caterpillars. They seemed to prefer taking them from the ground to taking them from the trees, though there were more on the tree-trunks than on the ground even. And the Woodpeckers seemed to have no difficulty in moving on the ground, though they moved more slowly than when dodging around a tree.

"Two mountain-ash trees on the place were infested by borers, though only slightly and only near the ground, and at the foot of one of these trees the Downy Woodpeckers made many a stand, while they probed the borer-holes with their bills.

"The Cuckoos came boldly into the village and fed and fed, flying about quite openly. The Nuthatches flew to a band of caterpillars on a tree-trunk, and were so

busy and absorbed in devouring the crawlers that I could put my hand on them before they started to fly, and then they merely flew to another tree close by, and attacked another mass of caterpillars.

“Blackbirds waddled over the grass by the sides of the streets picking up the crawlers, and even a Woodcock spent several hours in the garden and on the lawn, *apparently* feasting on tent-caterpillars, but I could not get near enough to be sure.

“The Vireos—White-eyed, Red-eyed and Warbling—the Cat-birds, Cedar-birds, and Rose-breasted Grosbeaks did good service to the trees and human beings, but the most evident destruction was done by the Chipping Sparrows when the moths emerged late in the summer. The moths were very abundant after four o'clock in the afternoon, flying about the trees to lay their eggs, and then the Chippies became fly-catchers for the time, and flew straight, turned, twisted, dodged, and tumbled ‘head over heels and heels over head’ in the air, just as the course of the hunted moth made necessary. A quick snap of the beak, and four brownish wings would float down like snowflakes, and their numbers on the walks, roads and grass showed how many thousands of moths were slain. In spite of the unwonted exercise the Chippies waxed fat, but not as aldermanic as the Robins, which, earlier, gorged themselves on the caterpillars until, as one observer said, ‘their little red fronts actually trailed on the ground.’”

The extent to which trees are subject to attack and their consequent need of insect destroyers may be more clearly understood if we consider for a moment the life of a tree in connection with the insects that prey upon it. Let us take, for example, the oaks of the genus *Quercus*.\* At the very beginning, before the acorn has germinated, it may be entered by a grub of the nut weevil (*Balaninus*) which destroys it, and the more or less empty shell becomes the abiding place of the larva of the acorn moth. Should, however, the acorn be permitted to grow, the roots of the young tree may be attacked by the white grubs of root-boring beetles. Escaping these, the oak carpenter worm (*Prionoxystus*) lays its eggs in cracks and crevices in the bark. On hatching, the worm or borer “perforates a hole the size of a half-inch auger, or large enough to admit the little finger, and requiring three or four years for the bark to close together over it. This hole, running inward to the heart of the tree, and admitting water thereto from every shower that passes, causes a decay in the wood to commence, and the tree never regains its previous soundness.” (Fitch.)

Other borers (*Buprestidæ*) feed upon the bark, eating the soft inner layer and

\* See Packard, Forest Insects, Fifth Report U. S. Entomological Commission.

the sap, over twenty species of borers and miners being known to infest the trunk of the oak. The limbs and twigs are affected by the larvæ of certain beetles (*Cerambycidae*) which act as girdlers or pruners, sometimes severing limbs ten feet in length and over an inch in diameter. (Fitch.) The weevils also bore into the twigs, making an excavation in which the eggs are laid, and the seventeen-year locust stings the branches, making perforations from one to two feet long for the receipt of the eggs.

The limbs and twigs are also affected by tree hoppers (*Membracidae*) and oak blights (*Aphididae*), which puncture them and feed upon their juices, exhausting the sap. Some ten species of scale insects, or plant-lice, are known to infest oaks, and over a hundred different species of gallflies are parasitic upon them.

Oak buds are eaten by the larvæ of certain noctuid moths, and oak leaves are injured by caterpillars, basket worms, skippers, miners, weevils, phylloxeras, galls and plant-lice of nearly one hundred and fifty species.

Altogether over 500 species of insects are known to prey upon the oak, and it is consequently obvious that if they were not in turn preyed upon, oak trees could not exist. But, thanks to the services of birds, as well as to predaceous and parasitic insects, the insectivorous foes of the oak are so held in check that, as a rule, their depredations are not attended by serious results. Remove these checks, however, and we may expect an immediate and disastrous increase in the enemies of the oak which they so successfully combat.

Without here attempting to go into detail we may at least mention one or two instances illustrative of the value of birds to trees. Weevils, borers, caterpillars, scale insects and plant-lice are all devoured by birds, but it is in eating the eggs of the enemies of the trees that birds perform a service of inestimable value. Prof. C. M. Weed, of the New Hampshire College of Agriculture, in studying the winter food of the Chickadee, has found that it feeds largely on the eggs of plant-lice. Thus the stomach of a specimen taken December 9, in a mixed growth of pines, maple, willow, and birches, was found to contain 429 eggs of plant-lice, together with insects of several species. The stomach of another Chickadee taken February 26 in a growth of pines and birches, contained 454 eggs of Aphides, an equal percentage (44) of what seemed to be dried castings from the old nests of tent-caterpillars, spiders' eggs, and eggs of the canker-worm.

Additional statistics of the forest haunting birds' food are given under the proper head, but we should call especial attention here to the great value to trees of our Cuckoos in devouring caterpillars. Over 48 per cent of the food of Cuckoos has been found by Professor Beal, of the U. S. Department of Agriculture, to con-

sist of caterpillars, the stomach of a single individual containing the remains of 217 web-worms well known to be one of the most destructive forms of insect life to trees. These are only two illustrations, among the hundreds which might be cited, of the service rendered by the birds to our forest.

Birds are of value to the forest, however, not only as the destroyers of their insect foes, but the birds with the squirrels, help plant the forest by distributing seeds. The seeds which are encased in a pulpy covering, those of the berry or fruit-bearing trees, are voided unharmed by the birds often at a point far distant from the parent tree, the bird thus acting as their distributor. Acorns, beech-nuts, and chestnuts are frequently dropped or hidden by birds, and the seeds of pines are released and scattered by the birds that seek them in their cones. In short, we believe it can be clearly demonstrated that if we should lose our birds we should also lose our forests.

#### THE BIRD AND THE FRUIT-GROWER.

In considering the relations of birds to the fruit-grower we encounter an artificial set of conditions which renders an attempt to determine the birds' position exceedingly difficult. In growing certain fruits, for example pears and apples, a natural forest environment is closely approximated, the trees furnishing a home for the birds which are not attracted by their fruit but by the insects that prey upon them. With smaller fruits (*e. g.*, berries), however, exactly the reverse occurs, that is, they furnish food but no shelter for the birds which, during the periods of fruitage, tempted by an abundant food supply, abandon their usual fare and may prove positively harmful. Catbirds and Robins in the cherry trees and strawberry beds, and Orioles in the vineyards undeniably cause considerable loss to the fruit-grower.

There are two sides to this question, however, and no species of birds should be condemned for the depredations of one month until we know its value during the remaining eleven. The bird, we repeat, is the property of the State, not of the individual. The State seeks to secure the greatest good for the greatest number of its citizens, and if it can be shown that a Robin or Catbird, in spite of its fruit-eating proclivities, is, on the whole, far more valuable than harmful, then assuredly he should not be sacrificed.

It does not necessarily follow that the fruit-growers' complaints are to be ignored. Their cause should be thoroughly investigated by qualified experts under the supervision of the Forest, Fish and Game Commission in order that no hasty or undesirable measures may be taken.

In the spring of 1900 the peach trees of the Hudson Valley were visited by large

numbers of birds which destroyed quantities of young peaches. The peach-growers took the law into their own hands and killed these birds by the thousand. Subsequently, and perhaps as a result, an unsuccessful attempt was made so to amend the Game Law of the State of New York that a fruit-grower might kill any bird which he believed to be injurious to his crops.

The birds in this case were Red Crossbills and White-winged Crossbills, which, as a rule, feed exclusively on the seeds of coniferous trees. Owing to a failure in their food supply for the season of 1899-1900 they came south in exceptional numbers and were common throughout the winter in places where they are rarely seen. The writer, in twenty years' experience, has not witnessed such an invasion of these boreal birds, and it is probable that they may not be as numerous again for twenty years more. While, on this occasion, Crossbills undoubtedly did much damage to the peach crop, the facts in the case render it improbable that they may again be destructive to peaches in the present generation. In their own range, under normal conditions, Crossbills are of value to forestry as distributors of the seeds of conifers, and it obviously would be a poor economist who would condemn a species for a few weeks, wrong-doing when its previous record showed it to be uniformly beneficial. The death penalty is an extreme measure to inflict on birds when the verdict is based on evidence from only one side. The planting of early Russian mulberries, which birds are more fond of than strawberries and cherries, is one way of protecting these fruits without harming the birds. Again, nets and various devices, including the discharge of firearms loaded only with powder, may prove as effective as the actual killing of the bird.

With pear and apple orchards, as has been said, this question of fruit-eating does not exist, and the service rendered them by birds has been most convincingly demonstrated by Mr. E. H. Forbush, from whose observations, published in the Massachusetts Crop Report for July, 1895, the following extract is taken. Selecting an old, neglected orchard, he made an especial effort to attract certain birds to it with the most interesting results. Mr. Forbush writes:

“The orchard itself is a typical old orchard, such as is often found on small farms. It has suffered greatly from neglect. Two-thirds of the original trees have died or are in the last stages of dissolution. This is largely the result of neglect and improper pruning. Dead limbs and hollows in the trees have offered nesting places for such birds as the Wren, Woodpecker and Bluebird.

“For three years, from 1891 to 1893, inclusive, the trees were trimmed and cared for. They were sprayed or banded to protect them from canker worms, and the ‘nests’ of the tent-caterpillar (*Clissocampa americana*) were removed. The result

was a scanty yield of apples from most of the trees. One or two bore quite plentifully.

“ In order to observe the effect of the feeding of birds in the orchard no care was taken in 1894 to protect the trees. During that year the tent-caterpillars were very numerous in the vicinity, and it became evident also that a great increase in the number of canker worms was taking place in the neighborhood. Although these insects made considerable inroads upon the trees, they did not seriously injure the foliage anywhere except in one or two instances. No attempt had been made previous to 1895 to foster or encourage the birds in the neighborhood, except that a few nesting boxes were put up in 1894, which were occupied in one case by a family of Wrens, and in another by the English or House Sparrow. We were careful, however, to destroy the nests of the House Sparrow.

“ In the fall of 1894 it was noticed that immense numbers of the wingless females of the fall canker worm (*Anisopteryx pomataria*) were ascending nearly all the trees and depositing their eggs; also, that the eggs of tent-caterpillar moths were numerous on the twigs, promising a plentiful supply for 1895.

“ Having allowed the insects one year to increase unmolested by man, we began in the winter of 1894-95 to encourage the presence of birds in the orchard.

“ In 1894 a small tree in the center of the orchard had been inclosed by a high board fence. The tree thus inclosed was used as an out-door experiment station for observations on the breeding and habits of the gypsy moth. During the winter of 1894-95, Mr. C. E. Baily made frequent visits to this tree to ascertain whether or not the birds were destroying the eggs of the gypsy moth. Incidentally, Mr. Baily observed many interesting things in connection with the feeding of birds on the eggs, larvæ and pupæ of insects which winter on the trees, and I am greatly indebted to him for many interesting notes on the feeding of birds in this orchard. He is a careful, conscientious observer, and is intimately acquainted with most of our native land birds.

“ Hunters and trappers are aware that many species of winter birds, such as Titmice, Woodpeckers, Crows, Jays and Nuthatches, are attracted by a skinned carcass suspended from a limb, and will remain in the vicinity until all the bones are picked clean, or until, with the approach of spring, insect food becomes more accessible.

“ Believing from my own observations that the Chickadees (*Parus atricapillus*) were feeding on the eggs of the fall canker worm, I asked Mr. Baily to attract the birds, if possible, to the orchard, by suspending pieces of meat, bone, suet, from the trees. These food materials are good for birds at times when the trees are covered with snow or ice, and when, lacking such nourishment, they might starve. Although

birds will frequently visit bait provided for them and in time will eat a considerable portion of the meat, they do not depend entirely on this aliment, but spend the greater portion of their time in searching for eggs and insects in the immediate vicinity.

“Finding a plentiful supply of food, the Chickadees remained about the orchard most of the winter, except for a week or two, when the meat gave out, but they were lured back again later by a fresh supply which was placed in the trees. Not only were the Chickadees attracted to the orchard in large numbers, but other birds came also. A pair of Downy Woodpeckers (*Dryobates pubescens*) and two pairs of Nuthatches (*Sitta carolinensis*) were frequent visitors, and a few Brown Creepers (*Certhia americana*) came occasionally. All these paid frequent visits to the meat and suet, and also thoroughly inspected the trees in search of insect food. They made excursions also to the trees in the neighborhood, but the greater portion of their attention was confined to the orchard in which the bait was suspended. As they became more accustomed to Mr. Baily's presence, they grew quite tame and could be viewed at a distance of a few feet. Indeed the Chickadees frequently alighted on his person and occasionally took food from his hand. He was thus enabled to determine accurately (without killing them) what they were feeding upon, and was soon convinced that they were destroying the eggs of the canker worm moth in large numbers, as well as the hibernating larvæ and pupæ of other insects injurious to trees.”

Investigation showed that this was the case, the stomachs of four birds containing no less than 1,028 canker-worms' eggs, while one Chickadee had eaten 41 canker-worm moths. As the moths at this season contained, on the average, 185 eggs each, it is probable that this single bird destroyed over 7,000 canker-worms' eggs in a day. Details of this interesting experiment are given in the statistical portion of this report, here we may turn at once to Mr. Forbush's results. In the spring “it soon became evident,” he continues, that the neighboring orchards which had not been under the birds' care, “would be entirely stripped of their leaves, while the old orchard retained its full foliage. Thus it was seen that the trees to which the Chickadees had been lured during the winter had been so well protected that the summer birds were able to destroy the few remaining larvæ, while the trees at a distance from these contained so many larvæ that the birds were not numerous enough to dispose of them or to make any effective reduction in their numbers. . . .

“During the month of May an attempt was made to render the place as attractive to the birds as possible. The undergrowth, which previous to 1894 had been trimmed out, was afterward allowed to grow, and in 1895 several low thickets had

been formed; the mulberry trees were stimulated by judicious trimming, and bore a considerable crop of early fruit which ripened in advance of the cherries, and served to attract them to the vicinity of the orchard. Ten nesting boxes were put up for the Wrens and Blue-birds; but as the Blue-birds were very rare this season none came to the orchard. Two families of Wrens, however, were reared in the boxes in place of one family last year. Nesting materials — strings, hair and straw — were hung in the trees and scattered about. Several marauding cats were killed, and an attempt was made to keep nest-hunting boys away from the neighborhood as much as possible. Thirty-six nests of birds were discovered in the neighborhood, as follows:

“Three red-eyed Vireos, ten Robins, four Baltimore Orioles, three Cuckoos, five Chipping Sparrows, three Least Flycatchers, two Redstarts, two Yellow Warblers, two Chickadees, two House Wrens.

“Of these all but three were destroyed, probably by boys, the nests being torn down and the eggs missing. The three which escaped destruction were two wrens' nests, which had been built in boxes upon buildings, and a robin's nest in a maple tree within ten feet of a chamber window. This wholesale destruction of nests discouraged several pairs of birds, and they disappeared from the neighborhood. Those remaining built new nests, and after a second or third attempt a few succeeded in rearing young. One nest of Orioles escaped the general destruction, and the birds were busy for a long time carrying canker-worms to their young. One of them was noticed to take eleven canker-worms in its beak at one time and fly with them to the nest. The Vireos, Warblers, Chickadees, Cuckoos, Orioles and Chipping Sparrows were particularly active in catching canker-worms, and the English Sparrow killed them in considerable numbers.

“If the thirty-six pairs of birds whose nests were found had succeeded in raising their young it is probable that they would have disposed of most of the canker-worms in the neighborhood. Five thousand of these larvæ are sufficient to strip a large apple tree. One hundred and eight would have been reared had each pair of birds raised three. According to Professor Aughey's experience sixty insects per day as food for each bird, both young and old, would be a very low estimate. Suppose each of these one hundred and eight birds had received its sixty insects per day, there would have been 6,480 caterpillars destroyed daily. The destruction of this number of caterpillars would be enough to save the foliage and fruitage of one apple tree. In thirty days the foliage of thirty apple trees could have been saved, or 194,400 canker-worms destroyed. This does not include what the old birds themselves would have eaten.”

Mr. Forbush concludes: "At the present time, July 23, 1895, the trees in the orchard appeared to be in good condition. They have not suffered from the slight pruning of their foliage which was effected by the few caterpillars and canker-worms which survived. The fruit is well set and it here remains to be seen whether the birds will have any considerable effect in preventing the ravages of the codling moth. No other orchard in the neighborhood will produce any fruit this season, with one exception."

Not the least valuable part of Mr. Forbush's report is his description of the methods employed to make his orchard attractive to birds. We shall return to this later, but such vitally important steps as the leaving of some undergrowth and killing of cats cannot be urged too often.

#### THE BIRD AND THE FARMER.

In the growing of field and garden crops, of grains and vegetables, the farmer produces a more artificial state of affairs than that which is occasioned by the fruit-grower, or, at least, the orchardist. The nature of his crops, their frequent tilling, and often early reaping, all combine to make them afford poor nesting-sites, even for such birds as would be likely to select them. To most insectivorous birds, however, areas devoted to farming purposes do not offer suitable nesting places, and it follows, therefore, that where the farmer most needs the services of insect-eating birds there these birds are deprived of surroundings in which they might find shelter and rear their young.

We shall later see how, to some extent, these conditions may be remedied. In the meantime we may inquire more closely into the relations of the bird and the farmer. Birds are of value on the farm (1) as insect-eaters, (2) as seed-eaters, (3) as mouse or rodent-eaters. Birds are injurious on the farm when they attack the crops, such damage being essentially restricted to corn, rye, and other grains. As in other cases, it is our object to learn what species are beneficial and what injurious, and to determine whether the harm done by certain species at certain seasons is outweighed by the good they do at other seasons.

The value of birds as insect-eaters is so obvious it will be unnecessary to dwell here on this phase of their relations to agriculture. One instance, however, may be cited in which birds preserved a crop through the destruction of its insect foes. It came under the observation of so excellent an authority as Prof. F. E. L. Beal, of the U. S. Department of Agriculture, from whose address before the New Jersey State Horticultural Society I quote as follows: "Field observation and stomach examination both show that the Rose-breasted Grosbeak makes the Colorado potato

beetle the principal part of its food whenever it can be obtained. A case which came under my own observation will show how thoroughly they do their work. A small field of about a fourth of an acre was visited by a pair of Grosbeaks as soon as the potatoes were fairly above the ground. At first the beetles increased faster than the birds could destroy them, but after the young of the birds had hatched the beetles began to diminish, and by the time the young were able to fly the field was clear — not a beetle was to be found.”\*

This illustrates also the tendency of birds to prey upon some insect which, in becoming unduly abundant, offers them an unusual supply of food. Birds, for example, have been known to gather in great numbers to repel, as it were, an invasion of grasshoppers. Quoting again from Professor Beal's address: “Ground-feeding birds eat these insects at all times when they can be obtained; but in the month of August, which is the month when they attain their maximum abundance and frequently become a pest, nearly all birds, no matter what their usual food habits may be, come to the ground and eat grasshoppers. Such birds as the Baltimore Oriole, and the Cuckoo, which normally find their food upon the trees, change their habits in August and leave the trees to forage upon the ground. A few years ago, when the western part of the country was devastated by the Rocky Mountain locust, it was found that nearly every species of bird, even the larger Hawks, and Ducks and Geese, fed upon them to a considerable extent.”

One of the notable achievements of the economic ornithologist has been to emphasize the value of seed-eating birds, the Sparrows, Doves, Blackbirds and others. It is a common error to believe that birds are of service to man only as insect-eaters, and that the non-insectivorous species, if not harmful, are, at least, of no particular use. But the fact is that these same insignificant looking Sparrows are the farmers' best allies in his never-ending warfare against weeds.

During the winter weed seeds form practically the entire fare of a number of species of Sparrows; the seeds of amaranth, crab grass, ragweed, and pigeon grass being the kinds devoured most frequently.

Dr. S. D. Judd, of the U. S. Department of Agriculture, who has made a special study of the food habits of seed-eating birds, states that 1,000 pigweed seeds were found in the stomach of a Snowbunting killed at Shrewsbury, Mass., in February, and that 700 seeds of pigeon grass were taken from a single Tree Sparrow; and the investigations of Professor Beal in the State of Iowa show that this species during the period of its presence, from October until April, destroyed each year about 875 tons of weed seeds.

\* Proc. Twenty-fourth Annual Meeting New Jersey State Horticultural Society.

Further practical evidence of the seed-eating ability of birds is furnished by Dr. Judd, who writes: "On a farm in Maryland, just outside the District of Columbia, Tree Sparrows, Fox Sparrows, White Throats, Song Sparrows and Juncos, fairly swarmed during December in the briers of the ditches between the cornfields. They came into the open fields to feed upon weed seed, and worked hardest where the smartweed formed a tangle on low ground. Later in the season the place was carefully examined. In one cornfield near a ditch the smartweed formed a thicket over 3 feet high, and the ground beneath was literally black with seeds. Examination showed that these seeds had been cracked open and the seed removed. In a rectangular space of 18 square inches were found 1,130 hayseeds, and only two whole seeds. Even as late as May 13, the birds were still feeding on the seeds of these and other weeds in the fields; in fact, out of a collection of 16 Sparrows 12, mainly Song, Chipping and Field Sparrows, had been eating old weed seed. A search was made for seeds of various weeds, but so thoroughly had the work been done that only half a dozen seeds could be found. The birds had taken practically all the seed that was not covered; in fact, the Song Sparrow and several others scratch up much buried seed."\*

To the recent researches of the economic ornithologist we must also turn for exact information concerning the food of Hawks and Owls. No birds have been more maligned and misunderstood than these birds of prey. The misdeeds of two or three species have brought all the members of their family into disrepute. Because one Hawk has been seen to catch a chicken all Hawks are "Chicken Hawks," and, consequently, to be killed whenever opportunity offers. Not only is no protection afforded these birds by law, but in some States a bounty has been given for their destruction. Indeed, a law of this nature was passed by the Massachusetts Legislature, and the history of the so-called "Scalp Act" in Pennsylvania furnishes a convincing illustration of the direct pecuniary loss which may follow ignorance of the economical value of birds. Quoting from the report for 1886 by Dr. C. Hart Merriam, Chief of the Biological Survey of the Department of Agriculture: "On the 23d of June, 1885, the Legislature of Pennsylvania passed an act known as the 'scalp act,' ostensibly 'for the benefit of agriculture,' which provides a bounty of fifty cents each on hawks, owls, weasels and minks killed within the limits of the State, and a fee of twenty cents to the notary or justice taking the affidavit.

"By virtue of this act about \$90,000 has been paid in bounties during the year

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\* Birds as Weed Destroyers. Year Book of U. S. Dept. of Agriculture for 1898, p. 226.

and a half that has elapsed since the law went into effect. This represents the destruction of at least 128,571 of the above-mentioned animals, most of which were hawks and owls.

“Granting that 5,000 chickens are killed annually in Pennsylvania by hawks and owls, and that they are worth twenty-five cents each (a liberal estimate in view of the fact that a large portion of them are killed when very young), the total loss would be \$1,250, and the poultry killed in a year and a half would be worth \$1,875. Hence it appears that during the past eighteen months the State of Pennsylvania has expended \$90,000 to save its farmers a loss of \$1,875. But this estimate by no means represents the actual loss to the farmer and the taxpayer of the State. It is within bounds to say that in the course of a year every hawk and owl destroys at least a thousand mice or their equivalent in insects, and that each mouse or its equivalent so destroyed would cause the farmer a loss of two cents per annum. Therefore, omitting all reference to the enormous increase in the numbers of these noxious animals when nature’s means of holding them in check has been removed, the lowest possible estimate of the value to the farmer of each hawk, owl, and weasel would be \$20 a year, or \$30 in a year and a half.

“Hence, in addition to the \$90,000 actually expended by the State in destroying 128,571 of its benefactors, it has incurred a loss to its agricultural interests of at least \$3,857,130, or a total loss of \$3,947,130 in a year and a half, which is at the rate of \$2,631,420 per annum. In other words, the State has thrown away \$2,105 for every dollar saved! And even this does not represent fairly the full loss, for the slaughter of such a vast number of predaceous birds and mammals is almost certain to be followed by a correspondingly enormous increase in the numbers of mice and insects formerly held in check by them, and it will take many years to restore the balance thus blindly destroyed through ignorance of the economic relations of our common birds and mammals.”

Detailed results of the analysis of the stomach contents of our Hawks made by the ornithologists of the U. S. Department of Agriculture fully substantiate this claim of the economic value of most of these birds and are given beyond.

Owls, because of their nocturnal habits, are even better mousers than Hawks. It is their habit to disgorge, in the form of pellets, the fur and bones of their prey, and in 675 such pellets, from the Barn Owl, taken in one of the towers of the Smithsonian Institution at Washington, Dr. A. K. Fisher found the remains of 1,119 meadow or field mice, 4 pine mice, 452 house mice, 134 rats, and several other species of small mammals, together with a few small birds of no especial economic importance.

No farmer whose corn in field or granary, whose potatoes and other crops have

been damaged by the destructive field mice, can fail to realize on reading these figures what a powerful ally he has in Owls.

In the face of all these benefits conferred by birds as insect, seed, and mouse-eaters, we perhaps can view more charitably the depredations of the Crows and Blackbirds in our corn and grain fields. The tarring of corn proves an effective means of making it unpalatable to Crows, but no such convenient means has been discovered for protecting fields of grain from the ravages of the hordes of Blackbirds which are attracted to them by the bountiful supply of choice food they offer, and in this instance man has so far disturbed nature's balance that the scales have been turned against him, and the bird has become an enemy rather than a friend.

#### THE BIRD AND THE CITIZEN.

While, indirectly, the citizen of course shares in the services rendered by birds to our agricultural interests, birds have an additional claim upon his good will. Birds destroy many undesirable insects, mosquitoes, for example, some species of which have recently been found to be so inimical to the health of the human race. Birds further increase the healthfulness of the world by acting as scavengers. It would be difficult to overestimate the value of the Buzzards, Vultures, and other offal-eating birds to the countries in which they live. In most instances the economic importance of these birds is too obvious to be overlooked, and they are, therefore, protected by law, and, by what is far more powerful than law, public sentiment.

In our Southern States the Turkey Buzzard and Black Vulture, or "Carrion Crow" have become so numerous and tame as a result of the protection there given them that they walk around the streets of the towns and cities in great numbers, and with no more evidence of fear than is shown by poultry. Every one realizes that a living Buzzard is of infinitely more value than a dead one, and in many years' experience in the South I have never seen a Buzzard molested.

In New York, it is true, we have no Buzzard, but on the waters of our seacoast, harbors, lakes and larger rivers, their place is taken by Gulls of several species, which, in feeding on the forms of aquatic life which, in dying, come to the surface, perform a sanitary service of the first importance.

While a discussion of the economic relations of birds might be supposed to confine us to a consideration of the material side of their lives, he would indeed be lacking in imaginative power, in ability to appreciate the usefulness of beauty, who did not find in these pre-eminently graceful, musical, attractive creatures a source of pleasure to mankind deserving our serious attention from the physiologic, and hence, economic standpoint.

The pursuit which takes us afield and gives us rest and exercise combined, and increases our resources by broadening our interest in nature, is not merely a pastime, but a recreation benefiting both mind and body, and better preparing us for our duties as citizens of the State. No one would think of asserting that the value of New York's game animals was to be reckoned in the terms of the bill-of-fare. A few thousand dollars would express their wealth to the butcher or restaurateur, but to the true sportsman they are an exhaustless mine of wealth. A day with dog and gun, rod or rifle may bring small return from a pecuniary point of view, but who can calculate the amount of physical good and pure enjoyment it has afforded? Game bag and creel may, indeed, be empty, while our mind is full of stimulating experiences, all increasing our eagerness to take to the field again.

So the hunter of birds with opera glass and camera finds an even deeper pleasure in his excursions into their haunts and study of their ways; a pleasure which no accounting of the value of birds to the State can ignore.

### What the State Does for the Bird.

In view of the economic importance of birds to our agricultural interests it may now well be asked what is the attitude of the State toward creatures whose welfare is so closely connected with that of its citizens? Does it take proper measures to protect them? Does it urge the employment of methods designed to aid in their increase?

It is true that the State formally recognizes the value of its assets in bird-life by the passage of laws intended to give birds legal protection, but no adequate means are provided for their enforcement. Where one person is prevented from killing a bird a thousand commit murder unchecked; nor can this evil be remedied without a material increase in the force of game wardens. The latter, as their official title implies, are appointed chiefly to enforce the laws relating to game while the laws concerning the far more numerous, and economically more valuable, non-game birds are generally dead letters.

So-called sportsmen shoot these birds in pure wantonness, pot-hunters slaughter them for market, foreigners kill them for food, milliners' agents collect them to supply fashion's demands, boys find them a tempting mark for bean-shooters and air-guns; while birds' eggs are taken as the legitimate prize of nearly every child who finds a nest. To these unnatural and remediable causes for the destruction of our birds should be added the ravages of the so-called domesticated cat. There are probably not less than two million cats in the State of New York. While many of

them are well-fed pets, the larger proportion are to a greater or less extent dependent on their own efforts, often preferably so, for food. A single cat has been known to catch sixty wild birds in a season, and a well-known naturalist and authority on the birds of New England estimates that at least 1,500,000 birds are killed annually by cats in the New England States.

It is unnecessary here to dwell on the decrease in bird-life following the clearing of forests, draining of land, accompanying the growth in our population, for this, in a measure, is unavoidable, it being my object only to show that so far as the State assumes an attitude towards the birds, that attitude is one of destruction.

### What the State Should Do for the Bird.

It being demonstrated that, in the main, birds are of great value to the State, it follows that the State should spare no effort to afford its citizens of the air the protection they deserve. How, then, may we most effectively prevent the great destruction of bird-life which occurs in this State? The most rational methods would appear to be: (1) Enforcement of the law; (2) licensing of cats and destruction of all non-licensed cats; (3) teaching children to realize the economic and æsthetic value of birds; (4) leaving hedge rows, undergrowth, and clumps of trees as resorts for birds. The laws of the State of New York relating to birds are so well drawn that their enforcement would give our non-game birds complete legal protection from their enemy man. But, as has been said, the present force of game wardens is far too small to afford our birds the protection which is their due. What is needed, however, is not an addition to the number of game wardens, but a new officer who shall be known as a *bird* warden, and whose especial duty shall be to enforce the laws designed to protect non-game birds. Such officer should not only prevent the illegal killing and trapping of birds, but should examine the stock of milliners and others who offer plumage for sale.

The growing interest in the study of nature and the establishment of nature study courses in our schools, in connection with the admirable campaign to teach the people the value of birds, inaugurated by the Audubon societies and the American Ornithologists' Union, has already created a sentiment in favor of bird protection without which the best of laws are practically ineffective.

Teachers have been quick to realize that the inherent, universal interest in bird-life can be made of great educational and moral value in the training of children. No force at the State's command could effectually prevent boys from robbing nests and killing birds. Nor should the boy be prevented by force from giving this wholly

natural exhibition of traits inherited from savage ancestors. The remedy here is to be applied, not by the State's bird wardens or police, but by its teachers. A normal, healthy boy should want to hunt birds and their nests, but a very little of the right kind of instruction at this stage of his life will often so broaden his interests that he soon finds living birds more attractive than dead ones.

As for the destruction of birds by cats, there can be no doubt that it would be largely decreased by the passage of a law requiring the annual licensing of cats, and authorizing the proper authorities to kill all non-licensed cats. Such a law should be supported not only by the friends of birds, but by the friends of cats as well. By the former because the restriction of the cat population to the well-fed tabby of the fireside would not only greatly reduce the cat population, but would do away with its worst element, the cats who hunt for a living. It should be supported by the latter because its enforcement would put an end to the existence of the many starving felines of our cities whose happiest fate is sudden death.

If birds are of value, as we believe them to be, we should not only prevent their decrease, but we should take such measures as seem calculated to assist their increase. We have seen that in destroying our forests we deprive many insectivorous birds of their homes, while in clearing hedge rows we often rob seed-eating birds of the protection the undergrowth affords them. With comparatively little trouble we can add greatly to the attractions of our farms and gardens from the birds' point of view. Clumps of trees left in the fields and rows of trees along the hedge rows will prove paying investments, and wherever it does not seriously interfere with the tilling of the land the undergrowth should be spared. During the winter food in small quantities may be used to attract birds, and in the summer water for bathing or drinking is always welcomed by them. Wren and Bluebird and Martin houses should be erected in suitable positions with the hope of securing bird tenants, who will pay a most profitable rental.

### The Facts in the Case.

Thus far the results of the work of economic ornithologists have been alluded to only in a general way. It is now proposed to take up systematically the economically more important of our birds and present the known facts regarding their food-habits. In the first place, however, due mention should be made of the sources whence this information is derived and some description should be given of the manner in which it is obtained.

## HOW A BIRD'S VALUE TO MAN IS ASCERTAINED.

To learn with scientific exactness the nature of a bird's food and then to determine whether it is an injurious or beneficial species requires especial training on the part of the investigator. He must not only be an ornithologist but he must also have a knowledge of botany and entomology. Three methods are employed by the economic ornithologist in studying a bird's food: (1) The bird may be caged in order that its dislikes, likes, and preferences, as well as the quantity of food it will consume in a given time may be ascertained; (2) the bird may be studied in nature, and (3) the contents of a bird's stomach may be examined. The last-named method yields by far the most definite and satisfactory results and is the one most frequently employed. While the individual student may, unassisted, make the best use of his opportunities to learn the character of a bird's food, the food habits of a species can be properly determined only through the analysis of a large number of stomachs taken at places throughout its range and representing all the seasons. Our most important investigations into the food habits of birds have, therefore, been made by specialists in the employ of the State who could secure the co-operation of others. Economic ornithologists representing the States of Illinois, New Hampshire, Massachusetts, Pennsylvania, Wisconsin, and Nebraska have contributed largely to our knowledge of the food habits of birds, but for the greater part of our exact knowledge of the economic value of our birds we are indebted to the Biological Survey of the U. S. Department of Agriculture at Washington. It is from the sources just mentioned then, and especially from the publications of the Biological Survey, that the following facts, based in the main on stomach examinations, are taken:

### Statistics of Food Habits.

#### WATER BIRDS.

As yet practically no systematic study has been made of the food of water birds. It is known, however, that Gulls are of great service as scavengers feeding on aquatic animals which, in dying, come to the surface. The truth of this statement was very forcibly impressed on my mind, when, some years ago, I visited the lower harbor of New York Bay to see the Gulls which were attracted there by the garbage which each day at high tide was deposited on the water by the scows of the Street-cleaning Department of New York City. The number of Gulls present on this occasion was beyond calculation, but certainly exceeded three hundred thousand. Before the scows began to discharge their cargo most of the birds were resting on

the water, but at the sound of the whistle giving the signal to dump, they arose in clouds and clustered thickly over the wake of each of the eleven scows to feed on the vegetable and animal matter thrown overboard. It was a most impressive object lesson in the economic value of these birds, which, until recently, have been destroyed in enormous numbers for millinery purposes.

In our interior States, Franklin's Gull, the Ring-billed Gull, and Black Tern feed largely on grasshoppers at certain seasons, and it is their habit to follow the plough in search of the grubs it exposes. A common sight in parts of the west, therefore, is a flock of Gulls and Terns hovering thick about the ploughman.

"The Snipe, Sandpipers, Plovers, Phalaropes, Curlews, etc.," Prof. Lawrence Bruner remarks,\* "are great destroyers of insects. Moving, as many of them do, in great flocks and spreading out over the meadows, pastures and hillsides, as well as among cultivated fields, they do a large amount of careful police service in arresting culprits among the insects. They even pry them out of burrows and crevices in the earth where these creatures lurk during the daytime, only to come forth after nightfall to destroy vegetation. The large flocks of Eskimo Curlew that formerly passed through Eastern Nebraska did magnificent work during years when the Rocky Mountain locust was with us, as did also the equally large flocks of Golden Plover. The Bartramian Sandpiper [Field or Upland Plover] even now is a great factor each summer in checking the increasing locusts on our prairies."

## LAND BIRDS.

### GROUSE AND QUAIL. Family Gallinæ.

**Ruffed Grouse: Partridge** (*Bonasa umbellus*).—"Of six specimens examined two had eaten 24 caterpillars; one, the grub of a beetle, one, 2 grasshoppers, one 7 harvest-men; one, fruit; one, foliage; one, seeds; one, partridge berries; and three, buds.

"A young chicken [Partridge], probably not over a week old, had in its stomach 13 caterpillars, the grub of a beetle and 7 harvest-men." †

While Partridges often feed on the buds of trees it does not appear that the habit is an injurious one, a certain amount of pruning being not undesirable.

**Quail: Bob-White** (*Colinus virginianus*).—"The Eastern Quail or Bob-White," writes Dr. Judd, ‡ "does much good by destroying weed seeds in fields where grain has been cut and a rank growth of weeds has taken its place. Seeds of rib grass,

\* Birds in their Relation to Agriculture. Proc. Nebraska Ornithologists' Union, 1901, p. 21.

† King, Economic Relations of Wisconsin Birds. Geology of Wisconsin, I, 591.

‡ Birds as Weed Destroyers. Year Book, Dept. of Agriculture. 1898, p. 231.

tickfoil, and berries of nightshade (*Solanum* sp.) are sometimes eaten, and pigeon grass and smartweed are frequently consumed in large quantities. The amount of grain found in the few stomachs thus far examined is surprisingly small, while the proportion of weed seed is astonishingly large, in some cases crops and gizzards being literally gorged with hundreds of seeds of ragweed."

Quail also eat potato-beetles and grasshoppers, and in Texas their food in the fall is said to consist "chiefly of various seeds and Mexican boll weevils, which are so disastrous to the Texas cotton fields." \*

#### DOVES. Family Columbidae.

**Mourning Dove: Carolina Dove** (*Zenaidura macroura*).—"The Mourning Dove is abundant throughout much of the United States, and is especially common in stubble fields and waste places, grown up to weeds. It is pre-eminently a seed-eater, and although at times turning its attention to grain, it nevertheless consumes an enormous amount of weed seed. The crop of one Dove secured in a rye field in Warner, Tenn., contained 7,500 seeds of *Oxalis stricta* [Yellow Wood-sorrel]." (Judd.)

"In the stomach of one kind I counted 4,016 seeds of the pigeon grass and 12 small snails; the latter were probably taken as gravel." (King.)

#### HAWKS, FALCONS, ETC. Family Falconidae.

It was because of the widespread misunderstanding of the food habits of our Hawks and Owls, and because of their unusual economic value, that one of the first acts of the Division of Economic Ornithology, now the Biological Survey, of the United States Department of Agriculture was to undertake a careful and elaborate study of the food of Hawks and Owls in order that their status might rest on the sound basis of observed facts.

This work was intrusted to Dr. A. K. Fisher, Assistant Ornithologist of the Survey, a naturalist of wide experience, who has won for himself a well-deserved reputation as a most careful and conscientious investigator.

After several years passed in accumulating material and in examining the contents of the stomachs of nearly 2,700 Hawks and Owls, Dr. Fisher concluded a volume of 200 pages in which are fully set forth the results of his studies. This volume forms Bulletin No. 3 of the Division of Ornithology and Mammalogy, and it is considered to be one of the most valuable contributions to economic zoology

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\*Schutze. The Summer Birds of Central Texas, p. 2.

ever made. From it the following statistics in regard to the food of our Hawks and Owls are quoted:

**Red-Shouldered Hawk : Chicken Hawk** (*Buteo lineatus*).—This and the following species are the commonest Hawks in the State and the ones to which the names Chicken Hawk and Hen Hawk are generally applied. The loud screaming *kèe-yer kèe-yer* of the Red-Shoulder as he sails far above the earth is a familiar sound and usually, though wrongly, associated by the farmer with depredations in the poultry yard.

*Summary of Contents of 220 Stomachs of the Red-Shouldered Hawk. (From Fisher.)*

- 3 stomachs contained poultry.
- 12 stomachs contained other birds.
- 102 stomachs contained mice.
- 40 stomachs contained other mammals.
- 20 stomachs contained reptiles.
- 39 stomachs contained batrachians.
- 92 stomachs contained insects.
- 16 stomachs contained spiders.
- 7 stomachs contained crawfish.
- 1 stomach contained earth worms.
- 2 stomachs contained offal.
- 3 stomachs contained fish.
- 14 stomachs were empty.

**Red-Tailed Hawk : Chicken Hawk** (*Buteo borealis*).—This species, of which a figure is given, is decidedly larger than the preceding. Its note is a long squealing whistle.

*Summary of the Contents of 562 Stomachs of the Red-Tailed Hawk. (From Fisher.)*

- 54 stomachs contained poultry or game birds.
- 51 stomachs contained other birds.
- 278 stomachs contained mice.
- 131 stomachs contained other mammals.
- 47 stomachs contained insects.
- 8 stomachs contained crawfish.
- 1 stomach contained centipede.
- 13 stomachs contained offal.
- 37 stomachs contained batrachians or reptiles.
- 89 stomachs were empty.



UPPER FIGURE, RED-TAILED HAWK  
LOWER FIGURE, COOPER'S HAWK  
ABOUT  $\frac{2}{5}$  NATURAL SIZE.



**Broad-winged Hawk** (*Buteo platypterus*).—The name "Chicken Hawk" is also applied to our Broad-winged Hawk, a somewhat smaller species than the two preceding, but closely related to them; but examination of 65 stomachs of this bird failed to show that one bird of the number had eaten poultry. The Broad-wing's note is a high, thin, long-drawn, piercing whistle.

*Summary of the Contents of 65 Stomachs of the Broad-winged Hawk. (From Fisher.)*

- 2 stomachs contained small birds.
- 15 stomachs contained mice.
- 13 stomachs contained other mammals.
- 11 stomachs contained reptiles.
- 13 stomachs contained batrachians.
- 30 stomachs contained insects.
- 2 stomachs contained earth worms.
- 4 stomachs contained crawfish.
- 7 stomachs were empty.

**Sparrow Hawk** (*Falco sparverius*).—When we study the food of our so-called Sparrow Hawk, we find it is a truly insectivorous bird as will be seen from the appended table:

*Summary of the Contents of 320 Stomachs of the Sparrow Hawk. (From Fisher.)*

- 1 stomach contained a game bird.
- 53 stomachs contained other birds.
- 89 stomachs contained mice.
- 12 stomachs contained other mammals.
- 12 stomachs contained reptiles or batrachians.
- 215 stomachs contained insects.
- 29 stomachs contained spiders.
- 29 stomachs were empty.

**Marsh Hawk** (*Circus hudsonius*).—A Hawk frequently observed, because of its habits of hunting in the open, is the Marsh Hawk; he may be known by the white patch at the base of his tail above, which shows conspicuously as he flies. This species is a mouser, as appears from the following summary of the contents of 124 stomachs:

*Summary of the Contents of 124 Stomachs of the Marsh Hawk. (From Fisher.)*

- 7 stomachs contained poultry or game birds.
- 34 stomachs contained other birds.
- 57 stomachs contained mice.
- 22 stomachs contained other mammals.
- 7 stomachs contained reptiles.
- 14 stomachs contained insects.
- 1 stomach contained indeterminate matter.
- 8 stomachs were empty.

**Cooper's Hawk** (*Accipiter cooperi*).— This and the following species are the real culprits among the Hawks; for their sins all the members of the family have been made to suffer. Compared with the mouse-eating species of the genus *Buteo* they are long, slim birds (see plate), which, as a rule, never scream nor soar, but lurk quietly in ambush as becomes true hunters. Comparison of the appended tables with those giving the food of the so-called Chicken Hawks will readily show how this name has in truth been misapplied.

The question is, how are we to distinguish these bird-killing Hawks from those which should be preserved. It is a difficult matter. Probably the only safe way to give justice to whom justice is due is to kill only the Hawks we actually see taking our chickens, and not murder indiscriminately every member of the Hawk family.

*Summary of the Contents of 133 Stomachs of Cooper's Hawk. (From Fisher.)*

- 34 stomachs contained poultry or game birds.
- 52 stomachs contained other birds.
- 11 stomachs contained mammals.
- 1 stomach contained a frog.
- 3 stomachs contained lizards.
- 2 stomachs contained insects.
- 39 stomachs were empty.

**Sharp-Shinned Hawk** (*Accipiter velox*).— This species closely resembles Cooper's Hawk in color and in habits. It is, however, so much smaller that it cannot prey to much extent on poultry but lives chiefly on small birds.

*Summary of the Contents of 159 Stomachs of the Sharp-Shinned Hawk. (From Fisher.)*

- 6 stomachs contained poultry or game birds.
- 99 stomachs contained other birds.
- 6 stomachs contained mice.
- 5 stomachs contained insects.
- 52 stomachs were empty.

**OWLS. Family Bubonidæ.**

Owls, because of their nocturnal habits, prey on small rodents, themselves nocturnal, to an even greater extent than Hawks and are therefore more valuable. We continue our extracts from Dr. Fisher's work previously mentioned.

**Barred Owl: Hoot Owl** (*Syrnium nebulosum*).—A common species much oftener heard than seen, its deep-voiced *whoo-whoo-whoo, too-whoo, too-whoo-at*, resembling the distant "whistle for crossing" of a locomotive, being a familiar sound to dwellers near woods.

*Summary of the Contents of 109 Stomachs of the Barred Owl. (From Fisher.)*

- 5 stomachs contained poultry or game.
- 13 stomachs contained other birds.
- 46 stomachs contained mice.
- 18 stomachs contained other mammals.
- 4 stomachs contained frogs.
- 1 stomach contained a lizard.
- 2 stomachs contained fish.
- 14 stomachs contained insects.
- 2 stomachs contained spiders.
- 9 stomachs contained crawfish.
- 20 stomachs were empty.

**Short-Eared Owl** (*Asio accipitrinus*).—The Short-Eared Owl, a species which lives in our marshes, is a famous destroyer of meadow mice, as may be seen from the appended statement :

*Summary of the Contents of the Stomachs of 101 Short-eared Owls. (From Fisher.)*

- 11 stomachs contained small birds.
- 77 stomachs contained mice.
- 7 stomachs contained other mammals.
- 7 stomachs contained insects.
- 14 stomachs were empty.

**Long-Eared Owl** (*Asio wilsonianus*).—Even the excellent record of the Short-Eared Owl is excelled by that of the present species.

*Summary of the Contents of 107 Stomachs of the Long-Eared Owl. (From Fisher.)*

- 1 stomach contained a game bird.
- 15 stomachs contained other birds.
- 84 stomachs contained mice.
- 5 stomachs contained mammals.
- 1 stomach contained insects.
- 15 stomachs were empty.

Dr. T. H. Montgomery, Jr.'s study of the food habits of four individuals of this species, which roosted in an arbor vitæ tree growing at his home near Philadelphia,\* showed that the food of each individual averaged nearly two mice per day.

**Screech Owl** (*Megascops asio*).—It has been shown that among our Hawks some species feed so largely upon insects as to be classed among the insectivorous birds, and so among our Owls we find that certain species subsist to a great extent upon insects. This will be evident on examination of the following summary of the food of our little Screech Owl:

*Summary of the Contents of 255 Stomachs of the Screech Owl. (From Fisher.)*

- 1 stomach contained poultry.
- 38 stomachs contained other birds.
- 91 stomachs contained mice.
- 11 stomachs contained other mammals.
- 2 stomachs contained lizards.
- 4 stomachs contained batrachians.
- 1 stomach contained fish.
- 100 stomachs contained insects.
- 5 stomachs contained spiders.
- 9 stomachs contained crawfish.
- 7 stomachs contained miscellaneous matter.
- 2 stomachs contained scorpions.
- 2 stomachs contained earth worms.
- 43 stomachs were empty.

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\* The American Naturalist, 1899, p. 563.



SCREECH OWL

UPPER FIGURE, GRAY PHASE, LOWER FIGURE, RUFIOUS PHASE OF PLUMAGE

ABOUT  $\frac{3}{8}$  NATURAL SIZE.



**Great Horned Owl** (*Bubo virginianus*).—While this large Owl feeds on both poultry and game birds it also preys upon mammals, some of which may be injurious. As a rule, however, the bird is so uncommon near civilization, and so quickly disappears with the fall of the forests that its relations to man are at the best indirect.

*Summary of the Contents of 127 Stomachs of the Great Horned Owl. (From Fisher.)*

31 stomachs contained poultry or game birds.

8 stomachs contained other birds.

13 stomachs contained mice.

65 stomachs contained other mammals.

1 stomach contained a scorpion.

10 stomachs contained insects.

17 stomachs were empty.

#### CUCKOOS. Family Cuculidæ.

Cuckoos, of which we have two species, the Yellow-billed and Black-billed, are great destroyers of caterpillars. In Farmers' Bulletin No. 54 of the United States Department of Agriculture, Professor Beal writes of them as follows:

“An examination of thirty-seven stomachs has shown that these Cuckoos are much given to eating caterpillars, and, unlike most birds, do not reject those covered with hair. In fact, Cuckoos eat so many hairy caterpillars that the hairs pierce the inner lining of the stomach and remain there, so that when the stomach is opened and turned inside out, it appears to be lined with a thin coating of fur.”

**Black-Billed Cuckoo** (*Coccyzus erythrophthalmus*).—“An examination of the stomachs of sixteen Black-billed Cuckoos, taken during the summer months, showed the remains of 328 caterpillars, eleven beetles, fifteen grasshoppers, sixty-three sawflies, three stink bugs, and four spiders. In all probability more individuals than these were represented, but their remains were too badly broken for recognition. Most of the caterpillars were hairy, and many of them belonged to a genus that lives in colonies and feeds on the leaves of trees, including the apple tree. One stomach was filled with larvæ of a caterpillar belonging to the same genus as the tent caterpillar, and possibly to that species. Other larvæ were those of large moths, for which the bird seems to have a special fondness. The beetles were for the most part click beetles and weevils, with a few May beetles, and some others. The sawflies were all found in two stomachs, one of which contained no less than sixty in the larval stage.” (Beal.)

**Yellow-Billed Cuckoo** (*Coccyzus americanus*).—"Of the Yellow-billed Cuckoo, twenty-one stomachs (collected from May to October, inclusive) were examined. The contents consisted of 355 caterpillars, eighteen beetles, twenty-three grasshoppers, thirty-one sawflies, fourteen bugs, six flies, and twelve spiders. As in the case of the Black-Billed Cuckoo, most of the caterpillars belong to hairy species, and many of them were of large size. One stomach contained twelve American tent caterpillars; another 217 fall webworms. The beetles were distributed among several families, but all more or less harmful to agriculture. In the same stomach which contained the tent caterpillars were two Colorado potato beetles; in another were three goldsmith beetles and remains of several other large beetles; besides ordinary grasshoppers were several katydids and three crickets. The sawflies were in the larval stage, in which they resemble caterpillars so closely that they are commonly called false caterpillars by entomologists, and, perhaps, this likeness may be the reason the Cuckoos eat them so freely. The bugs consisted of stink bugs and cicadas or dogday harvest flies, with the single exception of one wheel bug, which was the only useful insect eaten, unless the spiders be counted as such." (Beal.)

#### KINGFISHER. Family Alcedinidæ.

**Kingfisher** (*Ceryle alcyon*).—Our one species of this family is rated destructive by fishculturists and is denied legal protection. We must remember, however, that value of birds to man which cannot be expressed in dollars and cents. The Kingfisher is far too interesting and characteristic a feature of our ponds, lakes and waterways to be exterminated. Admitting that certain individuals of the species are injurious, it does not follow that the whole race should be condemned.

#### WOODPECKERS. Family Picidæ.

"Farmers are prone to look upon Woodpeckers with suspicion. When the birds are seen scrambling over fruit trees and pecking at the bark, and fresh holes are found in the tree, it is concluded that they are doing harm. Careful observers, however, have noticed that, excepting a single species, these birds rarely leave any important mark on a healthy tree, but that when a tree is affected by wood-boring larvæ, and insects they are accurately located, dislodged, and devoured. In case the holes from which the borers are taken are afterwards occupied and enlarged by colonies of ants, these ants in turn are drawn out and eaten." (Beal.)

**Downy Woodpecker** (*Dryobates pubescens*).—This our smallest and most



*Rouj Agassiz Puertes*

UPPER FIGURE, BLACK-BILLED CUCKOO  
LOWER FIGURE, YELLOW-BELLIED SAPSUCKER  
ABOUT  $\frac{3}{4}$  NATURAL SIZE



common Woodpecker, is also the most beneficial. Professor Beal\* states that 75 per cent of its food consists of insects, including ants, beetles, bugs, flies, caterpillars, and grasshoppers.

King found in the stomachs of this species wood-boring grubs, larvæ, caterpillars, ants, beetles, and other insects. The species also feeds to a small extent on wild fruits.

**Hairy Woodpecker** (*Dryobates villosus*).—This species resembles the preceding in color, but is longer. According to Beal 68 per cent of its food is animal matter 21 per cent of the whole food being caterpillars. The same writer states that F. M. Webster saw this species peck a hole in the cocoon of a cecropia moth and devour its contents; only 2 out of 20 cocoons examined being uninjured.

King found 11 larvæ of wood-boring beetles and 12 geometers in the stomach of one Hairy Woodpecker; another contained 13 larvæ of long-horned beetles and 4 cockroach oötheca.

**Flicker : Clape : High-hole: Golden-Winged Woodpecker** (*Colaptes auratus*).—In some States this Woodpecker is ranked as a game bird and its killing is permitted at certain seasons. Study of the bird's food, however, shows that it should at all times be protected. While feeding on wild fruits, the bird's chief economic value is derived from its destruction of ants which, Professor Beal states, constitute 43 per cent of its whole food. In each of two stomachs of the Flicker examined by this investigator were found over 3,000 ants; Bruner states that the stomach of a Flicker killed near Lincoln, Nebraska, contained nearly 1,000 Chinch bugs.

**Pileated Woodpecker : Logcock** (*Ceophlæus pileatus*).—This fine large species is now confined to the most heavily forested portions of the State. The trunk of a white pine, fallen but as yet externally sound, which I examined in Vermont, showed twelve cavities made by this bird in its search for wood-boring larvæ. The largest was twelve inches long, four inches wide, and eight inches deep. The heart of the tree proved to be riddled by the passages of the borers which the Woodpecker, when alighting on the tree, had doubtless heard at work.

While most of the wood-borers eaten by this species are obtained from dead trees, the borers begin their work in living trees and any agent which tends to hold them in check is therefore of value to our forests.

**Red-Headed Woodpecker** (*Melanerpes erythrocephalus*).—"The Red-Headed Woodpecker (*Melanerpes erythrocephalus*) is well known east of the Rocky Mountains, but is rather rare in New England. Unlike some other species, it pre-

\* Preliminary Report on the Food of Woodpeckers. Bull. No. 7, Biological Survey, U. S. Dept. of Agriculture.

fers fence posts and telegraph poles to trees as a foraging ground. Its food, therefore, naturally differs from that of the preceding species, and consists largely of adult beetles and wasps which it frequently captures on the wing, after the fashion of flycatchers. Grasshoppers also form an important part of the food. The Red-head has a peculiar habit of selecting very large beetles, as shown by the presence of fragments of several of the largest species in the stomachs. Among the beetles were quite a number of predaceous ground beetles, and unfortunately some tiger beetles, which are useful insects. The Redhead has been accused of robbing the nests of other birds; also of attacking young birds and poultry and pecking out their brains, but as the stomachs showed little evidence to substantiate this charge it is probable that the habit is rather exceptional."

**Yellow-Bellied Sapsucker** (*Sphyrapicus varius*).—It is this species which is responsible for the numerous rows of holes so commonly seen in the trunks of apple and other trees. They are made to supply the bird with sap and when numerous may result in the death of the tree through girdling. The Sapsucker also feeds upon the insects which are attracted to the sap flowing from the punctures it has made, but that the bird is primarily a sap-eating rather than insect-eating species is apparently shown by its brushy, instead of spiny-tipped, tongue.

The Sapsucker, then, may become an injurious species when it pays too close attention to one tree, riddling a section of its bark so thickly that circulation is destroyed and death follows.

#### NIGHTHAWK AND WHIP-POOR-WILL. Family Caprimulgidæ.

Both the Nighthawk and Whip-Poor-Will feed exclusively on insects, and feeding at dusk and by night, when other birds are sleeping, they do unusually good service by devouring species which might otherwise escape.

**Nighthawk** (*Chordeiles virginianus*).—The food of the Nighthawk consists of moths, beetles, including June bugs, ants, grasshoppers, flies, mosquitoes, and crickets. Mrs. Bailey mentions one bird of this species, the stomach of which contained 573 large winged ants, parts of 72 small winged ants, and 16 grasshoppers.

In the south, where the Nighthawk is known as Bull-bat, it is often shot for so-called sport in large numbers, though the facts show that no bird is more deserving of protection.

**Whip-poor-will** (*Antrostomus vociferus*).—The Whip-poor-will feeds nearer the ground than the Nighthawk and is more often seen than heard. It eats ants, grasshoppers, potato beetles, June bugs, moths, and other winged insects.



UPPER FIGURE, PILEATED WOODPECKER

LOWER FIGURE, DOWNY WOODPECKER

ABOUT  $\frac{1}{2}$  NATURAL SIZE.





UPPER FIGURE, NIGHTHAWK  
 $\frac{1}{3}$  NATURAL SIZE.

LOWER FIGURE, WHIP-POOR-WILL  
 $\frac{1}{2}$  NATURAL SIZE.



**SWIFTS. Family Micropodidæ.**

**Chimney Swift** (*Chætura pelagica*).—No detailed study of the food of the Chimney Swift appears to have been made. The species, however, so far as known, is exclusively insectivorous and in view of its abundance is doubtless of much economic importance.

**HUMMINGBIRDS. Family Trochilidæ.**

**Ruby-Throated Hummingbird** (*Trochilus colubris*).—The juices of plants, spiders, plant-lice, and other small insects constitute the food of the Hummingbird, which also may be of service in pollenizing the flowers it visits.

**FLYCATCHERS. Family Tyrannidæ.**

As their name indicates, the birds of this family are insectivorous. The food habits of only four species appear to have been more than superficially studied.

**Kingbird** (*Tyrannus tyrannus*).—"In its food habits this species is largely insectivorous. It is a true flycatcher by nature, and takes a large part of its food on the wing. It does not, however, confine itself to this method of hunting, but picks up some insects from trees and weeds, and even descends to the ground in search of myriapods or thousand legs. The chief complaint against the Kingbird is that it preys largely upon honeybees; and this charge has been made both by professional bee keepers and others. Many observers have seen the bird at work near hives, and there is no reason to doubt the honesty of their testimony. One bee raiser in Iowa, suspecting the Kingbirds of feeding upon his bees, shot a number near his hives, but when the birds' stomachs were examined by an expert entomologist not a trace of honeybees could be found.

"The Biological Survey has made an examination of 281 stomachs collected in various parts of the country, but found only 14 containing remains of honeybees. In these 14 stomachs there were in all 50 honeybees, of which 40 were drones, 4 were certainly workers, and the remaining 6 were too badly broken to be identified as to sex.

"The insects that constitute the great bulk of the food of this bird are noxious species, largely beetles—May beetles, click beetles (the larvæ of which are known as wire worms), weevils, which prey upon fruit and grain, and a host of others. Wasps, wild bees, and ants are conspicuous elements of the food, far outnumbering the hive bees. During summer many grasshoppers and crickets, as well as leaf hoppers and other bugs, are also eaten. Among the flies were a number of robber flies

—insects which prey largely upon other insects, especially honeybees, and which have been known to commit in this way extensive depredations. It is thus evident that the Kingbird by destroying these flies actually does good work for the apiarist. Nineteen robber flies were found in the stomachs examined; these may be considered more than an equivalent for the four worker honeybees already mentioned. A few caterpillars are eaten, mostly belonging to the group commonly known as cutworms, all the species of which are harmful. About 10 per cent of the food consists of small native fruits, comprising some twenty common species of the roadsides and thicket, such as dogwood berries, elder berries, and wild grapes. The bird has not been reported as eating cultivated fruit to an injurious extent, and it is very doubtful if this is ever the case, for cherries and blackberries are the only ones that might have come from cultivated places, and they were found in but few stomachs.

“Three points seem to be clearly established in regard to the food of the Kingbird—(1) that about 90 per cent consists of insects, mostly injurious species; (2) that the alleged habit of preying upon honeybees is much less prevalent than has been supposed, and probably does not result in any great damage; and (3) that the vegetable food consists almost entirely of wild fruits which have no economic value. These facts, taken in connection with its well-known enmity for Hawks and Crows, entitle the Kingbird to a place among the most desirable birds of the orchard or garden.” (Beal.)

**Phoebe** (*Sayornis phæbe*).—“The Phoebe subsists almost exclusively upon insects, most of which are caught upon the wing. An examination of 80 stomachs showed that over 93 per cent of the year’s food consists of insects and spiders, while wild fruit constitutes the remainder. The insects belong chiefly to various species and include many click beetles, May beetles, and weevils. Grasshoppers in their season are eaten to a considerable extent, while wasps of various species, many flies of species that annoy cattle, and a few bugs and spiders are also eaten. \* \* \*

“There is hardly a more useful species about the farm and it should receive every encouragement. To furnish nesting boxes is unnecessary, as it usually prefers a more open situation, like a shed or nook under the eaves, but it should be protected from cats and other marauders.” (Beal.)

**Wood Pewee** (*Contopus virens*).—“Of forty-one specimens examined, eighteen had eaten 66 small beetles, among them 7 metallic-green beetles and several lamellicorns; fourteen, 41 dipterous insects, among them 12 large crane-flies. \* \* \*

“I have seen one Wood Pewee capture and feed to its young, which had recently left the nest, 41 insects in the course of 41 minutes. Several of these insects were moths.” (King.)



UPPER FIGURE, KINGBIRD  
ABOUT  $\frac{1}{2}$  NATURAL SIZE.  
LOWER FIGURE, PHOEBE  
ABOUT  $\frac{2}{3}$  NATURAL SIZE.



**Least Flycatcher: Chebec** (*Empidonax minimus*).—“Of twenty-three specimens examined ten had eaten 30 beetles—among them 2 squash beetles (*Diabrotica vittata*), a lady-bird and 2 weevils; four, 18 dipterous insects; one, 2 small heteropterous insects, equal in size to Chinch bug; four, 39 hymenopterous insects, 2 small ichneumon flies and 37 winged-ants; two, 3 caterpillars; one, a moth; two, 4 small dragon-flies; and one, a small spider.” (King.)

#### LARKS. Family Alaudidæ.

**Horned Lark** (*Otocoris alpestris*).—The Horned Larks, including this, the winter visitant form and the Prairie Horned Lark (*O. a. praticola*), which breeds throughout the central portion of the State, are of economic value as weed-seed eaters; while the latter also eats various species of insects. No detailed study of their food has been published.

#### CROWS and JAYS. Family Corvidæ.

To the members of this family are attributed numerous misdeeds, and although much attention has been given to their food habits, their injurious habits are said to be so nearly balanced by beneficial ones that it is difficult to determine which outweighs the other.

**Crow** (*Corvus americanus*).—“That he [the Crow] does pull up sprouting corn, destroy chickens, and rob the nests of small birds has been repeatedly proved. Nor are these all of his sins. He is known to eat frogs, toads, salamanders, and some small snakes, all harmless creatures that do some good by eating insects. With so many charges against him, it may be well to show why he should not be utterly condemned.

“The examination of a large number of stomachs, while confirming all the foregoing accusations, has thrown upon the subject a light somewhat different from that derived solely from field observation. It shows that the birds-nesting habit, as in the case of the Jay, is not so universal as has been supposed; and that, so far from being a habitual nest robber, the Crow only occasionally indulges in that reprehensible practice. The same is true in regard to destroying chickens, for he is able to carry off none but the very young ones, and his opportunities for capturing them are somewhat limited. Neither are many toads or frogs eaten, and as frogs are of no great practical value, their destruction is not a serious matter; but toads are very useful, and their consumption, so far as it goes, must be counted against the Crow. Turtles, crayfishes, and snails, of which he eats quite a large number, may be considered neutral, while mice may be counted to his credit.

"In his food, however, the Crow makes amends for his sins in the rest of his dietary, although even here the first item is against him. Predaceous beetles are eaten in some numbers throughout the season, but the number is not great. May beetles, 'dor-bug,' or June bugs, and others of the same family, constitute the principal food during spring and early summer, and are fed to the young in immense quantities. Other beetles, nearly all of a noxious character, are eaten to a considerable extent. Grasshoppers are first taken in May, but not in large numbers until August, when, as might be expected, they form the leading article of diet, showing that the Crow is no exception to the general rule that most birds subsist, to a large extent, upon grasshoppers in the month of August. Many bugs, some caterpillars, mostly cutworms, and some spiders, are also eaten—all of them either harmful or neutral in their economic relations. Of the insect diet Mr. E. A. Schwarz says: 'The facts, on the whole, speak overwhelmingly in favor of the Crow.'

"Probably the most important item in the vegetable food is corn, and by pulling the newly sprouted seeds the bird renders himself extremely obnoxious. Observations and experiments with tame Crows show that hard, dry corn is never eaten if anything else is to be had, and if fed to nestlings it is soon disgorged. The reason Crows resort to newly planted fields is that the kernels of corn are softened by the moisture of the earth, and probably become more palatable in the process of germination, which changes the starch of the grain to sugar. The fact, however, remains that the Crows eat corn extensively only when it has been softened by germination or partial decay, or before it is ripe and still 'in milk.' Experience has shown that they may be prevented from pulling up young corn by tarring the seed, which not only saves the corn but forces them to turn their attention to insects. If they persist in eating green corn it is not easy to prevent the damage; but no details of extensive injury in this way have yet been presented, and it is probable that no great harm has been done.

"Crows eat fruit to some extent, but confine themselves for the most part to wild species, such as dogwood, sour gum, and seeds of the different kinds of sumac. They have also a habit of sampling almost everything which appears eatable, especially when food is scarce. For example, they eat frozen apples found on the trees in winter, or pumpkins, turnips, and potatoes which have been overlooked or neglected; even mushrooms are sometimes taken, probably in default of something better.

"In estimating the economic status of the Crow, it must be acknowledged that he does some damage, but, on the other hand, he should receive much credit for the insects which he destroys. In the more thickly settled parts of the country the

Crow probably does more good than harm, at least when ordinary precautions are taken to protect young poultry and newly planted corn against his depredations. If, however, corn is planted with no provision against possible marauders, if hens and turkeys are allowed to nest and to roam with their broods at a distance from farm buildings, losses must be expected."

While, from the nature of the case, birds' eggs and young birds can form but a small portion of the annual food-supply of the Crow, I believe it to be indisputable that during the nesting season they constitute a large percentage of the Crow's food. Nest-robbing is not occasional but is the characteristic habit of the Crow. Not only do they eat eggs and young birds, but they feed their offspring on them. Doubtless few Crows live through May and June without preying on smaller birds and the possibilities are that almost any one of the birds destroyed (either in the egg or out of it) is of greater economic value than the Crow. The Crow, therefore, in addition to the direct damage it may do our crops, robs us of the services of birds far more desirable than itself. Even if the Crow, aside from its cannibal-like propensities, was wholly beneficial, it would not, it seems to me, render us as great a service as would have been performed by the birds it destroys. In short, in my opinion, the Crow is one of the worst enemies of our small insectivorous and seed-eating birds, and as such it is undeserving of protection.

**Blue Jay** (*Cyanocitta cristata*).—“The Blue Jay is a common bird of the United States east of the Great Plains, and remains throughout the year in most of its range, although its numbers are somewhat reduced in winter in the Northern States. During spring and summer the Jay is forced to become an industrious hunter for insects, and is not so conspicuous a feature of the landscape as when it roams the country at will after the cares of the nesting season are over.

“Ornithologists and field observers in general declare that a considerable portion of its food in spring and early summer consists of the eggs and young of small birds, and some farmers accuse it of stealing corn to an injurious extent in the fall. While there may be some truth in these accusations, they have almost certainly been exaggerated. No doubt many Jays have been observed robbing nests of other birds, but thousands have been seen that were not so engaged.

“In an investigation of the food of the Blue Jay 292 stomachs were examined which showed that animal matter comprised 24% and vegetable matter 76% of the bird's diet. So much has been said about the nest-robbing habits of the Jay that special search was made for traces of birds or birds' eggs in the stomachs, with the result that shells of small birds' eggs were found in three and the remains of young birds in only two stomachs. Such negative evidence is not sufficient to controvert

the great mass of testimony on this point, but it shows that the habit is not so prevalent as has been believed. Besides birds and their eggs, the Jay eats mice, fish, salamanders, caterpillars, snails, and crustaceans, which altogether constitute but little more than 1 per cent of its diet. The insect food is made up of beetles, grasshoppers, caterpillars, and a few species of other orders, all noxious, except some 3½% of predaceous beetles. Thus something more than 19% of the whole food consists of harmful insects. In August the Jay, like many other birds, turns its attention to grasshoppers, which constitute nearly one-fifth of its food during that month. At this time, also, most of the other noxious insects, including caterpillars, are consumed, though the beetles are chiefly eaten in spring.

“The vegetable food is quite varied, but the item of most interest is grain. Corn was found in 70 stomachs, wheat in 8, and oats in 2, all constituting 19% of the total food. Corn is evidently the favorite grain, but a closer inspection of the record shows that the greater part was eaten during the first five months of the year, and that very little was taken after May, even in harvest time, when it is abundant. This indicates that most of the corn is gleaned from the fields after harvest, except what is stolen from the cribs or gathered in May at planting time.

“The Jay’s favorite food is mast (*i. e.*, acorns, chestnuts, chinquapins, etc.), which was found in 158 of the 292 stomachs and amounted to more than 42% of the whole food. In September corn formed 15 and mast 35%, while in October, November and December corn dropped to an almost inappreciable quantity, and mast amounted to 64, 82 and 83%, respectively. And yet in these months corn is abundant and everywhere accessible. The other elements of food consist of a few seeds and wild fruits, among which grapes and blackberries predominate.

“The results of the stomach examination show, (1) that the Jay eats many noxious insects; (2) that its habit of robbing the nests of other birds is much less common than has been asserted; and (3) that it does little harm to agriculture, since all but a small amount of the corn eaten is waste grain.” (Beal.)

Personally, my attitude toward the Jay is that which I hold in regard to the Crow. It is not unusual for the Jay to eat birds’ eggs, and in so doing he does an injury which the good deeds to his credit are far from balancing. As with the Crow, any one of the insect or seed-eating birds killed by a Jay would doubtless have been more desirable than the Jay itself, and where a single Jay, as often happens, destroys a whole nestful of eggs it becomes a positively injurious species. I believe, therefore, that the Blue Jay is no more deserving of protection than is the Crow. Both birds, however, are far too interesting to be exterminated, but no steps should be taken which will result in their increase. Belonging to a family

noted for the intelligence and adaptability of its members, Crows and Jays can adjust themselves to the changes incident to civilization far more readily than many of the birds which become their victims, and, in cases of this kind, man should help to restore nature's balance by according protection to the weaker species; not to their enemies.

#### STARLINGS. Family Sturnidae.

**Starling** (*Sturnus vulgaris*).—The Starling was first successfully introduced into this country by Mr. Eugene Schieffelin, under whose direction 80 birds were released in Central Park, New York City, March 6, 1890; and 40 more on April 25, 1891. There was evidently room in this new environment for these birds for they so thrived that their descendants are now numbered by thousands; flocks containing several hundred being frequently seen in the upper part of New York City and eastward along the sound.

The Starling, therefore, is now firmly established in this country, and if it continues to multiply at the rate already shown to be possible, it will in comparatively few years become one of our most abundant birds.

Whether this species will prove to be beneficial or injurious it is difficult to surmise. In its own habitat it is said to be on the whole economically valuable; but under wholly new surroundings, where its relations to other species are as yet undetermined, one cannot predict what its place in nature will be. There can be no question, however, that the present is the time to give this matter serious consideration. In a few years Starlings will be as far beyond control as English Sparrows are now.

#### BLACKBIRDS, ORIOLES, ETC. Family Icteridae.

In this family are included several species reputed to be the worst enemies, among birds, to the farmer. The Blackbirds, of several species, are especially condemned as grain destroyers. Raising only one brood they begin to flock early in July and before the grain is harvested have gathered in enormous bodies which unquestionably do much damage. It is, therefore, not without cause that our law refuses Blackbirds protection at all seasons. The question is, shall we go further than this? Shall we attempt to reduce the numbers of these birds? On this point Professor Beal writes:\*

“In a treatise on the destructiveness of grain-eating birds it is natural that the reader should expect at least a suggestion of a remedy. Unfortunately it is much

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\*Birds that Injure Grain, Yearbook of the Dept. of Agriculture, 1897, p. 353.

easier to point out the evil than to prescribe the cure. Stomach investigation shows conclusively that birds do not subsist upon grain alone, even at times when it is possible to obtain it. Moreover, the greatest amount of grain is not eaten at harvest time, but during the winter months, when other food is scarce and waste kernels can be picked up in the fields. If any kind of grain is preferred by a certain species, we should expect the bird to subsist upon that grain almost exclusively when it can be obtained, that is, at harvest time. That this is not the case is shown by the fact that many birds of the same species have been shot at the same time in a grainfield, and while some stomachs were full of grain, others were only partly filled, and still others were wholly filled with other food. So many cases of this kind have occurred that it seems practically certain that few birds willingly subsist exclusively upon any kind of grain for a considerable length of time. With many species this is in notable contrast to their marked fondness for the seeds of certain useless plants, upon which at some seasons they subsist almost entirely.

“If it be admitted that birds do not as a rule display an inordinate appetite for grain, the question naturally arises: What is the cause of the tremendous ravages they sometimes commit? Both stomach examination and field observation point to the same answer: Too many birds of the same or closely allied species are gathered together within a limited area.

“As already pointed out, the Upper Mississippi region presents such exceptionally favorable breeding grounds for Blackbirds, especially the Redwing and Yellowhead, that they swarm there in countless numbers. Settlement and cultivation have not yet encroached materially upon their haunts, but have added a source of food, which, coming before the great natural supply, has served to render the race more vigorous and prolific.

“An attempt to exterminate these species would be not only ill-advised but hopeless. States have offered bounties for their destruction without perceptibly thinning their ranks. Is there, then, any remedy for the evil? The writer is forced to confess that he has none to suggest, except in the case of Crows and Blackbirds that pull up sprouting corn. This can be prevented by thoroughly tarring the seed, which, if properly done, neither injures its vitality nor prevents the use of machinery in planting. There is, however, some hope for the future, though perhaps a distant one. While the advance of civilization has thus far not affected these birds or their haunts, the time must surely come when it will. Increased density of population will broaden the area of cultivation, and this in time must lead to the draining of the smaller marshes and ponds, thus turning over to agriculture much land that has heretofore been worse than waste, since it has served as a

breeding ground for the birds that have destroyed the crops. With the breeding places more restricted and an environment otherwise changed by increased population, the number of birds must surely decrease, and in time the proper equilibrium will be restored. \*In the meantime, it behooves the farmer to apply such remedies as the exigencies of the case suggest, and where these gregarious species are overabundant it might be well to exempt them from the general protective laws, in order that each landholder may be free to protect himself as best he can."

**Crow Blackbird: Purple Grackle and Bronzed Grackle** (*Quiscalus quiscula et æneus*).—"Crow Blackbirds are fond of grain, and being of good size and abundant, evidently have the power to do great harm. Moreover, the examination of more than 2,000 of their stomachs shows that grain formed 45 per cent of the food of the year, and that corn alone constitutes 35 per cent. From this it might be expected that they would attract much attention from grain growers, and such is the case. Hundreds of communications have been received testifying to their destructiveness; yet many of these acknowledge the fact that Blackbirds eat a large quantity of insects, especially during the breeding season, and that many insects are fed to the young. This last is also borne out by stomach examination. A review of the yearly diet shows that the greater part of the corn eaten is taken during the fall and winter months. That eaten in winter and early spring (March and April), except the small quantity taken from corncribs, must be waste grain, or picked up in places where grain is left in the shock for a long time. No one will begrudge the birds the corn gathered from the hog lot or about the cattle crib, but when they attack the ripening grain in September it is a different story, and in cases where the birds are so abundant that they take a large part of the crop, it will be difficult to persuade the unfortunate farmer that they did enough good earlier in the season to pay for this loss. There can be no doubt that in many parts of the country these birds are too numerous for the farmer to realize the best results from their services." (Beal.)

**Red-winged Blackbird** (*Agelaius phœnicus*).—"In investigating the food habits of the Red-wing over 700 stomachs were examined. These were collected in every month of the year, and show that a little more than 13 per cent of the year's food is grain. This is a remarkably small percentage when it is considered that this bird has been the subject of more complaints on the score of grain eating than any other species. In order to understand thoroughly the grain-eating propensities of the Red-wing, a special study of its food for the five months from May to September, inclusive, has been made. Of the stomachs taken in May, 46 per cent contained grain. This percentage falls to 11 in June and then rises in July and culminates in

August at 72, after which it decreases rapidly. The average for the five months is 46 per cent, that is, in every 100 birds taken 46 have eaten grain. If now we examine the grain-eating record as exhibited by the quantity of that food the results are quite different. In May grain constitutes 21 per cent of the food by bulk; in June it decreases to 5 per cent; in July it rises to its maximum of 42 per cent; in August it falls off slightly, after which it rapidly decreases and disappears. The average consumption of grain for the five months is 25 per cent of the whole food. Again, if the two months of July and August are considered alone, it is found that out of every 100 birds 68 have eaten grain, but that the grain constitutes only 40 per cent of the total food for the two months. \* \* \*

“Of the different kinds of cereals, oats is the favorite with the Red-wings, constituting more than half of the grain eaten. Corn stands next in order, and wheat last of all. At the same time many noxious insects and much weed seed are destroyed. The former amounts to over 26 per cent of the year’s food, the latter to nearly 57 per cent. Seeds of noxious weeds, eked out by grain found scattered in the fields, form the almost exclusive diet of these birds during the colder months. Even in August, when the destruction of grain is at its height, weed seed forms more than 30 per cent of the food.” (Beal.)

**Rusty Blackbird** (*Scolecophagus carolinus*).—“The Rusty Grackle (*Scolecophagus carolinus*) of the eastern United States and Brewer’s Blackbird (*S. cyanocephalus*) of the west are similar birds, whose habits of associating in large flocks would indicate that they could do great damage to grain fields if they chose to visit them for food. Stomach examinations show that the eastern bird lives to a great extent upon animal substances, principally insects, and as the species retires to the extreme northern edge of the country and beyond to breed, it does not appear in most of the grain-raising States until the crops of wheat and oats have been harvested. It feeds to some extent on corn, but the damage appears to be slight. Brewer’s Blackbird, on the contrary, breeds over the greater part of its range and only retires from the northern part during a short time in winter. It is more of a grain eater than the Rusty Grackle and does considerable damage in wheat-growing areas in the far west. Like the Rusty Grackle, it is a great consumer of insects.” (Beal.)

**Cowbird** (*Molothrus ater*).—This bird is said not to be seriously injurious to grain, but its habit of laying in the nests of smaller and much more valuable species, the young of which are, in consequence, often starved, should be sufficient to warrant us in denying it legal protection.

**Bobolink** (*Dolichonyx oryzivorus*).—This species furnishes an illustration of a bird which is beneficial in one locality and harmful in another. While with us in

its breeding season the Bobolink is an undeniably useful bird, feeding on insects and weed seeds, but during its migrations in August and September, when it visits the rice-fields of South Carolina and Georgia, it is quite as undeniably injurious. Admitting that the injury it does in the south is in excess of the good it does in the north, we fear that we are not as yet sufficiently altruistic to destroy this well-loved bird for the benefit of those whom it harms, and for the present, therefore, each State will doubtless deal with its birds without relation to their status in other parts of their range.

**Baltimore Oriole : Hangbird** (*Icterus galbula*).—“Observation both in the field and laboratory shows that caterpillars constitute the largest item of its fare. In 113 stomachs they formed 34 per cent of the food, and are eaten regularly in varying quantities during all the months in which the bird remains in this country, although fewest are eaten in July, when a little fruit is also taken. The other insects consist of beetles, bugs, ants, wasps, grasshoppers, and some spiders. The beetles are principally click beetles, the larvæ of which are among the most destructive insects known; and the bugs include plant and bark lice, both very harmful, but so small and obscure as to be passed over unnoticed by most birds.” (Beal.)

In spite of this good record Orioles are known to do much damage to grapes in the latter part of August by puncturing one or more grapes in a bunch, thereby decreasing their market value. As has been previously suggested, however, the vineyards can be protected from them by the discharge of unshotted guns, and as comparatively few birds of this species remain north of the latitude of New York after the first week in September, it would clearly be undesirable to kill so useful and beautiful a bird when by the exercise of a little vigilance for a comparatively short period the harm it might do may be prevented.

**Meadowlarks** (*Sturnella magna*).—“The Meadowlark is almost wholly beneficial, although a few complaints have been made that it pulls sprouting grain, and one farmer claims that it eats clover seed. As a rule, however, it is looked upon with favor and is not disturbed.

“In the 238 stomachs examined, animal food (practically all insects) constituted 73 per cent of the contents and vegetable matter 27 per cent. As would naturally be supposed, the insects were ground species, such as beetles, bugs, grasshoppers and caterpillars, with a few flies, wasps and spiders. A number of the stomachs were taken from birds that had been killed when the ground was covered with snow, but still they contained a large percentage of insects, showing the bird's skill in finding proper food under adverse circumstances.

“Of the various insects eaten, crickets and grasshoppers are the most important,

constituting 29 per cent of the entire year's food and 69 per cent of the food in August. It is scarcely necessary to enlarge upon this point, but it can readily be seen what an effect a number of these birds must have on a field of grass in the height of the grasshopper season. Of the 238 stomachs collected at all seasons of the year, 178, or more than two-thirds, contained remains of grasshoppers, and one was filled with fragments of 37 of these insects. This seems to show conclusively that grasshoppers are preferred and are eaten whenever they can be procured. The great number taken in August is especially noticeable. This is essentially the grasshopper month, *i. e.*, the month when grasshoppers reach their maximum abundance; and the stomach examination has shown that a large number of birds resort to this diet in August, no matter what may be the food during the rest of the year.

“Next to grasshoppers, beetles make up the most important item of the Meadowlark's food, amounting to nearly 21 per cent, of which about one-third are predaceous ground beetles. The others are all harmful species, and when it is considered that the bird feeds exclusively on the ground, it seems remarkable that so few useful ground beetles are eaten. Many of them have a disgusting odor, and possibly this may occasionally save them from destruction by birds, especially when other food is abundant. Caterpillars, too, form a very constant element, and in May constitute over 28 per cent of the whole food. May is the month when the dreaded cut worm begins its deadly career, and then the bird does some of its best work. Most of these caterpillars are ground feeders, and are overlooked by birds which habitually frequent trees; but the Meadowlark finds them and devours them by thousands. The remainder of the insect food is made up of a few ants, wasps and spiders, with a few bugs, including some chinch bugs.

“The vegetable food consists of grain, weed, and other hard seeds; grain in general amounts to 14, and weed and other seeds to 12 per cent. The grain, principally corn, is mostly eaten in winter and early spring, and must be, therefore, simply waste kernels; only a trifle is consumed in summer and autumn, when it is most plentiful. No trace of sprouting grain was discovered. Clover seed was found in only six stomachs, and but little in each. Seeds of weeds, principally ragweed, barn grass, and smartweed, are eaten from November to April, inclusive, but during the rest of the year are replaced by insects.

“Briefly stated, more than half of the Meadowlark's food consists of harmful insects; its vegetable food is composed either of noxious weeds or waste grain, and the remainder is made up of useful beetles or neutral insects and spiders. A strong point in the bird's favor is that, although naturally an insect eater, it is able to subsist on vegetable food, and, consequently, is not forced to migrate in cold weather



UPPER FIGURE, TREE SPARROW

LOWER FIGURE, SNOWFLAKE

ABOUT  $\frac{2}{3}$  NATURAL SIZE.



any farther than is necessary to find ground free from snow. This explains why it remains for the most part in the United States during winter, and moves northward as soon as the snow disappears from its usual haunts.

“There is one danger to which the Meadowlark is exposed. As its flesh is highly esteemed the bird is often shot for the table, but it is entitled to all possible protection, and to slaughter it for game is the least profitable way to utilize a valuable species.” (Beal.)

### SPARROWS AND FINCHES. Family Fringillidæ.

“While Sparrows are noted seed eaters, they do not by any means confine themselves to a vegetable diet. During the summer, and especially in the breeding season, they eat many insects, and probably feed their young largely upon the same food. An examination of the stomachs of three species—the Song Sparrow (*Melospiza*), Chipping Sparrow (*Spizella socialis*), and the Field Sparrow (*Spizella pusilla*), shows that one-third of the food consists of insects, comprising many injurious beetles, such as snout-beetles or weevils, and leaf-beetles. Many grasshoppers are eaten, and in the case of the Chipping Sparrow these insects form one-eighth of the food. Grasshoppers would seem to be rather large morsels, but the bird probably confines itself to the smaller species; indeed, this is indicated by the fact that the greatest amount (over 36%) is eaten in June, when the larger species are still young and the small species most numerous. Besides the insects already mentioned, many wasps and bugs are taken. Predaceous and parasitic hymenoptera and predaceous beetles, all useful insects, are eaten only to a slight extent, so as a whole the Sparrows' insect diet may be considered beneficial.

“Their vegetable food is limited almost exclusively to hard seeds. This might seem to indicate that the birds feed to some extent upon grain, but the stomachs examined show only one kind—oats—and but little of that. The great bulk of the food is made up of grass and weed seed, which form almost the entire diet during the winter, and the amount consumed is immense.” (Beal.)

In his important paper on “The Relations of Sparrows to Agriculture,”\* Dr. Judd remarks: “It is evident that a group of birds so abundant, so widely distributed, and in such constant association with farms and gardens, must play an important part in rural economy, and that a thorough investigation of their food habits should be useful. The results of such an investigation are embodied in the present paper and amply demonstrate the value of these birds to the agriculturist—

\* Bull. 15, Div. Biological Survey, U. S. Dept. of Agriculture, 1901, p. 7.

a value greater than that of any other group of birds whose economic status has thus far been investigated. The native Sparrows contrast markedly in this respect with the introduced English Sparrow, the pernicious habits of which have formed the subject of a special report, and are briefly treated in this bulletin for purpose of comparison (see p. 92). This naturalized Sparrow is a pest wherever it is found, while the native Sparrows are well worthy of protection and encouragement."

**Snowflake: Snowbunting** (*Passerina nivalis*).—"From the examination of the stomachs collected, it would appear that the Snowflake derives fully half its subsistence from two weeds—amaranth and ragweed, and that it does not to any great extent feed on the seeds of crab-grass, pigeon-grass, or other grasses, though it should be stated that McIlwraith reports it as eating the seeds of broom sedge (*Andropogon scoparius*). Only one per cent of the food contained in the 46 stomachs examined was grass seed. But in addition to the fact that the number of stomachs examined was too small to permit final conclusions to be drawn, for other reasons this should not be taken as showing a distaste for grass seed. The taste for similar food, as shown by the partiality of the birds for grain, and the quantity of grass seed eaten by the closely allied, more southerly ranging Longspurs, indicate that the abstinence of the Snowflake from this food is due to necessity and not choice. We must remember that the grass seed, which falls to the ground when ripe instead of clinging to the stalk, as do many of the seeds of amaranth, lamb's-quarters, and ragweed, is probably buried under the snow during most of the time the Snowflakes are here. The amaranth is tall and its seeds are particularly clinging, and after very heavy snowfalls it is probably the most available food supply the Snowflakes have. Its seeds form half the food found in the stomachs collected in February and March, some of which contained 500 to 1,500 each. Such a wholesale destruction of the seeds of this rank weed as is thus indicated is not accomplished by any other bird whose food habits have thus far been investigated. With most species of seed-eating birds amaranth is by no means an important article of diet.

"On account of its work as a good weed destroyer and the apparent absence of any noticeable detrimental food habits, the Snowflake seems to deserve high commendation, and should receive careful protection. Feeding in latitudes that have been deserted by most other weed-destroying birds, these birds render a distinct and most effective service to the northern farmer. And to this should be added that it is their habit, and that of their congeners, the Longspurs, to feed far out in the open plains without regard to the presence of trees or shrubs. In this way they accomplish work that would otherwise be left undone; for most of the other mem-

bers of the Sparrow family that subsist entirely, or nearly so, on weed seed in the winter will not be found far from convenient shelter to which they can repair in case of danger." (Judd.)

In spite of their great economic value, Snowflakes are killed in great numbers to be sold for food under the name of "Reedbirds." On August 30, 1902, 78,000 odd birds of this species were found in cold storage warehouses in New York City, where they were held in defiance of the State law.

**Purple Finch** (*Carpodacus purpureus*).—The Purple Finch at certain seasons feeds largely on buds and blossoms and is said to damage fruit trees in this manner. No thorough study of the food habits of the bird appears to have been made, and until our knowledge of its economic status rests on sound basis we may well withhold judgment concerning its economic value. In the meantime we may remember how comparatively few blossoms, under the most favorable conditions, bring forth mature fruit, and consequently how many can be spared without affecting the yield of a tree.

Due consideration should also be given to the fact that the Purple Finch is known to feed on plant lice. (See King.)

**American Goldfinch: Thistle Bird** (*Astragalinus tristis*).—"The Goldfinch, or Wild Canary, is as useful as it is beautiful, and as a weed destroyer has no equals. It confines its attention very largely to one family of plants, the compositæ, and it is especially fond of thistles, wild lettuce, wild sunflower, and ragweed. It is so often seen on thistles, both Canada and bull thistles, that it is commonly known as the Thistle bird. Near Washington, D. C., a flock of a dozen birds were seen during the latter part of August feeding on sunflowers that had escaped from cultivation, and in the central and western States the Goldfinches do much good by eating the seeds of wild sunflowers and other closely related weeds. They have also been seen feeding upon wild lettuce (*Lactuca spicata*), and probably eat prickly lettuce (*Lactuca scariola*), which has proved the most rapidly spreading weed ever introduced into this country, but as yet no actual observations as to the latter food habit have been made. Stomachs collected in August were filled with seed of compositæ, mostly sunflowers (various species of *Helianthus*) and thistles (*Carduus lanceolatus* and other species).

"At Burlington, Iowa, during July and August, Mr. Paul Bartsch found Goldfinches feeding exclusively upon bull thistle (*Carduus lanceolatus*). He was able to approach within a few feet of several birds while thus engaged, and noticed that the seeds or akenes were bitten off and swallowed, while the plumes or pappus floated away. When there was no wind, the pappus often failed to fly away, and clung to

the birds, almost burying them with down. A dozen of the birds were killed and their gizzards and gullets were found literally crammed with thistle seeds. At Sing Sing, N. Y., Goldfinches have been seen eating the seeds of the Scotch thistle (*Onopordon acanthium*) and boneset (*Eupatorium perfoliatum*). Cone flowers (*Rudbeckia hirta*), prairie sunflowers (*Gaillardia*), evening primroses, catnip, elephant's foot (*Elephantopus* sp.), and mullein also form part of their food, and late in the season they turn their attention to ragweed and consume great quantities of the seeds of this troublesome species. In winter and spring large flocks feed to some extent upon the seeds of conifers and catkin-bearing trees, such as the sycamore and birch. In destroying the seeds of the gray birch (*Betula populifolia*) on the edge of the grass lands they do some good, for this tree has a habit of seeding adjacent pastures, which then grow into a thicket of young saplings." (Beal.)

**Chipping Sparrow** (*Spizella socialis*).—Professor Weed writes of a family of Chipping Sparrows, which he watched on June 22, from 3:40 A. M. to 7:50 P. M.: "During this busy day the parent birds had made almost two hundred visits to the nest, bringing food nearly every time, though some of the trips seemed to be made to furnish grit for the grinding of the food. There was no long interval when they were at work, the longest period between these visits having been twenty-seven minutes. Soft-bodied caterpillars were the most abundant elements of food, but crickets and crane-flies were also seen, and doubtless a great variety of insects were taken."

**Tree Sparrow** (*Spizella monticola*).—"Examination of many stomachs shows that in winter the Tree Sparrow feeds entirely upon seeds of weeds; and probably each bird consumes about one-fourth of an ounce a day. In an article contributed to the New York *Tribune* in 1881 the writer estimated the amount of weed seed annually destroyed by these birds in the State of Iowa. Upon the basis of one-fourth of an ounce eaten daily by each bird, and supposing that the birds averaged ten to each square mile, and that they remain in their winter range two hundred days, we shall have a total of 1,750,000 pounds, or 875 tons, of weed seed consumed by this one species in a single season. Large as these figures may seem, they certainly fall far short of the reality. The estimate of ten birds to a square mile is much within the truth, for the Tree Sparrow is certainly more abundant than this in winter in Massachusetts, where the food supply is less than in the western States, and I have known places in Iowa where several thousand could be seen within the space of a few acres. This estimate, moreover, is for a single species, while, as a matter of fact, there are at least half a dozen birds (not all Sparrows) that habitually feed on these seeds during winter." (Beal.)

**Song Sparrow** (*Melospiza melodia*).—“Taking the food habits of the Song Sparrow as a whole, it will be readily seen that this bird does much more good than harm and is worthy of protection and encouragement. Only two per cent of the food consists of useful insects, while 18 per cent is composed of injurious insects; and grain, largely waste, amounts to 4 per cent, while the seeds of various species of weeds constitute 50 per cent.” (Judd.)

**Rose-breasted Grosbeak** (*Zamelodia ludoviciana*).—“When the Colorado potato beetle first swept over the land, and naturalists and farmers were anxious to discover whether or not there were any enemies which would prey upon the pests, the Grosbeak was almost the only bird seen to eat the beetles. Further observation confirmed the fact, and there can be no reasonable doubt that where the bird is abundant it has contributed very much to the abatement of the pest, which has been noted during the last decade. But this is not the only good the bird does, for many other noxious insects besides the potato beetle are also eaten.

“The vegetable food of the Grosbeak consists of buds and blossoms of forest trees and seeds, but the only damage of which it has been accused is the stealing of green peas. The writer has observed it eating peas and has examined the stomachs of several that had been killed in the very act. The stomachs contained a few peas and enough potato beetles, old and young, as well as other harmful insects, to pay for all the peas the birds would be likely to eat in a whole season. The garden where this took place adjoined a small potato field which earlier in the season had been so badly infested with beetles that vines were completely riddled. The Grosbeaks visited the field every day, and finally brought their fledged young. The young birds stood in a row on the topmost rail of a fence and were fed with the beetles which their parents gathered. When a careful inspection was made a few days later, not a beetle, old or young, could be found; the birds had swept them from the field and saved the potatoes.” (Beal.)

**English Sparrow : House Sparrow** (*Passer domesticus*).—The economic status of the English Sparrow has been more discussed than that of any other bird. There is no doubt, however, that the Sparrow is an undesirable bird. While the grounds for objection to its presence in the city may be limited to its noisiness and filth-producing habits, in the country more serious reasons for condemning it as undesirable can be given. It is not only destructive to fruit and grain, but it occupies feeding places formerly inhabited by native, and, economically, more desirable birds. It does not follow that through pure aggressiveness the Sparrow expels from their homes our Wrens, Bluebirds, Swallows and Martins. The Sparrow's success in replacing these birds is due primarily to its non-migratory habits. Permanently

resident at or near one place it takes possession of the available nesting sites before our migratory native birds return from the south, and once established the Sparrow is a difficult bird to dislodge. Surprisingly fecund, it begins to breed in March, at the first indication of warm weather, and has been known to rear six broods in a season. At this rate it has been estimated\* that should the progeny of one pair of Sparrows all live and breed, at the end of ten years they would amount to 275,716,983,698 Sparrows.

The growing use of self-propelling vehicles in our cities increases the seriousness of the Sparrow question. Within a few decades it is probable that comparatively few horses will be used in our larger towns and cities. There has been a decrease of over 8,000 horses, or about 11 per cent, in the horse population of New York City in the past six years.

As the horses diminish in numbers there will be a corresponding diminution in the food supply of the Sparrows. Eventually they will exist in our cities, except in the parks, only in small numbers.

We cannot hope that this loss of food will be followed by the death of what will gradually become the surplus Sparrow population; but, in view of the Sparrow's proved ability to adapt himself to widely-varying conditions, we must believe that when the city fails to yield him a living he will spread into the surrounding country. There he will be brought into direct competition with our native species, with what result it is not difficult to predict.

The extermination of the Sparrow in this country is believed to be an impossibility; but it probably can be kept in check by persistent and continuous effort under the direction of the State; and, in the opinion of the writer, the subject is of sufficient importance to warrant prompt action on the part of the State.

### TANAGERS. Family Tanagridæ.

**Scarlet Tanager** (*Piranga erythromelas*).—“Of twenty-nine specimens examined, one had eaten ants; three, three ichneumon flies, two of them *Thalassa lunator*?, the other a small species having an extent of wing of one-tenth of an inch; eight, twenty-six caterpillars; three, six diptera, three of them tipulids; seventeen, forty-seven beetles; three, six hemipterous insects; four, seven grasshoppers; one, a small dragon-fly; one, a very large spider; and two, ten harvest-men. Curculios, elaters, and leaf-chaffers, some of them three-fourths of an inch long, were repre-

\*The English Sparrow in North America. Bull. I, Div. Economic Ornithology and Mammalogy, U. S. Dept. of Agriculture, p. 29.



UPPER FIGURE, CEDAR WAXWING  
LOWER FIGURE, RED-EYED VIREO  
ABOUT  $\frac{2}{3}$  NATURAL SIZE.



sented among the beetles. From the stomachs of three young birds less than a week old were taken four caterpillars, one fly, one small grasshopper, one hemipterous insect, together with undetermined fragments." (King.)

#### SWALLOWS. Family Hirundinidæ.

"Field observation will convince any ordinarily attentive person that the food of Swallows must consist of small insects captured in mid-air, or perhaps in some cases picked from the tops of tall grass or weeds. This observation is borne out by an examination of stomachs, which shows that the food consists of many small species of beetles which are much on the wing; many species of diptera (mosquitoes and their allies), with large quantities of flying ants and a few insects of similar kinds. Most of them are either injurious or annoying, and the numbers destroyed by Swallows are not only beyond calculation, but almost beyond imagination.

"It is a mistake to tear down the nests of a colony of Cliff Swallows from the eaves of a barn, for, so far from disfiguring a building, the nests make a picturesque addition, and their presence should be encouraged by every device. It is said that Cliff and Barn Swallows can be induced to build their nests in a particular locality, otherwise suitable, by providing a quantity of mud to be used as mortar. Barn Swallows may also be encouraged by cutting a small hole in the gable of the barn, while Martins and White-bellied Swallows will be grateful for boxes, like those for the Bluebird, but placed in some higher situation." (Beal.)

#### WAXWINGS. Family Ampelidæ.

**Cedar Waxwing : Cherry Bird** (*Ampelis cedrorum*).—"The Cedar Waxwing, or Cherry Bird, inhabits the whole of the United States, but is much less common in the west. Although the great bulk of the species retires southward in winter the bird is occasionally found in every State during the colder months, especially if wild berries are abundant. Its proverbial fondness for cherries has given rise to its popular name, and much complaint has been made on account of the fruit eaten. Observation has shown, however, that its depredations are confined to the trees on which the fruit ripens earliest, while later varieties are comparatively untouched, this probably owing to the fact that when wild fruits ripen they are preferred to cherries, and constitute the bulk of the Cedar Bird's diet.

"In 152 stomachs examined animal matter formed only 13 and vegetable 87 per cent, showing that the bird is not wholly a fruit eater. With the exception of a

few snails, all the animal food consists of insects, mainly beetles—and all but one more or less noxious, the famous elm-leaf beetle being among the number. Bark or scale lice were found in several stomachs, while the remainder of the animal food was made up of grasshoppers, bugs and the like. Three nestlings were found to have been fed almost entirely on insects.

“Of the 87 per cent of vegetable food, 74 consisted entirely of wild fruit or seeds and 13 of cultivated fruit, but a large part of the latter was made up of blackberries and raspberries, and it is very doubtful whether they represent cultivated varieties. Cherry stealing is the chief complaint against this bird, but of the 152 stomachs only 9, all taken in June and July, contained any remains of cultivated cherries, and these aggregate but 5 per cent of the year's food. As 41 stomachs were collected in those months, it is evident that the birds do not live to any great extent on cultivated cherries.” (Beal.)

“The Cedar Bird eats caterpillars, spiders, and grasshoppers, but does most good in destroying the elm-leaf beetle that strips our village and city trees of leaves. Mrs. Mary Treat writes of one town in which elms had been ruined for several years before the Cedar Birds came and which were afterward comparatively free from beetles. From one calculation, it is shown that 30 Cedar Birds would destroy 9,000 worms during the month when the cutworm caterpillar is exposed.” (Bailey.)

### SHRIKES. Family Laniidæ.

Two species of this family are found in New York. One, the Northern Shrike or Butcherbird, comes in late fall and passes the winter when it feeds largely on small birds. The other, the Loggerhead, comes in the summer and appears to be gradually increasing. It feeds largely on grasshoppers and should be protected.

**Butcherbird: Great Northern Shrike** (*Lanius borealis*).—The Northern Shrike is a predaceous species, preying on insects, meadow mice, and birds. While with us it feeds largely on the two latter, Dr. Judd reporting that during December, January, and February, 55 per cent of its food is birds, while 22 per cent is mammals. In New York State, therefore, it cannot be considered, on the whole, a beneficial species.

**Loggerhead Shrike** (*Lanius ludovicianus*).—The Loggerhead is with us during the summer when its food consists largely of grasshoppers. Dr. Judd remarks that the Loggerhead's beneficial qualities outweigh 4 to 1 its injurious ones.

**VIREOS. Family Vireonidæ.**

Vireos are gleaners, searching the foliage carefully for leaf-eating insects and their eggs; peering beneath the leaves, and examining crevices in the bark for forms of insect-life which are especially injurious. Several of the Vireos are abundant and the service they render is correspondingly important.

**Red-eyed Vireo** (*Vireo olivaceus*).—"From the stomachs of eighteen of this species were taken fifteen caterpillars, five other larvæ; eight beetles—among them five weevils, one longhorn and darkling beetle, seventy heteropterous insects—among them sixty-seven chinch-bugs; sixteen winged ants, one ichneumon (?), five dragon-flies, two dipterous insects—one of them *Tabanus atratus*; and seven dogwood berries. Of thirty-six other specimens examined, fifteen had eaten caterpillars; two other, larvæ; nine beetles—among them two *Coccinella mali*; three, grasshoppers; two, ants; two, moths; four, insects, none of which were identified; and seven, fruits or seeds, among which were raspberries, dogwood berries, berries of prickly ash and sheep berries." (King.)

**Yellow-throated Vireo** (*Vireo flavifrons*).—"Of twenty-one specimens examined, seven had eaten caterpillars—among them geometers; seven beetles—among them weevils and a buprestis; three, grasshoppers; two, moths; two, heteropterous insects—among them leaf-hoppers; three, dipterous insects." (King.)

**Warbling Vireo** (*Vireo gilvus*).—"Of sixteen specimens examined, eight had eaten thirty-four caterpillars; two, five beetles, among which were a lady-bird (*Coccinilla G—notata*), and a *Diabrotica duodecim-punctata*; three, three heteropterous insects; two, two crane-flies; one, grasshoppers; two, twenty-eight insects' eggs; and one, dogwood berries." (King.)

**WARBLERS. Family Mniotiltidæ.**

With few exceptions the members of this large family, containing many abundant species, feed exclusively upon insects.

**Black and White Warbler** (*Mniotilta varia*).—"Owing to the small size of these birds, they find it profitable to feed extensively upon very small insects. For this reason they are able to do a work for which the Nuthatches and Woodpeckers are not so well fitted. It is, therefore, especially desirable that they should attain a greater abundance with us.

"Food: Of seventeen specimens examined, three had eaten five ants; two, twenty-one caterpillars, twenty of which were small measuring-worms; three, four moths; three, five diptera; six, sixteen beetles, one of which was a curculio; two,

seven heteroptera; one, a caddis-fly; and one a small snail (Physa). Two had eaten one hundred and one insects' eggs, but these, I believe, were contained in the insects which the birds had eaten." (King.)

**Redstart** (*Setophaga ruticilla*).—"Its broad-based bill, and strong depending rictals, giving to the mouth, when open, the shape of a wide funnel, its keen vision, and its whole aerial outfit are adjusted to the gall-flies, leaf-miners, and other diminutive insects among which it lives, and upon which, I have no doubt, it feeds. Could it be induced to live in orchards, vineyards, gardens and parks, it would there perform a work which the Pewee, the Least Flycatcher and the Kingbird cannot. Mr. Samuels says he has known a pair to build, and rear a brood, in a garden within five rods from a house.

"Food: From the contents of eleven stomachs, examined collectively, were taken fourteen small beetles, some of them .09 of an inch long; four very small moths, four small hymenopterous insects, one an ichneumon, and one, one of the Proctretypidæ? .1 of an inch long; one heteropterous insect .08 of an inch long, and a large number of dipterous insects, the majority of them less than one-tenth of an inch long. Three others had in their stomachs a single small larva each." (King.)

#### PIPITS and WAGTAILS. Family Motacillidæ.

**American Pipits: Titlark** (*Anthus pensilvanicus*).—No extended study of the food habits of this species appears to have been made. It is asserted, however, by various authors to feed on beetles, spiders, seeds in the fields, and along shore on minute shells, shrimps, etc.

#### WRENS and THRASHERS. Family Troglodytidæ.

**House Wren** (*Troglodytes ædon*).—"As regards food habits, the House Wren is entirely beneficial. Practically, he can be said to live upon animal food only, for an examination of 52 stomachs showed that 98 per cent of the stomach contents was made up of insects or their allies, and only 2 per cent was vegetable, including bits of grass and similar matter, evidently taken by accident with the insects. Half of this food consisted of grasshoppers and beetles; the remainder of caterpillars, bugs, and spiders. As the House Wren is a prolific breeder, frequently rearing from twelve to sixteen young in a season, a family of these birds must cause considerable reduction in the number of insects in a garden. Wrens are industrious foragers, searching every tree, shrub, or vine for caterpillars, examining every post and rail of



UPPER FIGURE, BLACK AND WHITE WARBLER  
LOWER FIGURE, AMERICAN REDSTART  
ABOUT NATURAL SIZE.



the fence, and every cranny in the wall for insects or spiders. They do not as a rule, fly far afield, but work industriously in the immediate vicinity of their nests. In this way they become valuable aids in the garden or orchard, and by providing suitable nesting boxes they may be induced to take up residence where their services will do most good. Their eccentricities in the selection of a home are well known. Almost anything from an old cigar box to a tomato can, an old teapot, a worn boot, or a horse's skull, is acceptable, provided it be placed well up from the ground and out of reach of cats and other prowlers." (Beal.)

**Brown Thrasher** (*Toxostoma rufum*).—“The food of the Brown Thrasher consists of both fruit and insects. An examination of 121 stomachs showed 36 per cent of vegetable and 64 of animal food, practically all insects, and mostly taken in spring before fruit is ripe. Half the insects were beetles, and the remainder chiefly grasshoppers, caterpillars, bugs, and spiders. A few predaceous beetles were eaten, but, on the whole, its work as an insect destroyer may be considered beneficial.

“Eight per cent of the food is made up of fruits like raspberries and currants which are or may be cultivated, but the raspberries at least are as likely to belong to wild as to cultivated varieties. Grain, made up mostly of scattered kernels of oats and corn, is merely a trifle, amounting to only 3 per cent, and though some of the corn may be taken from newly planted fields, it is amply paid for by the May beetles which are eaten at the same time. The rest of the food consists of wild fruit or seeds. Taken all in all, the Brown Thrasher is a useful bird, and probably does just as good work in its secluded retreats as it would about the garden, for the swamps and groves are no doubt the breeding grounds of many insects that migrate thence to attack the farmers' crops.” (Beal.)

**Catbird** (*Galeoscoptes carolinensis*).—Professor Beal states that “cultivated fruits can be protected from Catbirds by the simple expedient of planting wild species or others which are preferred by the birds. Some experiments with Catbirds in captivity showed that the Russian mulberry was preferred to any cultivated fruit that could be offered”.

He adds: “The stomachs of 213 Catbirds were examined and found to contain 44 per cent of animal (insect) and 56 per cent of vegetable food. Ants, beetles caterpillars, and grasshoppers constitute three-fourths of the animal food, the remainder being made up of bugs, miscellaneous insects and spiders. One-third of the vegetable food consists of cultivated fruits, or those which may be cultivated, such as strawberries, raspberries, and blackberries; but while we debit the bird with the whole of this, it is probable—and in the eastern and well-wooded part of the country almost certain—that a large part was obtained from wild vines. The rest

of the vegetable matter is mostly wild fruit, such as cherries, dogwood, sour gum, elder berries, greenbrier, spice berries, black alder, sumac, and poison ivy.

“Although the Catbird sometimes does considerable harm by destroying small fruit, the bird cannot be considered injurious. On the contrary, in most parts of the country it does far more good than harm, and the evil it does can be reduced appreciably by the methods already pointed out.”

#### CREEPERS. Family Certhiidae.

**Brown Creeper** (*Certhia familiaris*).—Probably few birds are more wholly beneficial than this persistent hunter after insects and other eggs. With an apparently never-satisfied hunger for the smaller forms of insect life that live in the crevices of the bark of trees, it searches the tree trunks from daylight until dark, and if the service it renders daily could be expressed in figures we should doubtless find that, individually, the Brown Creeper was among our most valuable birds.

#### NUTHATCHES AND CHICKADEES. Family Paridae.

The members of this family feed largely on the eggs of beetles, plant lice, and other forms injurious to vegetation.

**White-breasted Nuthatch** (*Sitta carolinensis*).—“Of thirty-five specimens examined, fourteen had eaten thirty-two beetles — among which were three elaters, one longhorn and a lady-bug (?); one, two ants; one, two caterpillars; one, two grubs of a beetle; one, a spider; one, a chrysalis; one, small toad-stools; five, acorns; and one, corn.” (King.)

**Chickadee** (*Parus atricapillus*).—The following facts in relation to the food of the Chickadee are taken from Mr. Forbush’s study of this species in Massachusetts, previously referred to:

“To determine how many eggs a single Chickadee would eat, a few birds were killed and their stomach contents examined, with surprising results. There was no difficulty in identifying the eggs of the canker-worm moth which were found in the bird’s stomach, as a great portion of the shells remained intact. The other insect contents of the stomach were identified for me through the kindness of Mr. A. H. Kirkland, B. Sc., assistant entomologist of the State Board of Agriculture, who made the examinations. Although it was impossible in all cases to learn with certainty the species to which certain insects belonged, it was evident they belonged to genera known to be of injurious habits.

“I take the following from Mr. Bailey’s notes:



UPPER FIGURE, CHICKADEE (*PARUS ATRICAPILLUS*)  
LOWER FIGURE, WHITE-BREASTED NUTHATCH (*SITTA CAROLINENSIS*)  
ABOUT  $\frac{5}{8}$  NATURAL SIZE.



“Number of Eggs of the Fall Canker-worm Found in the Stomachs of Chickadees.

	EGGS.
No. 1, - - - - -	273
2, - - - - -	261
3, - - - - -	216
4, - - - - -	278

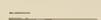
making in all 1,028 eggs found in the stomachs of four birds. Four birds killed later in the season had eaten the female imagos of the spring canker-worm (*Palca-crita vernata*), as follows:

	MOTHS.
“No. 1, - - - - -	41
2, - - - - -	18
3, - - - - -	27
4, - - - - -	19

making a total of 105. In Nos. 2, 3 and 4 of the last table there were a large number of eggs also. It is safe to say that there were 150 eggs in each stomach, in addition to the female moths eaten.

“Mr. Bailey carefully counted the eggs in the ovaries of twenty of these female moths, with the following result:

No. 1, - - - - -	158
2, - - - - -	272
3, - - - - -	127
4, - - - - -	184
5, - - - - -	213
6, - - - - -	135
7, - - - - -	140
8, - - - - -	220
9, - - - - -	200
10, - - - - -	130
11, - - - - -	111
12, - - - - -	160
13, - - - - -	193
14, - - - - -	131
15, - - - - -	281
16, - - - - -	242
17, - - - - -	116
18, - - - - -	281
19, - - - - -	192
20, - - - - -	217



“It will be seen from this table that the average number of eggs found in each moth is 185. Mr. Bailey is very positive, from his continuous field observations, that each Chickadee will devour on the average 30 female canker-worm moths per day from the 20th of March until the 15th of April, provided these insects are plentiful. If the average number of eggs laid by each female is 185, one Chickadee would thus destroy in one day 5,550 eggs; and in the twenty-five days the canker-worm moths ‘run’ or crawl up the trees, 138,750. It may be thought that this computation is excessive, and it is probable that some of the moths were not captured until they had laid some of their eggs, but the Chickadees are also busy eating these eggs. \* \* \* When we consider further that 41 of these insects, distended as they were with eggs, were found at one time in the stomach of one Chickadee, and that the digestion of the bird is so rapid that its stomach was probably filled several times daily, the estimate made by Mr. Bailey seems a very conservative one. He now regards the Chickadee as the best friend the farmer has, for the reason that it is with him all the year, and there is no bird that can compare with it in destroying the female moths and their eggs.” (Forbush.)

#### KINGLETS, GNATCATCHERS, ETC. Family Sylviidæ.

The small size of Kinglets combined with their great activity permits them to explore the terminal buds more easily than larger birds could, and they therefore occupy an important position in the army of bird tree protectors.

**Rusty-crowned Kinglet** (*Regulus calendula*).—“Of seven specimens examined, two had eaten four small caterpillars; three, five beetles; one, an ant; one, a chalcis-fly, and two bits of insects not identified.” (King.)

**Golden-crowned Kinglet** (*Regulus satrapa*).—“Of nine specimens examined two had eaten twelve small diptera; three, nine small beetles; one, four caterpillars; one, a small chrysalis, and three, very small bits of insects, too fine to be identified.” (King.)

#### THRUSHES, BLUEBIRDS, ETC. Family Turdidæ.

**Robin** (*Merula migratoria*).—“The Robin builds its nest in orchards and gardens, and occasionally takes advantage of a nook about the house, or under the shelter of the roof of a shed or outbuilding. Its food habits have sometimes caused apprehension to the fruit grower, for it is fond of cherries and other small fruits, particularly the earlier varieties. For this reason many complaints have been lodged against it, and some persons have gone so far as to condemn the bird. The



UPPER FIGURE, GOLDEN-CROWNED KINGLET  
LOWER FIGURE, RUBY-CROWNED KINGLET  
LEFT-HAND FIGURE, BROWN CREEPER  
NATURAL SIZE



Robin is, however, too valuable to be exterminated, and choice fruit can be readily protected from its depredations.

“An examination of 330 stomachs shows that over 42 per cent of its food is animal matter, principally insects, while the remainder is made up largely of small fruits or berries. Over 19 per cent consists of beetles, about one-third of which are useful ground beetles, taken mostly in spring and fall, when other insects are scarce. Grasshoppers make up about one-tenth of the whole food, but in August comprise over 30 per cent. Caterpillars form 6 per cent, while the rest of the animal food, about 7 per cent, is made up of various insects, with a few spiders, snails, and angle-worms. All the grasshoppers, caterpillars, and bugs, with a large portion of the beetles, are injurious, and it is safe to say that noxious insects comprise more than one-third of the Robin's food.

“Vegetable food forms nearly 58 per cent of the stomach contents, over 47 being wild fruits, and only little more than 4 per cent being possibly cultivated varieties. Cultivated fruit amounting to about 25 per cent was found in the stomachs in June and July, but only a trifle in August. Wild fruit, on the contrary, is eaten every month, and constitutes a staple food during half the year. No less than forty-one species were identified in the stomachs; of these, the most important were four species of dogwood, three of wild cherries, three of wild grapes, four of greenbrier, two of holly, two of elder; and cranberries, huckleberries, blueberries, barberries, service berries, hackberries, and persimmons, with four species of sumac, and various other seeds not strictly fruit.

“The depredations of the Robin seem to be confined to the smaller and earlier fruits, and few, if any, complaints have been made against it on the score of eating apples, peaches, pears, grapes, or even late cherries. By the time these are ripe the forests and hedges are teeming with wild fruits, which the bird evidently finds more to its taste. The cherry, unfortunately, ripens so early that it is almost the only fruit accessible at a time when the bird's appetite has been sharpened by a long-continued diet of insects, earth-worms, and dried berries, and it is no wonder that at first the rich juicy morsels are greedily eaten. In view of the fact that the Robin takes ten times as much wild fruit as cultivated fruit, it seems unwise to destroy the birds to save so little. Nor is this necessary, for by a little care both may be preserved. Where much fruit is grown it is no great loss to give up one tree to the birds; and in some cases the crop can be protected by scarecrows. Where wild fruit is not abundant, a few fruit-bearing shrubs and vines judiciously planted will serve for an ornament and provide food for the birds. The Russian mulberry is a vigorous grower and a profuse bearer, ripening at the same time as the cherry, and,

so far as observation has gone, most birds seem to prefer its fruit to any other. It is believed that a number of these planted around the garden or orchard would fully protect the more valuable fruits." (Beal.)

**Wood Thrush** (*Hylocichla mustelina*).— Professor Forbes writes after examining the contents of twenty-two birds of this species: "Seventy-one per cent of their food consisted of insects and twenty per cent of fruit, a small ratio of spiders and mollusks, and an unusually large percentage of Myriopoda making up the remainder." After discussing in detail the bird's economic relations the same author adds: "Its advances, therefore, are to be cordially encouraged by the gardener and farmer—a fact which must be especially agreeable to every lover of bird music, who has learned to recognize the full, clear, rich, exquisite strains of this songster."

**Hermit Thrush** (*Hylocichla guttata pallasii*).— Of the food contents of the stomachs of twenty-one Hermit Thrushes Professor Forbes writes: "Eighty-four per cent of the food consisted of insects, four per cent of spiders, and twelve per cent of thousand-legs. Ants amounted to fifteen per cent, Lepidoptera to nineteen per cent, including a few Phalænidæ, and Diptera only to three—chiefly the larvæ of Bibio. Coleoptera make thirty per cent of the carabidæ."

**Bluebird** (*Sialia sialis*).—"So far as known, this bird has not been accused of stealing fruit or of preying upon any crops. An examination of 205 stomachs showed that 76 per cent of the food consists of insects and their allies, while the other 24 per cent is made up of various vegetable substances, found mostly in stomachs taken in winter. Beetles constitute 28 per cent of the whole food, grasshoppers 22, caterpillars 11, and various insects, including quite a number of spiders, comprise the remainder of insect diet. All are more or less harmful, except a few predaceous beetles, which amount to 8 per cent, but in view of the large consumption of grasshoppers and caterpillars, we can at least condone this offense, if such it may be called. The destruction of grasshoppers is very noticeable in the months of August and September, when these insects form more than 60 per cent of the diet.

"It is evident that in the selection of its food the Bluebird is governed by abundance rather than by choice. Predaceous beetles are eaten in spring, as they are among the first insects to appear; but in early summer caterpillars form an important part of the diet, and are replaced a little later by grasshoppers. Beetles are eaten at all times, except when grasshoppers are more easily obtained.

"So far as its vegetable food is concerned, the Bluebird is positively harmless. The only trace of any useful product in the stomachs consisted of a few blackberry seeds, and even these more probably belonged to wild than cultivated varieties. Following is a list of the various seeds which were found: Blackberry, chokeberry,



UPPER FIGURE, WOOD THRUSH  
LOWER FIGURE, HERMIT THRUSH  
ABOUT  $\frac{2}{3}$  NATURAL SIZE.



juniperberry, pokeberry, partridge berry, greenbrier, Virginia creeper, bittersweet, holly-strawberry bush, false spikenard, wild sarsaparilla, sumac (several species), rose haws, sorrel, ragweed, grass, and asparagus. This list shows how little the Bluebird depends upon the farm or garden to supply its needs, and indicates that by encouraging the growth of some of these plants, many of which are highly ornamental, the bird can be induced to make its home on the premises." (Beal.)

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# Tree Planting on Streets and Highways.

BY WILLIAM F. FOX.

**T**REE PLANTING is one of the best expressions of altruism. The man who plants trees is thinking of others rather than himself. He enables people to gratify their love of the beautiful, to enjoy better health, to become more prosperous; he makes the world better and happier.

Trees purify and cool the air, increase the value of surrounding property, and are pleasing to the eye. They should be placed along the highways, on our village and city streets, on lawns and in parks, on schoolhouse grounds, on the farm, in the dooryard, and wherever shade or shelter may be needed. Planted in commemoration of persons or events, they become living monuments that endure when the inscriptions on the yellow, moss-covered marbles of the churchyard are no longer legible.

## Highway Planting.

Trees should be set out along every road for shade. In addition, the farm lanes can be lined advantageously with fruit or nut-bearing trees that will bring money to their owner and add to the attractive appearance of his surroundings. Objections may be made in some localities to placing trees along a public road, because their shade would tend to make it wet and muddy. If such conditions exist, the fault is in the road, and not in the trees; there are some very muddy highways along which nothing has been planted. Although a row of trees may retard somewhat the evaporation of moisture at the surface of the roadbed, at the same time they drain its foundation by the rapid absorption of water through their roots. When a roadbed is properly constructed, drained and ditched, the trees will do no harm; on the contrary, they will furnish a grateful shade to the traveler, and prevent dust without creating mud.

There are roads along which no trees are allowed, because some resident argues that the sun is needed to dry up the mud and sloughs which in spring make traveling slow and difficult. But in summer the sun-baked mud is pulverized under the wagon wheels, creating clouds of dust that are worse than the mud. With a well-built highway, shaded by trees, both of these nuisances would be avoided. Even a

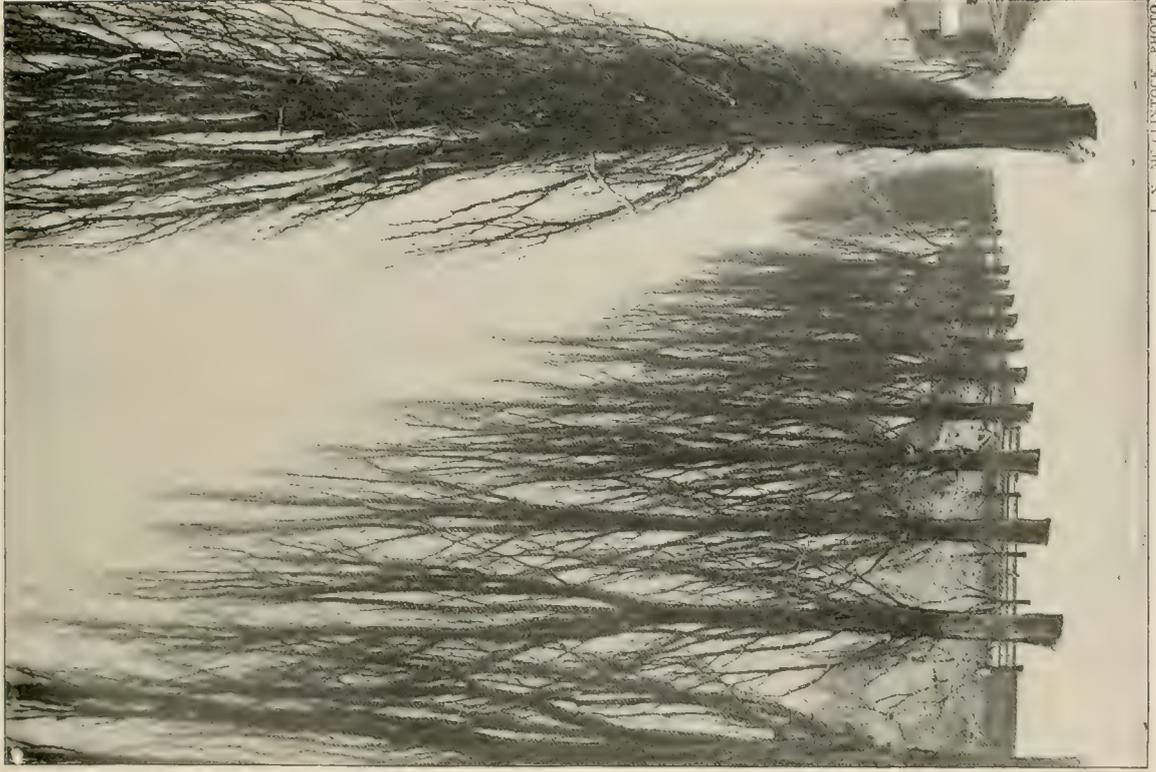
poor road will permit of one row of trees, which should be placed on the south or west side, as its direction may require, to temper the heat of the afternoon sun.

One of the finest, smoothest roads in the State may be found in the Adirondack forest—from St. Hubert's Inn to the Ausable Lakes—; and yet it is well shaded by trees that meet overhead, shutting out the sun except where the road is flecked with light that streams through the small openings in the leafy cover. But this road was constructed in proper shape, and of suitable material.

Some States—noticeably New York and Massachusetts—have made large appropriations recently for good roads, and these annual expenditures will not only be continued but will probably be increased. With the money thus provided long lines of stone highways with perfectly drained roadbeds have been constructed, and with each succeeding year many more miles will be finished. We are entering on an era of good roads. But the good work of the road-builders will not be complete until trees are planted at proper distances on each side of the highway. In his Annual Report for 1901, Hon. Edward A. Bond, State Engineer and Surveyor (New York), states that the actual cost of 134 miles of stone macadam roads was \$7,955 per mile. Now it takes 196 trees to plant each side of a highway for one mile; and the cost of the planting will be less than two per cent of that of the road construction. Having expended over \$7,000 on the roadbed, there surely should be no objection to paying \$150 more in order to have a cool, shady driveway. Of course, "dirt" roads have been constructed in some localities under the Good Roads Law at a much less cost per mile; but the argument still holds good, in that the work will not be complete until the trees are planted. Why not amend the law so as to include the tree planting?

### Highway Law.

The law of 1869, which is still in force, provides that any inhabitant liable to highway tax who shall plant by the side of a public road "any forest shade trees or fruit trees" shall be allowed in abatement of his highway tax one dollar for every four trees set out. Similar laws for the reduction of road taxes, or for the payment of a bounty, have been enacted in other States—Massachusetts, Connecticut and Pennsylvania. In New York the law specifies that Elms must be planted, at least seventy feet apart; that Maples "or other forest trees" shall not be set nearer than fifty feet, except Locusts, which may be set at intervals of thirty feet. Fruit trees must be planted at least fifty feet apart. Proper penalties are prescribed for any one who shall injure a tree, or who shall hitch a horse or any animal to, or leave the same standing near enough to injure a tree used for shade or ornament, at



J. V. MCCLINTOCK, PHOTO.

POPLAR STREET, ROCHESTER, N. Y.



HARD MAPLES.

COUNTRY ROAD NEAR JEFFERSONVILLE, VT.



“any schoolhouse, church, or public building, or along any public highway.” The kinds of trees mentioned in the law referred to are well adapted to highway planting; and the distances apart at which they must be set are based on the space which each species is known to occupy. While the distances specified in the State law are correct as regards highway planting, shorter intervals may be used in cities, where trees seldom attain a height and spread equal to that of the same species when grown in the open country.

### Selection of Trees.

Nothing has been found that will equal our American Elm and Hard Maple for wide roads and double rows. As our Elms often attain a spread of one hundred feet it is evident that the seventy feet demanded in the law is none too wide a space. The trees should be allowed to assume their full size and natural shape without crowding or interfering with each other. Transplanted, or “second growth,” Hard Maples along a country road attain a large size and beautiful appearance, which require all of a fifty-foot space. Other species — Oaks, Basswood, White Ash, Locust, Willow, Horse Chestnut, Black Cherry, Buttonball, Beech and the two Soft Maples — can be used with good results in order to obtain variety. By planting the Scarlet Oak, Red Maple and Pepperidge, the brilliancy of the autumn coloring can be enhanced by the bright reds displayed by the leaves of these species.

In some localities the Elms have been killed or seriously injured by insects; and these pests have wrought a widespread destruction recently among the maples in the Adirondack and Catskill forests, and in village streets. The Horse Chestnuts also have been defoliated; and it may be that other species will be injured in time. While it is difficult to check the ravages of insects when large forest areas are attacked, this evil can be controlled, if not prevented, where the trees along our highways and streets are endangered, as shown by the successful use of spraying apparatus or other remedies. The planting of any particular species should not be discontinued merely because the trees may be attacked at some future time by insects. The good work should go on, and if, in years to come, there should be a recurrence of this evil we can safely trust to the remedies prescribed by our entomologists for the prevention or abatement of the pest.

There are some forest trees which are not adapted to roadside planting, because they assume a different form when grown in the open, the branches growing lower down and the trunk failing to reach its usual height, although it may attain a large diameter. For this reason, the Birches, especially the Yellow Birch, are not desirable for streets or roadside use.

Nut-bearing trees, the Chestnut, Butternut, and Hickories, are available for highway planting. They are handsome, large trees, each species having peculiarities of habit that make it worth the notice of an observant traveler, particularly in winter, when the pleasing arrangement of their limbs can be better seen and studied. Their branches may suffer to some extent from boys in quest of nuts; but that is liable to happen wherever these trees may stand. In some European countries the roads are lined with fruit trees. But there it is well understood that the fruit, though it overhangs the highways, belongs to the farmer, whose property is respected accordingly. In this country, where widely different ideas prevail, it might be necessary to concede the traveler's claim in case fruit trees were planted along or within the "right of way."

### Street Planting.

There are many reasons why trees should be planted in cities and villages. During the hot days of summer the streets which are shaded by trees are preferred to those which lack this protection. The temperature is much lower; and as the pavements are not exposed to the glare of the sun, there is less of reflected heat. The streets that are lined with shade trees are more attractive to the eye; and their superiority is readily apparent when compared with those on which there are no trees. The shaded streets being cooler they are more desirable for residences, and, other things being equal, property is more valuable and commands higher rents. The air is purer by reason of the foliage, which inhales carbonic acid and exhales oxygen. The leaves absorb the poisonous gases generated in hot weather by the decomposition of animal and vegetable matter, and thus an active source of disease is eliminated. During hot summer days the diseases incidental to that season are not so prevalent in streets and localities which are protected from the heat of the sun by large overhanging trees.\* At a meeting of the New York Medical Society a resolution was passed in which the opinion was expressed that "one of the most effective means for mitigating the intense heat of the summer months, and diminishing the death rate among children, is the cultivation of an adequate number of trees in the streets."

The city of Washington is justly known as one of the most beautiful cities in America on account of the seventy thousand trees that adorn its streets; and there are many New England towns famed for their attractive appearance, due largely to

\* See "Vegetation a Remedy for the Summer Heat of Cities." By Stephen Smith, M. D., LL. D. Appleton's Popular Science Monthly, February, 1899.



A. G. VARELA, PHOTO.

GINKGOS.—AVENUE LEADING TO DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.



THE ELMS OF LENOX.



the beautiful trees planted by village improvement societies. It is said that Paris has 80,000 shade trees, and that \$60,000 are expended annually in caring for them and planting additional ones. Both Washington and Paris have nurseries in which seedlings of desirable species are propagated with special reference to the requirements of street planting. Poorly developed plants or saplings are discarded, and only the straight, thrifty ones are selected for use on the city streets.

In street planting care should be exercised to select species which, when fully grown, will be of a size suitable to the width of the street; and in making a choice only such should be selected as are best adapted to the peculiar conditions which influence their growth in cities. Some trees that can be safely used for road planting in the country are too susceptible to the deleterious influences of the smoke, dust, gas, and pavement of our towns.

Along country roads or village streets, saplings transplanted from some neighboring grove or forest may be set out; but for city streets nursery stock alone should be used. In fact, it would be better to buy nursery trees for village planting also, unless compelled to use the other for economical reasons. If one must go to the forest for young trees, pains should be taken to obtain as straight, thrifty and perfect specimens as possible.

### Selection of Species.

In making a choice the first thing to be considered is the width of the street; also, the width of the sidewalk or nearness of the houses. Some trees, the Elm for instance, will injure the foundation walls of a house by the pressure from its far-spreading roots. Where the house stands near the curb, trees with a tap root are preferable.

The following list includes all, or nearly all, the species which are desirable for street planting, most of which are quite common throughout New England and the Middle States. They are named in the order of their desirability, although in some instances their preferment is somewhat a matter of taste, concerning which any discussion would be a waste of time.

#### *Wide streets.*

American or White Elm.  
Hard or Sugar Maple.  
Tulip Tree.  
Basswood (Linden).  
Horse Chestnut.

#### *Narrow streets.*

Norway Maple.  
White or Silver Maple.  
Red Maple.  
Ailanthus.  
Cucumber Tree.

Sweet Gum.	Ginkgo.
Sycamore (Buttonball).	Bay Willow.
White Ash.	Pin Oak.
Scarlet Oak.	Red Flowering Horse Chestnut.
Red Oak.	Black or Yellow Locust.
White Oak.	Hackberry.
Honey Locust.	Hardy Catalpa ( <i>speciosa</i> ).
American Chestnut.	Lombardy Poplar.

In any attempt to secure a comprehensive variety it should be remembered that, including the conifers, there are over five hundred native species in the United States and Canada, and that there are over ninety in the Middle and New England States. Many of these are used in forestry work, but are not adapted to streets and highways; and many others are desirable for lawns or parks but nowhere else.

The Elm stands first on the list by right of its superior size, beauty, and adaptability to street planting. It is rapid in growth, withstands transplanting and pruning better than most other kinds, and will grow on almost any soil. Its habit is such that any pruning of the lower limbs is seldom necessary, a valuable feature in a street tree. It thrives not only on country roads and village streets, but also in our larger towns. New Haven has attained national fame as the "Elm City," on account of the many beautiful trees of this kind which line its streets. There are various forms of the American Elm. Emerson, in his "Trees of Massachusetts," describes three distinct shapes. The most desirable one for a shade tree is that with the umbrella-shaped top, and slender, pendant branches on its outer edge. In transplanting or in giving orders to a nursery, care should be taken to secure this particular form. The English and Scotch Elms have been planted extensively in some places; but as these species are inferior in appearance and much more liable to attack from insects their use should be discouraged. The English Elm retains its foliage longer each fall, but that is all that can be said in its favor; in fact, all the species introduced from Europe hold their leaves when most of our native trees are bare.

The Hard Maple or Sugar Maple is so well and favorably known as a shade tree that it is unnecessary to dwell here upon its beauty and symmetrical proportions. It is seen at its best in village streets and along country roads, where the conditions are better suited to its fullest development. In the crowded streets of large towns this species, in some places, has been unable to withstand the effects of smoke, dust and other unfavorable conditions. But it can be planted with good results on streets where the houses stand on large lots, with plenty of ground or wide lawns

around them. On city blocks, where the houses are in solid rows, preference should be given to the Norway Maple, a nursery tree which resembles the native Hard Maple closely, although not so large. The Norway puts on its leaves earlier in spring, and retains its verdure later in the fall. The varied and brilliant autumnal colors displayed by the leaves of our native Hard Maple make this species desirable for ornament as well as shade. No other tree combines so many shades of color in the fall—scarlet, orange, yellow, and green. These different hues may be seen on one tree, often on one branch, and sometimes on one leaf.

The Tulip Tree will compare favorably with the Hard Maple in height and beauty. In favored situations it attains a height of 125 feet or more, with a diameter of six to eight feet. It bears transplanting well, grows rapidly, is very hardy, and is free from destructive insects. The constant, tremulous motion of its broad leaves gives it a lively, attractive appearance. The limbs of the mature trees are more or less curved, producing a beautiful effect, which is heightened by the straight lines of the tall mast-like trunks. In the latter part of May it decks itself with terminal flowers of a dark, rich yellow, streaked with green and orange. The Tulip Tree cannot be transplanted successfully except when it is of a small size.

The Basswood, or American Linden, commends itself to the lover of trees by its ample shade, fragrant flowers and bright green foliage, which in spring contrasts well with its dark colored branches. In the fall its leaves assume a rusty hue that detracts somewhat from its appearance then, especially as most of the other trees are displaying their autumnal coloring at that time. In the excurrent character of the trunk and arrangement of its branches the Linden displays a graceful habit after the leaves have fallen, making it an attractive and desirable tree in winter. The curious, ribbon-like bract to which the pea-shaped seeds are attached makes it in early summer an interesting study to the passer-by. The Linden is extensively planted as a shade tree in Holland and some other European countries. In Berlin one of the principal avenues, *Unter den Linden*, takes its name from the trees that shade its walks and driveways. Botanists are apt to regard this tree with a peculiar interest, for the father of Linnæus, the Swedish naturalist, took his family name from a large, beautiful Linden, or Linn, that stood near his home.\*

The Horse Chestnut is the earliest of our trees. Before the buds have opened on many of the others, and while the willows are showing only a "green mist" the Horse Chestnut unfolds its cunningly packed leaflets to the sun, a welcome sight to those who are waiting and watching for spring. Its large leaves afford a shade more

\*At that time many of the Swedes had Christian names only, and when they wanted a family name it was customary to adopt that of some natural object in the vicinity—Berg (hill), Strom (stream), etc.

dense than that of any other tree. In parks and on lawns, where its growth is not restricted, this tree assumes a grand, massive appearance that always arrests the eye. In early spring it is gay with large white and pink flowers whose erect panicles standing on the upturned tips of the branches are suggestive of a leafy candelabra, an effect that is heightened when one remembers the peculiar appearance in this respect of the tree in winter. In most families of plants, the order of opening in the flowers is either from the bottom upwards—or from the top downwards—proceeding to open regularly up or down. Mr. Joseph Meehan observes that in the Horse Chestnut there are open flowers simultaneously on every portion of the thyse or spike, so that the tree seems to be covered with flowers as if by magic in a growth of but a few days.\* Objection has been made to the Horse Chestnut because at times there is too much litter on the sidewalks under it. But if people sweep their sidewalks daily there need be no trouble from this source; and if they do not keep their walks clean they will neglect their trees also, in which case it is immaterial what species is planted. The question of insects is discussed later on. The Horse Chestnut, like the Ailanthus and Lombardy Poplar, is not indigenous to the United States, having been introduced here in 1746. In April of that year John Bartram, writing to Peter Collinson,† acknowledges the receipt of the seeds, of which he had hopes, as “some seemed to be pretty sound.” Gen. Brisbin notes that the first tree is said to be still standing on the estate of Mr. Lemuel Wells, Yonkers, N. Y.‡ John Evelyn, in his famous *Silva*, written in 1662, says that the Horse Chestnut derived its name from the fact that the fruit was used for “curing broken-winded horses, and other cattle, of coughs.” But the peculiar shape of the scar left on the twig by the fallen leaf, which resembles the track of a horse's hoof and imprint of the nails, is very suggestive when taken in connection with the translation of *hippocastanum*, its Greek or botanical name.

The Sweet Gum, or Liquidambar, so named from the fragrant balsam which exudes when the trunk is wounded, is an ornamental tree of about eighty feet in height and two feet in diameter, attaining in some localities a much greater size. It is a rapid grower and thrives on almost any soil. Its glossy, star-shaped leaf makes it a favorite with all students of leaf forms. The tree is interesting in winter also on account of the corky ridges or wings attached to the twigs and smaller branches which give it a peculiar appearance. In autumn its foliage changes to a deep

\* Meehan's Monthly. Philadelphia, Pa., May, 1902.

† Memorials of John Bartram and Humphrey Marshall. William Darlington, M. D., LL. D. Philadelphia: Lindsay & Blakiston. 1849.

‡ Gen. James S. Brisbin, U. S. A. Trees and Tree Planting. New York: Harper & Brothers. 1888.



COURTESY PROF. A. S. BICKMORE.

TREES HAVE FLOWERS ALSO.







J. V. MC CLINTOCK, PHOTO.

THE OAKS OF FLUSHING.

PIN OAKS.

crimson interspersed with yellow. Where a variety of species may be deemed desirable, this tree should not be omitted, as it can be used in street planting for several blocks with good effect.

Of the various species of Ash, the White Ash is the one best adapted for ornament and shade. It may be classed fairly among the large trees, the trunk attaining considerable height before it subdivides, which, like the Elm, makes it desirable for street purposes. Its foliage is pleasing in appearance, growing in irregular, waving masses, but without any abrupt or broken outlines. The Ash, however, is among the last to put out its leaves in spring, and among the first to lose them in the fall. In the latter season its foliage assumes a variety of colors, violet, brown, and dark chocolate. Wilson Flagg notes that the Ash is the only tree that shows a clear brown as one of its regular series of tints in the living leaf. Like most trees with compound leaves it sheds its spray with the leaves in fall, leaving naked angular branches that detract from the beauty of its habit in winter. Its freedom from disease and insects commends it to all tree planters.

In street planting the Oaks have hitherto been used but sparingly. The few that appear here and there along country roads seem to owe their existence to accident rather than design. This is probably due to their slower growth, a disadvantage which is fully offset by their hardiness and longer life. The Oak is a noble tree, its size and sturdy character entitling it to a prominent place in our streets and parks. In growth it is no slower than some other species which have been freely planted. The village of Flushing, L. I., is noted for the beautiful Oaks that shade some of its streets.

The Scarlet Oak is a desirable tree for many reasons, one of them being the crimson leaves which charm the eye long after the other trees are bare. Its foliage is unusually persistent, and in some seasons the ruddy glow of its leaves may be seen in brilliant contrast with the first snow.

The Red Oak is the most rapid in growth of all the Oaks, attains a great size, and exhibits the best proportions of any of the acorn-bearing species. It has less of the gnarled and contorted habit so characteristic of the Oaks in general.

The Pin Oak may be described as a middle-sized tree, available for roads and streets of medium width. It thrives best on moist ground. In shapely habit and general massing of foliage it will compare favorably with any of its genus, while the smooth, deeply pinnatifid leaves, bright green on both sides, add greatly to its beauty. The lowest branches of the Pin Oak are generally the longest, a peculiarity that distinguishes it from most of the deciduous trees, and which emphasizes its beautiful proportions, giving it a conical outline. Like all the Oaks its leaves are

among the last to fall, and, without displaying brilliant colors, they contribute materially to the variety of autumnal tints. Its immunity from insects, fairly rapid growth, and the satisfactory results that have hitherto attended its use, make it a desirable tree. The famous Oaks that beautify the streets of Flushing include a large number of this species.

The White Oak is superior in vigor and longevity. It does not grow as tall as the Red Oak, but attains a greater spread. Its red and russet-colored leaves are very persistent, often clinging to the tree during the entire winter, a feature regarded by many with unfailing interest. It is to be hoped that, with the revival of tree planting in our towns and villages, the Oaks will receive the consideration which their many good qualities deserve.

The Honey Locust is the latest of our trees to put forth its foliage. This is the only thing that can be said against it, and that is not always a disadvantage. When its pinnate leaves do appear the beauty of their waving, feathery spray fully excuses any complaint of tardiness. It is a tall, graceful tree, free from insects thus far, unaffected by smoke or dust, and well entitled to a place along our streets and in our parks. Where a dense, cool shade is wanted the Honey Locust would not answer the purpose, owing to its open foliage through which the sunlight streams freely; but this peculiarity makes it desirable for lawns or places where plants or grass might suffer from too much shade. A distinctive feature may be observed in the sharp, stout thorns, three to five inches long, often three-forked or growing in clusters on the trunk. The tree takes its common name from the sweet contents of the long, purple bean pods that hang conspicuously on the branches after the leaves have fallen.

The Common or Yellow Locust is one of our most beautiful trees on account of its profusion of pinnate leaves, and the pendant racemes of white flowers which in June fill the air with an agreeable perfume. The Locust is reputed to be a favorite nesting place for birds, its spiny stipules furnishing protection from many of their enemies. Prof. Sargent, in his *Silva of North America*, notes that the Yellow Locust continues to grow until the beginning of autumn, and that the ends of the branches in summer are covered with young light yellow-green leaves which stand out conspicuously against the dark background of the older foliage. This tree grows rapidly, and its size makes it available for streets of medium, rather than narrow width; but owing to the brittle character of its branches it should not be placed where it will be exposed to strong winds. This species has one peculiar advantage as a lawn or roadside tree in that the grass beneath its shade is always green owing to the fertilizing property of its leaves, which like all leguminous plants enriches the soil. But





A. G. VARELA, PHOTO.

DOUBLE ROW OF SYCAMORES. — INDIANA AVENUE, WASHINGTON, D. C.



A. G. VARELA, PHOTO.

LINDENS. — MASSACHUSETTS AVENUE, WASHINGTON, D. C.

the Locusts have suffered almost everywhere so much from the attacks of insect borers that this liability should be well understood before planting them to any great extent.

Where rapid growth and great size is desired, the Sycamore, or Buttonwood, may claim a place. Its lower branches are high above the ground, affording an open space beneath the tree — which is often desirable when planted near a house — and furnishing ample shade without obstructing the view of the street or road; but owing to its irregular, inferior habit and liability to fungal diseases, it should be used sparingly in streets or parks, and only where variety is desired. The European Sycamore, or Oriental Plane, which resembles the American species closely, is preferable in every respect, and can be obtained from any nursery. The Sycamore is easily recognized by its peculiar bark, which falls off in flakes from the lower part of the trunk, giving that portion of the tree a scabby, spotted appearance, while the upper part of the trunk and the branches are smooth and of a creamy white. It is known also by the “buttonballs” hanging from its branches, a dry, globular fruit filled with seeds, and conspicuous in winter. Tree students, in their outdoor studies, are always pleased to note the conical bud hidden under the base of each leaf stalk and fitting so nicely into the cone-shaped recess in the petiole. It is an interesting tree, and, as found in the lowlands of the Mississippi basin, is the largest of all our deciduous species. The Thames Embankment Boulevard, a famous avenue in London, is lined with Sycamores.

Hitherto the American Chestnut has not been planted on our streets or roads; but there is no good reason why it should not be given a place occasionally. It grows very fast, attains a large size, is handsome in form and proportion, and fulfills all the requirements of a first-class shade tree. The boys might prove troublesome when the fruit is ripening; but that is all that can be said in objection, a difficulty easily obviated by a little police work during the short time in which the burs are opening. The Chestnut, too, is not without its claim to beauty. In July its branches are covered with a profusion of cream colored catkins that attract the eye and enable one to identify it then, even at a great distance.

The White or Silver Maple is a favorite shade tree in both town and country, surpassing all other species, except the Carolina Poplar, in rapidity of growth. It bears transplanting as well as any other, withstands pruning, and is exceedingly graceful. Its slender, pendant branches are easily swayed by the breeze, giving it a waving, flowing appearance, that is made still more attractive by its silvery hue when agitated by the wind, the under side of the leaves having a whitish color which is then exposed to view. The deeply cleft shape of the leaves adds also to

its beauty. Where it is desirable to obtain shade as soon as possible, and at the same time have a beautiful tree, this species should be selected. Of the two soft maples the White is readily distinguished from the Red at first sight by the upward curve of the tips on the lower branches, a distinct peculiarity which adds to the pleasing outlines of this tree.

The Red Maple is a rapidly growing tree of attractive appearance, the light gray bark on the limbs affording a pleasing contrast to its bright green foliage. In addition to many of the good qualities belonging to the maple it displays a scarlet leaf in autumn, which changes later to a dark crimson. Its foliage is the first to change color, some trees showing their red leaves early in August, and the conspicuous red flowers make it noticeable also in early spring. As it seldom attains its full size when planted in cities it is well adapted to narrow streets.

There seems to be a general prejudice against the Ailanthus, or Ailantus as sometimes spelled; and yet it withstands the injurious effects of city life better than any other species. It has a peculiar beauty also in the graceful sweep of its large pinnate leaves, suggestive of the Stag Horn Sumach, which remain green until they fall. Objection has been made to the disagreeable odor of its flowers, but this lasts for only a few days, and can be entirely obviated by planting pistillate trees. The peculiar bark, in which there is traced an arabesque-like pattern, is an interesting study, while the large clusters of reddish bronze samaras on a pistillate tree in autumn make it a thing of beauty and object of enjoyment worth a long walk to see. Brisbin states that it was first introduced in the United States by Mr. William Hamilton, in 1784, and that a sucker, planted from the original tree in 1809, is at present standing in the Bartram Botanic Garden. In 1820 Mr. William Prince, a nurseryman at Flushing, Long Island, imported the Ailanthus from Europe, and from this stock most of the trees in New York and its vicinity were supplied. Although an exotic it reproduces itself readily, its winged seeds often lodging in the cracks of paved areas, where the young trees may be seen growing in nooks and corners along the house line. The Ailanthus is not only immune from insect blight, but there is no species that can approach it in the ability to thrive in the poor soil and amid the unfavorable conditions of city streets.

The Cucumber Tree is a magnolia of stately growth, with a trunk from sixty to eighty feet in height. It grows rapidly, develops a pyramidal form, and fulfills all the requirements of a desirable shade tree. It is advisable to use a small tree in transplanting. Its common name is due to the fruit, which, when green, resembles somewhat a small cucumber.

For narrow streets, or where there is little space between the house line and the

curbstone, the Japanese Ginkgo is well adapted, as it does not attain a wide spread. When fully grown it is over sixty feet high, but in New York, with its cold winters, this species does not grow to its full size, although hardy and thrifty in other respects. This tree is not slow in growth, but still it furnishes little shade until it approaches maturity, when it assumes a tapering form with ample foliage. Thus far the Ginkgo has been free from destructive insects. Its peculiar, fan-shaped leaves, in form like those of the maiden hair fern, retain their olive green color until early autumn, when they change to a rich yellow or orange. Though not an evergreen it is a conifer, of the yew family, a distinction seldom noticed by many who are familiar with the appearance of the tree.

The Willows furnish some species that are available for shade and ornament. The one best adapted for street planting is the Bay or Laurel-leaved Willow. As it is not a large tree it should be reserved for narrow streets. The slender, tapering leaves, which are bright, glossy, and of a deep green on both sides, form a conspicuous feature of this species.

The Hackberry is a medium sized tree, which, in its general appearance, resembles the Elm. Its straight trunk does not divide until it has attained considerable height, a peculiarity which is an advantage in a street tree; but, as its roots generally rise above the ground for some distance from the trunk it is better adapted to village streets or wide avenues, where the flagstones of the sidewalk do not extend to the curb. While it is not a tree of the first magnitude, it is generally too large for narrow streets. Though a native it is rarely found in our woods; but young trees can always be obtained from nurseries. It is so uncommon that, aside from botanists, foresters, or lovers of trees, it is seldom recognized by its right name. There are places in New York where some lone specimen is described by the people in its vicinity as "the lost tree" or "the unknown tree," and is the subject of marvelous stories as to its origin or characteristics. The Hackberry is easily identified, however, by its elm-like leaf and habit, by its peculiar bark, covered with hard, warty, excrescences, and by the small, dark red, berry-shaped fruit, which clings to the stems long after the leaves have fallen—often during the entire winter. Its rapid growth under all ordinary conditions of soil or climate, together with its freedom from disease and insects, entitles it to consideration in making a selection.

The Hardy Catalpa is a tree 50 to 70 feet high, of erect habit and ornamental character—a desirable kind in certain situations. In June it is resplendent with white or violet-tinged flowers, growing in large, upright, pyramid-shaped clusters. Objection has been made to the Catalpa as a street tree, because it is liable to injury

from people who persist in breaking off the flowering branches. For this reason the lower limbs should be trimmed sufficiently to prevent any injury from this source. The leaves, which are the largest seen on any of our shade trees, show no pleasing color in the fall, but turn black at the first frost. When stripped of its broad leaves the branches have a coarse blunt appearance, relieved somewhat by the display of long slender pods that hang in profusion from their tips. There are two American catalpas, and also a Japanese species, with intergrading forms or variants which necessitate some care on the part of a purchaser, for some dealers have not supplied pure seed when the Hardy Catalpa (*C. speciosa*) was called for.

The spire-shaped, erect form of the Lombardy Poplar makes it available for narrow streets and sidewalks. A single tree of this species, properly placed in a park or lawn, often makes an effective addition to the beauty of the landscape. As its branches are fastigiata, pointing upwards at a sharp angle with the trunk, it has a peculiar fascinating appearance when the wind is blowing, the upper part of the tree waving with a graceful, feathery motion, unlike that of other species. It has the advantage of rapidity in growth which, in turn, is offset by its short life. It casts but little shade, and so its use on country roads should be discontinued. But it is a great favorite as a road tree in some parts of Europe, especially in France, where it may be seen in unbroken rows stretching away for many miles.

The European White Birch or Weeping Birch has a pendant habit with small, finely shaped leaves that render it very attractive, especially when standing alone on a lawn where there is nothing to detract from its graceful outlines or the swaying movement of its drooping branches. If used as a street tree it should not be planted along the curb, but set at a proper distance within the fence line where its white bark will be less liable to injury. Where an entire block or street is thus planted, a striking uniformity is obtained as shown in the accompanying illustration.

The reasons for including certain trees in the foregoing list, and also the omission of others, may be questioned by some whose experience in arboriculture makes them competent authorities in everything relating to tree planting; but the list is not offered as furnishing anything like a definite, absolute rule. As already stated, the proper selection of trees for streets and roads is largely a matter of opinion and taste, replete with pros and cons. It would be presumptuous for any one to attempt to offer a list that would meet all requirements with absolute certainty. The names submitted here are offered in the way of suggestion rather than authoritative information, and are intended for the benefit of those who may not have the opportunity or inclination to study the question exhaustively.

While it is well to give a decided preference to our native trees, this should not



J. Y. MC CLINTOCK, PHOTO.

WHITE BIRCHES.— ROCHESTER, N. Y.



A. KNECHTEL, PHOTO.

A TREELESS STREET.



be done to the exclusion of foreign ones. Some of the common trees on our streets and highways, the Horse Chestnut, Ailanthus, and Lombardy Poplar for instance, are introduced species which at one time were regarded as foreigners. It is fair to assume that there are still others with beauty and useful qualities which would render them welcome and enable them in time to take a place among our common well-known trees.

### Undesirable Species.

Some trees are omitted, not so much on account of doubtful qualities but because the list already offers ample opportunity for selection from the large number named. There are, doubtless, several other species which might be planted with satisfactory results, but many of them have defects which should be considered carefully before making a selection.

The Ash-leaved Maple, a short-lived tree, puts out its lower branches too near the ground to permit its use on streets. The Canoe Birch does the same, and if the lower branches were cut off the pyramidal form of the tree would be destroyed and its beauty greatly impaired. The Kentucky Coffee Tree is so unsightly in winter, resembling then a dead tree, that it is better omitted in street planting, especially as it will thrive only in good moist ground. The European Ash lasts but a few years in our climate, and is in no way superior to our American White Ash. The Sour Gum or Pepperidge is a beautiful tree in autumn, but it is too apt to fail in transplanting. The Mountain Ash and Flowering Dogwood are beautiful, but the bright red berries of the one and attractive flowers of the other invite injury; their proper place, if on a street or road, is inside the fence and in some dooryard. The Sycamore Maple has a fine appearance and dense shade, but with so many other Maples, it is hardly needed; like the Copper Beech and Schwedler's Crimson-leaved Maple, its place is in the park or arboretum. The Yellow Wood is one of our neatest, prettiest trees, with cream-colored flowers that attract swarms of bees when in bloom; but it has low branches, and its wood is so brittle that the trunk is very apt to split downwards from where it first divides. The Paulownia, Koelreuteria, and other exotics, beautiful and attractive as they are, should be reserved for private grounds or secluded parkings where they can receive the care and attention which they always require. The Carolina Poplar, or Cottonwood, is often recommended because of its very rapid growth; but this tree sheds a downy, cottony tuft which clings to the clothing of passers-by, causing so much annoyance that, in many towns,

orders were issued for its removal.\* All of these species are pleasing in appearance, and each has some good quality to commend its use, but they should be reserved for lawns, dooryards and parks, where they will appear to better advantage than along the curbstones.

None of the evergreens have a place on the list, for they are of little use as shade trees. Most of them are forest trees, which, when growing in the open, assume a different habit, their lower limbs commencing at the ground. A row of White Pines, properly trimmed, might be used on a country road, and the Tamarack, or American Larch, looks well in the farmer's dooryard; but all evergreens require skill and great care in transplanting, and seem out of place in city streets. Many of them, however, are highly ornamental, and very useful for park and lawn purposes; and then there is the unquestionable advantage which evergreens have in winter, giving beauty to a roadside when all the other trees are bare.

### Destructive Insects.

Objection will probably be made to some of the species named because of their liability to injury from destructive insects. But if all such trees are to be thrown out, the choice will be narrowed down to a very few kinds, the excluded ones embracing many of our finest and most popular shade trees. Even then, there is no assurance that the remaining species, although free from insects hitherto, will continue in their immunity. The freedom of certain trees from insect blight is due largely to the fact that few have been planted, and that the pests find plenty of food in the other species. While it may not be possible to fully exterminate these borers and insects, or prevent entirely the injury from this source, the evil can be so controlled that their destructive work can be greatly minimized; and, as regards some species and insects, entirely obviated. It would seem that the better plan is to continue planting whatever species may be desirable, and, then, through intelli-

\* The Common Council of Albany passed an ordinance in 1871, providing that "No person shall plant or maintain in the city of Albany any tree of the species commonly called the Cottonwood, and any person who shall maintain, or suffer to remain, after reasonable notice by the Street Department to remove such tree, shall be deemed guilty of a misdemeanor, and shall incur a penalty not exceeding ten dollars for each day such tree shall remain after notice to remove, or by imprisonment in the Albany County Penitentiary not exceeding three months, or both, in the discretion of the Court." Pursuant to this law all the Cottonwoods on the streets of Albany were cut down. The ordinance is still in force.

In other cities orders were issued for the removal of this species; but it does not appear that it was a penitentiary offense for an obstinate citizen to "maintain" his preference for a Cottonwood.

gent methods and faithful work control the evil as far as possible. The potato bug was a formidable enemy at one time; but the farmers kept on planting and fighting until they succeeded in overcoming or controlling it. It has been demonstrated that by spraying trees, by using suitable emulsions and insecticides, and by gathering the cocoons the destructive work of insects can, for the most part, be prevented or, at least, controlled. The State Entomologist is ready at all times to furnish information and advice to any who need his assistance. With proper care and attention the trees can be protected; but, if this care and attention will not be given, the selection of the tree is of little importance.

### Rapidity of Growth.

Trees have been described here as of rapid growth and slow growth. These are largely relative terms which, to some people, may convey but little meaning. They will be better understood when the growth rate of some of our well-known species is noted. Beginning with a three-inch sapling, the following named trees will, in twenty years, under favorable conditions, attain a diameter approximately as follows:

White or Silver Maple, - - - - -	21 inches
American Elm, - - - - -	19 "
Sycamore or Buttonball, - - - - -	18 "
Tulip Tree, - - - - -	18 "
Basswood, - - - - -	17 "
Catalpa ( <i>speciosa</i> ), - - - - -	16 "
Red Maple, - - - - -	16 "
Ailanthus, - - - - -	16 "
Cucumber Tree, - - - - -	15 "
Chestnut, - - - - -	14 "
Yellow Locust, - - - - -	14 "
Hard Maple, - - - - -	13 "
Horse Chestnut ( <i>hippocastanum</i> ), - - - - -	13 "
Honey Locust, - - - - -	13 "
Red Oak, - - - - -	13 "
Pin Oak, - - - - -	13 "
Scarlet Oak, - - - - -	13 "
White Ash, - - - - -	12 "
White Oak, - - - - -	11 "
Hackberry, - - - - -	10 "

The height which each species may be expected to attain is omitted here, as it will assume the usual proportion to the diameter.

Trees may be planted in the spring or fall, preferably in the spring before the buds open. If, through lack of information or experience, there should be a difficulty in determining what to plant it would be well to note the kinds that thrive best in the vicinity, and choose accordingly. Having decided on the species, the tree or trees should be ordered from some nursery, because, as a general thing, better results will be obtained. Nursery stock bears transplanting better than that from the woods; for the roots are not spread out so widely as those of forest trees which, by reason of poorer soil, are obliged to reach out further for nourishment, and, hence, sustain more injury when the tree is dug up. In size the plant should be from two to three inches in diameter near the ground, and from ten to twelve feet high. But little is gained by using larger ones, as the smaller trees soon overtake or pass them, and the larger the tree the greater the risk in transplanting. Maples, Elms and Lindens, however, may be used with larger diameters than other species. The Oak thrives better when the smaller sizes are planted.

Nursery trees cost from fifty cents to one dollar each, according to the size or scarcity, to which must be added the expense of freight and cartage. When ordered in large quantities a suitable deduction in price is made. But for villages and roads it may be more convenient and economical in some localities to obtain the young trees from the neighboring woods. In that case pains must be taken to select straight, thrifty specimens with clean, healthy bark, well-shaped top, and regular arrangement of branches.

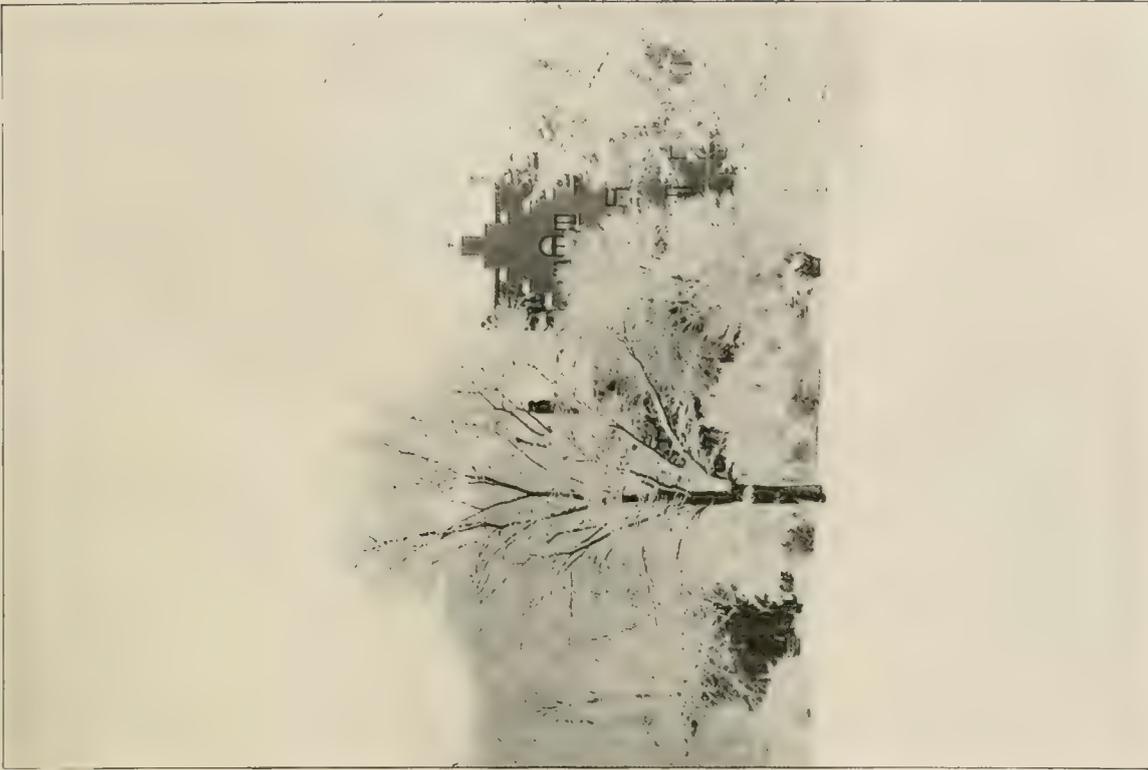
### Transplanting.

In digging up a young tree the roots should be preserved as far as practicable, the circular trench being at least six feet in diameter, or three feet from the stem in all directions. Any unnecessary breaking or wounding of the roots must be avoided, and all the slender rootlets should be secured as far as possible. The more earth that can be taken up with the roots the better. A solid lump is not necessary; but whatever soil clings to the roots should be retained and not allowed to fall off through jolting or careless handling.

Having dug up the sapling, examine the roots carefully, cut off cleanly and smoothly with a sharp knife all the bruised or broken ones, cutting them back to the sound wood. Then these roots will not decay, and the new fibres or rootlets will grow quickly. If there is a long tap root it should be shortened to conform to the depth of the hole in which the tree is to stand. Do not allow the roots to be exposed to the sun or wind; cover them up immediately with damp straw or bags, or, dip them in liquid mud repeatedly until a thick coating is formed that will



J. V. MC CLINTOCK, PHOTO.



J. V. MC CLINTOCK, PHOTO.

TREES ARE BEAUTIFUL IN WINTER AS WELL AS IN SUMMER.



exclude the air, and keep them moist. If the fibrous roots become dry through lack of some such precaution the work will probably prove a failure.

The stem of the tree may be cut back from the top; but the frequent method of pruning forest saplings down to a bare pole is not advisable. It is better to allow three or four of the limbs to remain, selecting those which will give the best arrangement; and then, in cutting them back, leave one bud on each. This will make a better shaped tree in time. The severe pruning of the transplanted tree is necessary on account of the loss in its roots; the more roots are cut off the greater the amount of pruning needed.

There must be a new growth of root fibres before the young tree can support its foliage safely. The leaves of a healthy tree are nourished by the sap which is drawn from the roots as fast as needed; but if this tree is transplanted the supply is partially cut off until new roots and fibres are formed to replace those lost in transplanting. If, during this period, the leaves and branches are allowed to keep on draining the sap, they will exhaust the supply before the new roots are grown, and the tree will soon wither or die.

The natural character of the soil should always be carefully studied, for trees that thrive in one place may fail in others. Some species that attain their highest development in sandy soils will not live in any other; some that find a natural habitat in rich ground must have the same soil conditions in order to fulfill the expectations of the planter; while others that thrive in low wet places will eke out but a scanty existence if planted on high, dry lands. The artificially prepared earth with which the hole is filled cannot be depended on to permanently counteract the unfavorable influence of adjacent soil.

The holes should be dug before the trees arrive, and the earth for filling should also be in readiness. The holes must be large enough so that the roots can be spread out in their natural position without cramping them in the least. It is well to dig them so that there will be a foot or more of additional space on all sides, and of ample depth. This is especially necessary in poor soil. In digging throw the top soil to one side and cart away the poorer earth which came from the lower part of the hole. In place of the latter use a rich soil, one-fourth manure, thoroughly mixed, worked until it is fine and free from lumps, sods or stones. Use no manure unless it is thoroughly mixed with earth; if it touches the roots it will burn or rot them. Where there is a good soil of sufficient depth, well adapted to the natural requirements of the species to be planted, much more may not be necessary aside from making the hole large enough so that all the roots can be spread out freely without any cramping or twisting.

In setting the tree two men are required. One is needed to hold the tree upright; the other will be fully occupied shoveling in the earth and then working it with his hands under and closely around the roots and fibrous branches. The earth must be thrown in slowly and in small quantities at a time; as fast as thrown in it should be rammed or trodden down until there can be no air spaces, and until every rootlet is brought in close contact with the soil. No water should be used; it is not necessary. If dashed into the hole, as sometimes done, it is apt to wash the earth away from the roots in places, leaving air holes. If water is used it is better to sprinkle the sides and bottom of the hole before planting; also the surface of the ground after the work is done. Frequent and thorough ramming is necessary. Young trees that have wilted and seem to be dying have been restored quickly to life and vigor by using heavy rammers that brought the loose earth in contact with the roots again.

In addition to a rich soil it is highly essential that there should be a good drainage. Moisture is beneficial; but if water collects around the roots the tree will die. Clay is impervious to water, and if a stratum of this soil is found near the bottom of the hole, drainage must be provided by digging a passage through it, building a stone drain, or sinking a very deep hole which can be filled to a proper height with broken rock, gravel, or ashes.

A tree should be set at the same depth that it formerly occupied; but when the hole has been filled the surface may be rounded up sufficiently to allow for the settling of the earth. If exposed to strong winds the young tree should be "staked," and fastened to the stakes by strips of cloth or any appliance that will not injure the bark. In setting out a forest tree it may be well to place it in the same position as to points of compass which it originally occupied. A cloudy day is better for planting than one when the sun shines clear and hot.

After the tree is planted the ground should be covered with a mulch, three or four inches deep, of straw, hay, or manure. The latter will serve, also, as a fertilizer. If nothing else is done, the loose stones that came out of the hole can be thrown back on the ground to keep it moist. For a few years the surface of the ground around the tree should be loosened each season to prevent it from becoming dry and hard. Grass and weeds should be kept out, as they weaken the growth of the young trees.

Although spring is the better time for transplanting, it may be desirable under some circumstances where nursery trees are used to order them in the fall, and then heel them in until spring. "Heeling in" is temporary planting in a trench, or merely placing them in the ground and covering the roots with a thick layer of

closely-packed soil to exclude the air. They can be placed closely together, and should be set in a slanting position with the tops inclined away from the prevailing winds. Heeling is also resorted to when nursery stock arrives before preparation has been made for planting.

This method is favored by some because, when trees are taken up in the spring the "callus" which forms on the mutilated roots will not put out its white, hairy-like fibres in time to furnish sap for the early buds that are dependent on them; but when taken up in the fall and heeled in, the callus forms during the winter, and is ready with its new fibrous growth to furnish nourishment as soon as transplanted.

### Pruning.

As trees grow larger and older they require pruning occasionally to remove dead limbs, to improve their shape, and, in the case of very old trees, to restore them to vigor. This work should not be entrusted to ignorant, inexperienced persons, as is too often the case. Men of this class frequent our cities, and solicit employment as tree pruners. With glib tongues they describe the defects, real or otherwise, in street or lawn trees, and obtain permission to do some work. As a result, beautiful specimens have been disfigured or irremediably injured. Whenever any extensive pruning becomes necessary proper means should be taken to secure the services of skilful, experienced men who have testimonials or recommendations signed by some competent authority in such matters.

Some of our best shade trees can be improved in appearance occasionally by trimming or cutting back in order to correct irregularities, or to attain some form better adapted to the situation. Such work can be done without injury to the trees; but it can be undertaken safely only by a skilful, professional tree pruner.

When a tree becomes "stag headed" by dying at the top the dead limbs thus exposed should be cut off, and the rest of the tree trimmed somewhat to correct the irregularity in its general outline. Old trees that have become bare and unsightly may often be restored to temporary vigor and clothed with foliage by severe pruning; but any extensive trimming of this kind is justifiable only when it is necessary to prolong the life of a tree which otherwise would soon die. Some species, Hard Maple for instance, along a walk or driveway can be made more serviceable under certain conditions by increasing their height, which is accomplished by cutting off a few of their lower limbs. But this operation requires careful, intelligent work, and should not be resorted to unless there are special reasons for it.

Pruning is necessary at times the same as surgery, and is successful only when skilfully done.

The best time for pruning is in the fall, soon after the leaves have dropped. Trees may be pruned in the spring with safety, but it must be done early and before there is any swelling of the buds. Soft maples will stand a moderate trimming during the sap season.

Whenever a branch is removed, whether a dead or a live one, it must be cut off close to and even with the trunk, no matter how large the wound. The new wood and bark will then, in time, cover the denuded space. The process by which this recovery is accomplished is well explained in Des Cars' treatise on tree pruning, a copy of which should be in the possession of every one who owns or has charge of trees. If a branch is not cut off close to the trunk, the projecting stub soon decays, its bark falls off, and the stump remains "like a plug of decaying wood driven into the trunk," from which the rotten mass extends rapidly to the heart of the tree.\*

In removing a large branch, enough of the outer portion should be first sawed off to prevent its weight from splitting the wood downward beyond the point where the final cut is to be made. All wounds made in pruning should be covered with coal tar or white lead to exclude the air from the raw surface. Coal or gas tar, by penetrating the pores of the wood, acts as a preservative, and at the same time prevents the inroads of fungi and insects. The painting of the exposed surface is more efficacious if done when the sap has ceased its flow, for then the material applied will adhere more readily to the wood.

Nearly two hundred and fifty years ago John Evelyn† in discussing the subject of pruning says: "Putatio, or Pruning, is the purgation of trees in general from what is superfluous. The antients found such benefit in pruning that they feigned a Goddess presided over it, as Arnobius tells us: and, in truth, it is in the discreet performance of this work that the improvement of our timber and woods does as much consist as in anything whatsoever. It is a misery to see how our fairest trees are defaced and mangled by unskillful wood-men and mischievous borderers, who go always armed with short hand-bills, hacking and chopping off all that comes in their way; by which our trees are made full of knots, stubs, boils, cankers, and deformed bunches, to their utter destruction. As much to be reprehended are those who

\* A treatise on Pruning Forest and Ornamental Trees. By A. Des Cars. Translated from French, with an introduction by Charles S. Sargent, Professor of Arboriculture in Harvard College. Published by the Massachusetts Society for the Promotion of Agriculture. Boston. 1894.

† Silva, A Discourse of Forest Trees and the Propagation of Timber. By John Evelyn, Esq., F. R. S. Written in 1662. 2 Vols. 4to. 802 pp.





A. B. STROUGH, PHOTO.

STREET WITH TREES PLANTED INSIDE THE WALK.—WATERTOWN, N. Y.



A. G. VARELA, PHOTO.

MAPLES AND ELMS.—NEW YORK AVENUE, WASHINGTON, D. C.

either begin this work at unseasonable times, or so maim the poor branches that, either out of laziness, or want of skill, they leave most of them stubs, and instead of cutting the arms and branches close to the bole, hack them off a foot or two from the body of the tree, by which means they become hollow and rotten, and are so many conduits to receive the rain and the weather, which conveys the wet to the very matrix and heart, deforming the whole tree with many ugly botches which shortens its life and utterly mars the timber." He also cautions the pruner "to cut smooth and sloping upwards, if upright boughs, otherwise downwards; and be sure to emplaster great wounds to keep out the wet, and hasten the covering of the bark: besides, for interlucation, remove exuberant branches, *et spissae nemorum comæ*, where the boughs grow too thick and are cumbersome, to let in the sun and air."

When one reads the old writings of this silvan worthy it would seem that there is nothing new to be said on trees or forestry, and that whatever one might write on the subject it would appear very much like plagiarism.

### Arrangement of Trees on Streets.

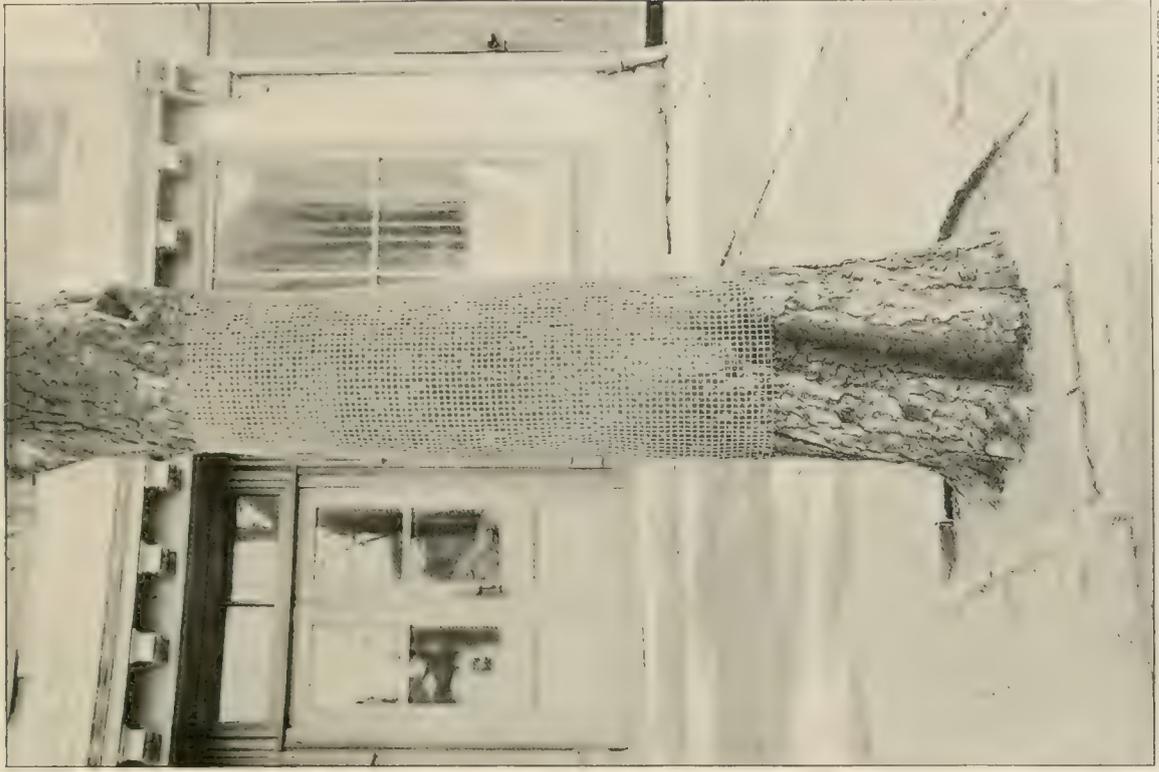
In street planting the trees should be placed with reference to the room they will need when fully grown, rather than with reference to the lot boundaries; otherwise, there will be irregularity, overcrowding and unoccupied spaces. The average city lot is too narrow to permit a tree on each, and so the proper spacing on a block must be determined irrespective of the wishes of the property owners, each of whom might want a tree in front of his house. If a block is fully planted, the trees on one side of the street should stand opposite the spaces on the other side. Planting at half distance, with the intention of removing every other tree in time, is sometimes done in order to obtain more shade at the start. But this plan is an objectionable one; the intermediate trees are seldom removed, and, in their crowded condition, become ill-shaped and undersized. The arrangement is a doubtful expedient, even if the superfluous ones are removed at the proper time; for while the trees are small they afford neither beauty nor shade, no matter how closely they were planted. The only case in which intervals might be filled with advantage is in a row of old trees that have passed maturity and are nearing their end. In such a case time can be saved by planting young ones in the spaces; for when the old decaying trees fall the young ones will be well along toward replacing them. On residential streets where the houses stand well back from the fence line, with lawns or wide yards in front, the trees should not be placed at the curb, but inside the walk where they will be free from injury, obtain more moisture, and afford an equally good shade.

An avenue should be planted throughout its entire length with the same species or, at least, for several blocks. By using one kind on a street a stately architectural effect is obtained that will always be pleasing and impressive. While variety may be desirable for its educational tendency, it should not be permitted because of the irregular, unsightly appearance caused by trees of different sizes and shapes. Lamp posts, as well as trees, are deemed ornamental by many people; but no one would even think of erecting posts of different heights, size and appearance on the same street. The advantages of a variety are better secured by planting different species on different streets. A pleasing and advisable variation of this rule has been suggested by Mr. Lewis Collins, Secretary of the Brooklyn Tree-Planting Society — that at the intersection of wide streets an Elm should be placed at each corner, an arrangement which would add rather than detract from the architectural appearance. A change of trees may be allowed on rural driveways where the irregularity of the scenery will better permit such an arrangement; but, even then, it is better to avoid abrupt, repeated changes by planting the same species for a considerable distance.

Although every residential street should be well shaded, an exception may be made in commercial thoroughfares. The latter, in some instances, might be planted and thus rendered more attractive without interfering with business operations. In European cities the commercial streets often present a pleasing picture on account of the foliage which also hides from view the marks of trade, while in Holland the wharves in some places are shaded by tall trees that mingle their branches and leaves with the yard arms and rigging of vessels unloading at the docks close by.

### Protection of Trees.

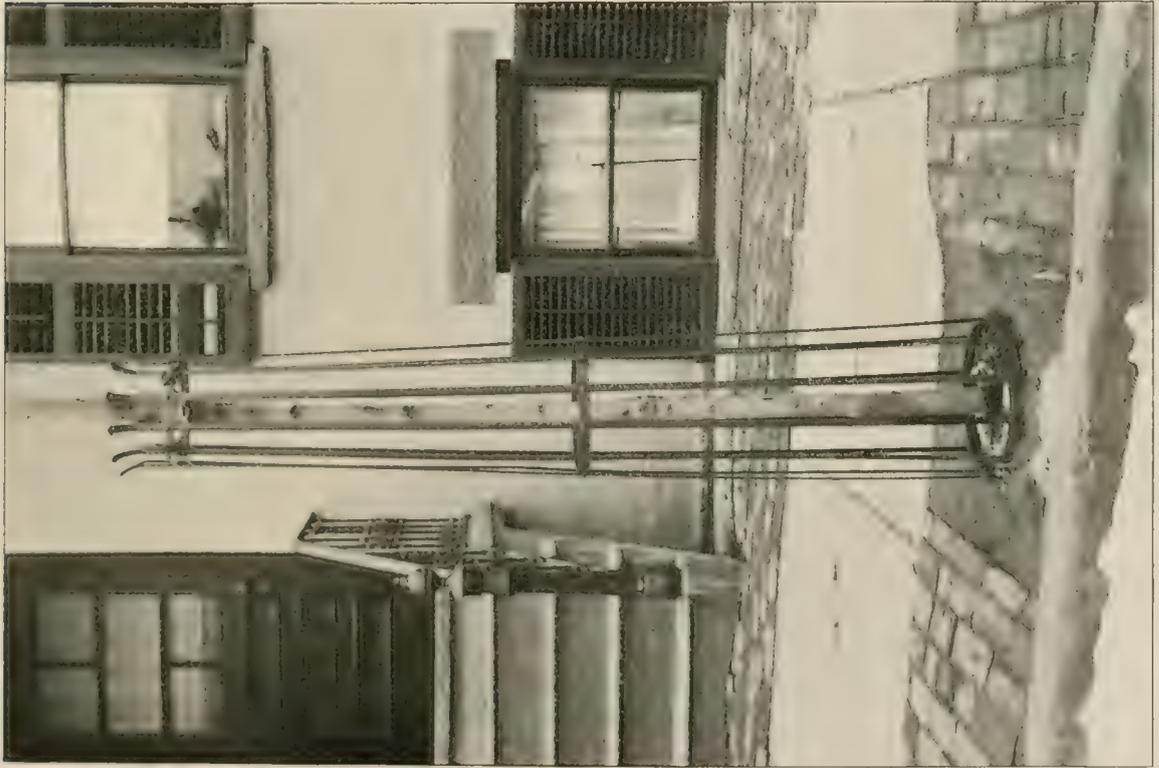
In towns and cities the trunk of every tree, whether young or old, newly planted or of full growth, should be enclosed to a proper height in wire netting of a small mesh. Unless this is done, or some similar precaution taken, it is not worth while to plant. The necessity for some such protection is readily apparent on examining trees from the curbstone side, and observing the large number on which the bark has been gnawed by horses. There is a feeling akin to pity when one notes the patient, repeated efforts of the tree to repair the injury — how it tries each year to cover the wound with new wood and bark, only to have it torn and widened by some fresh attack. It is wasted time to discuss punitive measures as a remedy for this evil. The horse is not to blame; and any law for the prosecution of the driver would be practically inoperative. A more sensible way would be to protect the tree by some of the simple, inexpensive devices which are available. All of the trees in Washington are protected by wire screens, of a large mesh, wrapped around the



A. B. STROUGH, PHOTO.

WIRE NETTING.

A CHEAP BUT EFFECTIVE PROTECTION.



A. B. STROUGH, PHOTO.

METALLIC FRAME FOR YOUNG TREES.

ORNAMENTAL, DURABLE AND INEXPENSIVE.



trunk. But this, in turn, will never be done until the care of the trees devolves upon the city authorities or a tree-planting society invested with necessary powers. The man in a rented house will not invest a cent to protect the tree in front of his residence, and the landlord cares nothing about it so long as he gets his rent.

The erection of electric wires for telephone service, trolley lines and illuminating purposes, is a prolific source of injury. It is a disputed question whether electricity itself does much harm; in fact, a mild current may be beneficial to trees as well as men. Prof. Stone states that, as shown by experiments, the alternating current is less disastrous to plant life than the direct current, and that either, when used at a certain strength, will accelerate growth and strength.\* The injury from the current is mostly local, being confined to points of contact; and this can be largely prevented by a complete insulation of the wires. But the mutilation or destruction of trees caused in the stringing of the wires is another matter. This evil can be prevented by the village or town authorities, unless a right of way has been granted which gives the railroad, telephone, or electric light company permission to remove any obstruction that interferes with the erection of its poles and wires.

### Protection from Insects.

Protection from insects requires constant care and watchfulness. As the householder, generally, has only a few trees to look after, he can, with proper care and diligence, effectually check any insect pest before serious damage is inflicted. But neglect and carelessness on his part may result in the loss of his trees. At the first sign of danger expert advice should be sought for as to the proper remedies and methods to be employed. Where a large number of trees on a street or lawn are attacked by insects a spraying with poisonous mixtures must be resorted to.

Spraying is done with a duplex pump operated by a steam or gasoline engine, the machinery and tank being placed in a light spring wagon, and hauled with one horse from place to place. With 95 pounds pressure, or thereabouts, trees eighty feet high can be sprayed; and by using ladders, and hose with a spray nozzle, the under side of the leaves can be thoroughly drenched. This apparatus is used on streets and in public parks, or wherever a large number of trees require treatment. The citizen who is mostly concerned with the trees of his own street front or lawn can obtain satisfactory results from a hand pump with plenty of hose. To be effective the spraying must be done at the time the insects begin to feed.

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\* Prof. George E. Stone, Hatch Experiment Station, Amherst, Mass. Dangers to Shade Trees; a paper read at a meeting of the Massachusetts Forestry Association, held in Worcester, Mass., Nov. 19, 1902.

Various mixtures have been tried — Paris green, London purple, and arsenate of lead — each with good effect. Prof. Felt, State Entomologist, recommends the following preparation as an effective one against the ravages of leaf-devouring species: 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 solution into the spraying tank, which should contain about eighty gallons of water. Where a contact insecticide becomes necessary, as in the case with sucking or biting insects, aphids, plant lice, scale pests, etc., he advises the use of this emulsion: Dissolve one-half pound of hard soap in one gallon of boiling water, and, while still hot, add two gallons of kerosene; emulsify by passing rapidly through a force pump till it assumes a uniform creamy consistency and the 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 before.

The cost of spraying depends necessarily on the extent of the work — the larger the number of trees, the less will be the average expense. In 1898 the cost of spraying Elms in Albany was about fifteen cents per tree for each application; and in 1900, with a more expensive apparatus and men working under the eight-hour law, it cost twenty-two cents. In Troy, trees were sprayed by contract at twenty-three cents for each spraying, a much higher price being charged for single or scattering trees. In New Brunswick, N. J., a contract for the season, including treatment as often as needed, was made at one dollar per tree. The expense, whatever it may be, is insignificant as compared with the value of the trees.

A simple and effective check on certain insects — the white-marked tussock moth for instance — consists in destroying the egg masses. In 1894 the school children of Rochester, N. Y., stimulated by liberal cash prizes, gathered 8,800,200 cocoons of this insect, and thoroughly eradicated the pest in that locality. Of the successful scholars, 65 received a \$10 gold piece each, while others received smaller awards. The prizes, which were offered and paid by the Genesee Valley Forestry Association, amounted to much more than was expected; but the money was well expended and cheerfully paid, as the city saved its shade trees and secured immunity from further ravages of a destructive insect.

The limits of this article will hardly permit of a description of the various insects and borers that infest our shade trees; or a recital of the many formulas for insecticides which have proved effective in checking their ravages.



A. B. STROUGH. PHOTO.

A WELL-PLANTED HIGHWAY.—JEFFERSON COUNTY, N. Y.



PORTABLE ENGINE AND PUMP FOR SPRAYING TREES.—ALBANY, N. Y.



The insects which kill or injure shade trees may be divided into three general classes: (1) the leaf-devouring or masticating species; (2) the leaf-piercing, non-masticating, or sucking insects; (3) the borers. Prof. Felt, in the previous reports\* of the Forest Commission, gives a minute description of the tussock moth, forest tent caterpillar, leopard moth, maple borer, maple tree pruner, cottony scale insect, elm leaf beetle, bag worm, fall web worm, spiny elm caterpillar, elm borer, elm bark louse, and elm snout beetle. These descriptions are accompanied by colored illustrations showing the insects at each stage of transformation; also, formulas for insecticides, spraying mixtures, and emulsions, together with the details of other methods that have proved effective.

### Municipal Control.

In towns where there are no well-organized tree-planting or village improvement societies the planting of street trees and their subsequent care should devolve on the city or village government, preferably, if in a city, on the park commissioners, as the officials in that department would be better qualified for the work, farther removed from political influences, and would be more apt to have the long tenure of office necessary to the proper management of the work. The planting and care of street trees belongs to the city government as much as street paving. Under the stimulus of local improvement societies individuals often do some planting; but when they sell their property or move away the trees are apt to be neglected. Moreover, it is difficult without municipal control to secure the concerted action necessary for planting a street its entire length with uniform and properly selected species.

Then, again, under the management of a special city department, properly supplied with funds, the spraying of trees and suppression of insect pests can be successfully accomplished; but it is doubtful if our trees can be preserved from this evil through the partial and disconnected efforts of individuals. As in Washington and Paris, every city should establish nurseries, supported by municipal appropriations, in which the various species best adapted to street planting can be propagated and grown with special reference to such use.

In some of our cities—New York and Brooklyn for instance—valuable and effective work has been accomplished by tree-planting societies; and their intelli-

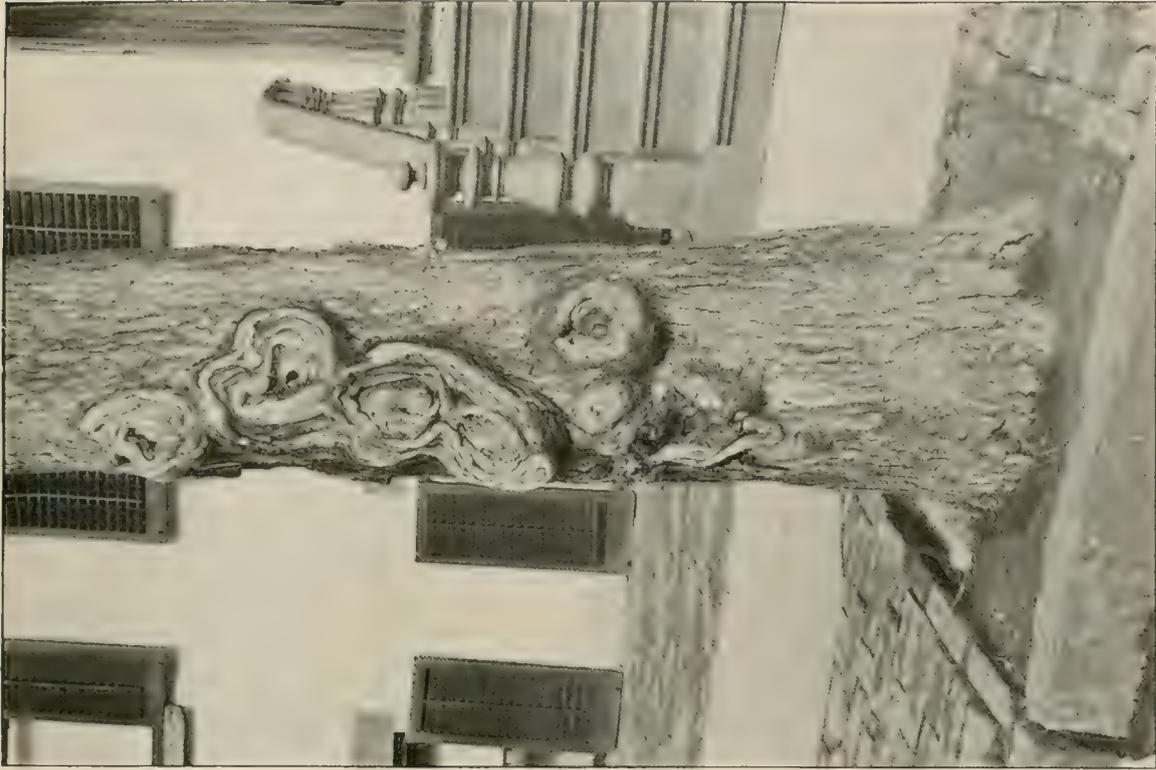
\*Insects Injurious to Shade Trees. E. P. Felt, D. Sc., State Entomologist. Fourth Annual Report, Forest, Fish and Game Commission, Albany. 1898. Also, Insects Injurious to Elm Trees, by same author. Fifth Annual Report of Commission, 1899. See, also, Prof. A. S. Packard, Fifth Report of the U. S. Entomological Commission, pp. 31-47. Washington. 1890.

gent efforts should receive, in some form or another, substantial recognition from the city government. While there may be legal objections to conferring municipal powers on individuals or associations, liberal appropriations might, with good precedent, be made for the benefit of a tree-planting society to enable it to carry on its work. Actuated by disinterested enthusiasm, and provided with funds for the employment of competent men, the society would do as good and intelligent work as any park commission, and, under certain circumstances, secure better results.

People who question the advisability of planting shade trees in cities rehearse the old story about the injurious effects of smoke, dust, and pavements, and then point to some sickly, deformed specimens in proof of their argument. But these unfortunate trees are the result of poor selection, bad planting, and neglect; and the blame should not be laid elsewhere. Asphalt pavement, though impervious to rain, will not prevent trees from obtaining moisture. On the other hand, it prevents evaporation; the earth beneath it is always damp, for there is still a supply of water from adjoining areas and small underground courses. For years the street trees of Washington and Paris have grown and flourished on the asphalt pavement of those cities.

It must be conceded, however, that asphalt or other impervious pavements lessen greatly the supply of moisture and prevent a sufficient aeration of the roots. To obviate this unfavorable condition as far as possible the flagging on the sidewalks should be cut out around the tree—leaving a circular space as large as the situation will permit—to facilitate artificial watering, to enable more of the rainfall to reach the roots, and to allow a frequent loosening of the earth at the surface. On narrow sidewalks this opening in the flagging should be in the form of an oblong rectangle in which the longest sides are parallel with the curbstone, as a larger space can thus be obtained without encroaching on the pathway. A still better plan would be to lay the flagging to the tree line only, leaving a strip of ground next the curbing, covered with gravel. The intervals between the trees are not used by people walking along the street. A slight slope in the surrounding flagstones—not enough to interfere with walking—will increase the area of drainage and amount of moisture received, and a portion of the water that falls on the house roofs can also be conducted in proper quantity from the eaves-troughs and leaders to the roots by conduits laid beneath the flagstones. Where there is an asphalt pavement, openings protected by iron gratings should be left in the gutter opposite each tree, through which water will find its way at every shower, or when the gutters are flushed from a hydrant.

Another unfavorable condition caused by a tight pavement is the prevention of



V. L. SIKOROLYI, PHOTO.

AN UNPROTECTED TREE,  
BARK GNAWED BY HORSES.



A. L. SPROUGH, PHOTO.

TREE USED AS A HITCHING POST, ALBANY, N. Y.



a proper aeration of the roots. This can be remedied to some small extent by the openings left in the flagging at the base of the trunk. But this affords only a partial remedy at the best, and so we cannot expect that a city tree on a closely paved street and sidewalk will develop the same thrifty growth and appearance as if it stood on a village street where the ground around it was exposed to air and sunlight.

People who believe in the efficacy of fertilizers in promoting tree growth are apt to consider the planting of paved streets a doubtful undertaking because there is no opportunity to enrich or cultivate the ground. But such discouragement does not seem to be based on sufficient reasons. Fertilizing material is beneficial to surface crops, but it can exert but little influence on roots that penetrate deeply in the earth, and which must draw their sustenance from the lower strata found there, good or bad as the case may be.

In many city streets the ground presents unnatural and unfavorable conditions. The surface has been cut down extensively by grading or blasting, which leaves exposed only the sterile earth of the lower strata; or a depression has been filled, in which case the planting must be done on "made ground" composed of ashes, street litter, old tinware, and all the other kinds of rubbish which are dumped in such places by the street cleaning bureau. Such conditions, however, should not be considered as a deterrent in planting; but they demand a more thoughtful study of the situation, with some additional effort in providing larger holes and an ample supply of fertile soil.

While smoke and dust undoubtedly are injurious to some species, leakage from gas mains has caused by far the greatest destruction of trees in city and village streets. No matter how hardy the species, how well it is planted, or how carefully it is fostered, if the ground becomes saturated with illuminating gas the tree is doomed. It may be assumed that a gas company will, in its own interest, endeavor to prevent any leakage in its mains. But the work of finding and stopping a small leak may cost more than the loss of the gas; and it is the small leak, when near a tree, that does the mischief.

A frequent source of injury is the unnecessary mutilation of the larger roots by laborers employed in digging the ditches for gas or water mains. In most cases this can be avoided by the exercise of some care and a slight expenditure of time, which should be insisted upon by the city authorities.

Let every citizen who finds enjoyment in well-shaded streets make an effort to procure the passage of a city ordinance placing the entire control of the trees of his town in the hands of a tree-planting society, or the park department, or some special commission, and use his influence, also, to see that ample funds are annually appropriated by the municipal or village government to carry on the work.

## Legislation.

John Evelyn said that men seldom plant trees till they begin to be wise; and so it may be well to note what the wise men in the Legislatures of various States have decreed as to tree planting on streets and highways. The Highway Law of New York has already been quoted. In other States the laws relating to tree planting are in part as follows:

### MASSACHUSETTS.

Chapter 196, Laws of 1890. Section 1. The mayor and aldermen of cities and selectmen of towns are authorized to designate and preserve trees in highways for ornament and shade, not less than one tree in every thirty-three feet and of one inch or more.

Sec. 2. Provides for marking the trees selected.

Sec. 3. Provides that whoever injures, defaces or destroys any designated tree shall forfeit not less than five nor more than one hundred dollars.

Chap. 330, Laws of 1899, Sec. 1. Every town shall at its annual meeting for the election of town officers elect a tree warden, who shall serve for one year and until his successor is elected and qualified. He may appoint such number of deputy tree wardens as he deems expedient, and may at any time remove them from office. He and his deputies shall receive such compensation for their services as the town may determine, and, in default of such determination, as the selectmen may prescribe. He shall have the care and control of all the public shade trees in the town, except those in public parks or open places under the jurisdiction of Park Commissioners, and of these also he shall take the care and control if so requested in writing by the Park Commissioners. He shall expend all funds appropriated for the setting out and maintenance of such trees. He may prescribe such regulations for the care and preservation of such trees, enforced by suitable fines, not exceeding twenty dollars in any one case, as he may deem just and expedient; and such regulations, when approved by the selectmen and posted in two or more public places in the town, shall have the force and effect of town by-laws. It shall be his duty to enforce all provisions of law for the preservation of such trees.

Sec. 2. Towns may appropriate annually a sum of money not exceeding in the aggregate fifty cents for each ratable poll in the preceding year, to be expended by the tree warden in planting shade trees in the public ways; or, if he deems it expedient, upon adjoining land, at a distance not exceeding twenty feet from said public ways, for the purpose of shading or ornamenting the same; *provided, however*, that the written consent of the owner of such land shall first be obtained. All

shade trees within the limits of any public way shall be deemed public shade trees.

Sec. 3. Whoever, other than a tree warden or his deputy, desires the cutting or removal, in whole or in part, of any public shade tree, may apply to the tree warden, who shall give a public hearing upon the application at some suitable time and place, after duly posting notices of the hearing in two or more public places in the town and also upon the said tree; *provided, however*, that the warden may, if he deems it expedient, grant permission for such cutting or removal, without calling a hearing if the tree in question is on a public way outside of the residential part of the town, the limits of such residential part to be determined by the selectmen. No tree within such residential part shall be cut by the tree warden, except to trim it, or removed by him without a hearing as aforesaid; but in all cases the decision of the tree warden shall be final.

Sec. 4. Towns may annually raise and appropriate such sum of money as they deem necessary, to be expended under the direction of the tree warden in exterminating insect pests within the limits of their public ways and places, and in the removal from said public ways and places of all trees and other plants upon which such pests naturally breed; *provided, however*, that when an owner or lessee of real estate shall, to the satisfaction of the tree warden, annually exterminate all insect pests upon the trees and other plants, within the limits of any public way or place abutting on said real estate, such trees and plants shall be exempt from the provisions of this section.

Sec. 5. Whoever affixes to any tree in a public way or place a play bill, picture, announcement, notice, advertisement or other thing, whether in writing or otherwise, or cuts, paints or marks such tree, except for the purpose of protecting it and under a written permit from the tree warden, shall be punished by a fine not exceeding fifty dollars for each offense.

Sec. 6. Whoever wantonly injures, defaces, breaks or destroys an ornamental or shade tree within the limits of any public way or place shall forfeit not less than five nor more than one hundred dollars, to be recovered by complaint, one-half to the complainant and the other half to the use of the town.

Sec. 7. Whoever negligently or carelessly suffers a horse or beast driven by or for him, or a beast belonging to him and lawfully in a public way or place, to break down, injure or destroy a shade or ornamental tree within the limits of said public way or place, or whoever negligently or willfully by any other means breaks down, injures or destroys any such tree, shall be liable to the penalties prescribed in the foregoing section, and shall in addition be liable for all damages caused thereby.

## NEW HAMPSHIRE.

Chap. 98, Laws 1902. Sec. 1. Mayors of cities and selectmen of towns shall appoint one or more tree wardens to be paid as the mayor or selectmen direct.

Sec. 2. Towns and cities shall control all the shade and ornamental trees in the public ways which the warden deems reasonably necessary. The warden shall mark all such trees.

Sec. 3. If any such trees prove to be private property the warden shall acquire them if it is possible to do so at a fair price. If unable to agree on price they may be acquired as provided for acquiring land for highway.

Sec. 4. Appropriations may be made not exceeding fifty cents for each ratable poll to be used for planting and caring for such trees.

Sec. 5. Provides for cutting trees upon consent of warden.

Sec. 6. Prohibits defacement except on consent of warden.

Sec. 7. Prohibits owners of land from burning brush near trees.

Sec. 8. Provides penalties for violations.

## CONNECTICUT.

Chap. 244, Laws 1902. Bounty.— Every person planting, protecting and cultivating elm, maple, tulip, ash, basswood, oak, black walnut, hickory, apple, pear, or cherry trees not more than sixty feet apart along any highway, to be paid ten cents for each tree, but not for more than five years.

Tree Wardens.— Each town may select a tree warden who may appoint deputies who are to be paid as the town may prescribe. He is to have control of all public shade trees in town except in parks under Commissioners. He may make rules for the care and preservation of such trees, to be enforced by fines not to exceed twenty dollars in each case. Such rules when approved by the town officials and posted have the force of town by-laws.

Planting Shade Trees.— Towns may appropriate sums not exceeding fifty cents for each ratable poll, to be expended by the tree warden in planting trees in the public ways, no trees to be planted without the consent of the adjoining owner. All transplanted trees and all other trees over six inches in circumference to be deemed public shade trees.

Removal of Shade Trees.— Provision is made for the removal of shade trees, with the consent of the tree warden, and for the destruction of insect pests. Persons injuring shade trees by cutting, painting, advertising on, etc., without the consent of the tree warden, shall be fined not exceeding fifty dollars. Every person willfully injuring a shade tree in a public place shall be fined not to exceed one hundred dollars.





JESSUP COLL. NO. 290.

COMMON AMERICAN CHESTNUT.



STROUGH.

HORSE CHESTNUT.



MC CLINTOCK.

HARDY CATALPA.



MC CLINTOCK.

WHITE ASH.

STUDIES IN TREE HABIT.



MC CLINTOCK.

HONEY LOCUST



STROUGH.

RED OAK.



STROUGH.

NORWAY MAPLE.



STROUGH.

WHITE MAPLE.

STUDIES IN TREE HABIT.



## PENNSYLVANIA.

Chap. 275, Laws 1901. Sec. 1. The burgess and council of any borough upon petition of a majority of the property owners on any public street may by ordinance require the planting of shade trees, and on failure of the owners, after notice, to plant, may cause the planting to be done and collect the same from the adjoining property owners.

Chap. 306, Laws 1901. Sec. 1. Any person liable to road tax who shall transplant to side of road on his own premises any fruit, shade or forest trees of suitable size shall be allowed on road tax one dollar for every two trees set out. No row of elms to be placed nearer apart than seventy feet; and no row of maples or other forest trees nearer than fifty feet, except locust and Carolina poplar, which may be thirty feet, and except fruit trees may be set forty feet; and all must be living and protected from animals.

Sec. 2. Any tree growing naturally by side of highways through cultivated land shall be allowed in same manner.

Sec. 3. Trees planted on highway in place of trees that have died shall be allowed for as provided in first section.

Sec. 4. No person to be allowed more than quarter of his annual road tax.

Sec. 5. Any person who cuts or injures any live tree planted or growing naturally as aforesaid, or suffers an animal of his to injure such a tree, shall pay a penalty of from one dollar to five dollars, or he may plant and maintain another tree in place of the one cut or injured.

## NEW JERSEY.

Chap. 285, Laws 1893. Sec. 1. Provides that there may be appointed in all municipalities a Commission of three freeholders without compensation, who shall have control and power to plant and care for shade trees on any of the public highways.

Sec. 3. Notice must be given when planting is contemplated, specifying streets, etc., and must be published in papers.

Sec. 4. The cost of planting, including guards around the trees, to be borne by the adjoining real estate. The same is a lien thereon and may be collected with the taxes.

Sec. 5. Cost of maintenance after planting is to be borne by municipality.

Chap. 162, Laws 1896. Sec. 1. Makes it unlawful to hitch or tie animals to trees adjoining any highway. Animals must not be left unattended near any such tree.

Sec. 2. Provides for penalties.

OHIO.

Statutes. Sec. 2307. Provides that upon petition of more than two-thirds of the ownership in feet on streets of cities of the second class and villages the council may provide by ordinance for planting and taking care of shade trees.

Sec. 2308. Provides that the ordinance may designate two of the petitioners to act without pay, who with the corporation engineer shall constitute a Board who may plant and care for the shade trees. Term of office, three years.

MINNESOTA.

Chap. 243, Laws 1895. Sec. 2. The Park Commissioners of each city are empowered to regulate the planting and preservation of shade trees in the streets and public grounds. No shade tree shall be destroyed except by leave of the Commissioners. The Commissioners may by ordinances provide for the enforcement of this section, and fix penalties for a violation of the same.

Sec. 3. Upon petition of a majority in number of the owners of real estate abutting any street asking for the planting of trees, the Commissioners may plant suitable shade trees along any part of such street.

Sec. 4. Provides for assessing the cost of such tree planting and maintenance for three years, on the owners of property benefited.

Sec. 5. Provides that the assessment must not exceed fifty cents per foot on any land benefited, and that trees that die must be replaced without further assessment.

Chap. 171, Laws 1899. Provides for tree planting in cities of more than 50,000 people.

CALIFORNIA.

Chap. 140, Laws 1893. Sec. 1. All public streets may be planted with shade trees along the sidewalks by order of the City Councils.

Sec. 2. Provides method of procedure in passing resolution for planting trees.

Sec. 3. Provides for hearings by owners of land adjoining streets to be planted, and that the choice of trees to be planted shall be governed by request of majority of owners of frontage.

Sec. 5. Provides for furnishing trees, and for planting under a contract which shall provide for care and maintenance for three years.

Sec. 7. Provides that all the work must be done under the direction of the superintendent of streets.

Sec. 9. Requires that the cost of street tree planting shall be assessed on the adjoining land.

Sec. 12. Provides for replacing dead trees after three years.

Sec. 13. Provides that the act shall apply to such municipalities as shall vote to come within its provisions.

#### FLORIDA.

Chap. 74, Laws 1901. Sec. 1. The County Commissioners are empowered to improve by shading the public roads and highways of their respective counties.

Sec. 2. It is the duty of said Commissioners upon petition of a majority of the freeholders along any public road to improve the same by planting suitable shade trees on such part as is mentioned in the petition, the work to be done in regular order and at proper season.

Sec. 3. Provides that upon petition of land owners the Commissioners shall set shade trees not less than three nor more than six inches in diameter, and not less than ten feet high, at a distance of one eighth mile apart and fifteen feet back from the center of the road on each side in two parallel lines *as markers* to guide the setting of remaining trees.

Sec. 4. Provides that after markers and guides are set as per Sec. 3, the Commissioners shall purchase suitable trees and cause them to be set by contract, not less than ninety feet nor more than one hundred and ten feet apart, to be placed so as to alternate with trees on opposite side of road. Trees are not to be paid for until they have put on sufficient growth to insure continued life; not more than twenty-five cents shall be paid per tree. The trees must be purchased from free holders and taxpayers, and not more than ten dollars shall be paid to any one in one year.

Sec. 5. Provides for paying the expense of planting out of the road tax fund.

Chap. 121, Laws 1901. Sec. 1. Provides that it shall be unlawful for any person to cut any shade tree within fifteen feet from center of road bed without permission from proper authority.

Sec. 3. Provides that an offender shall be fined not less than five dollars nor more than twenty-five dollars.

It is evident from the foregoing extracts that the absence of shade trees on our streets and highways is not due to any lack of legislative provision for their installation, care, and maintenance. All that is needed now is a stimulation of public interest in this subject. This can be best accomplished by the organization everywhere of tree planting societies, village improvement leagues, outdoor art associations or any movement which, through combined, intelligent effort, will have an opportunity to assert itself and attain the desired beneficent results.

## Autumn Foliage.

In the selection of species for street and highway planting some consideration should be given to the colors which the leaves will display in the fall months, a matter as important as that of tree habit or graceful outline. Although a purely esthetic one its importance has been urged at times by scientists as well as writers on woodland scenery. We hail with pleasure the green foliage of each returning spring, but delight none the less in the brilliant display made by the painted leaves in autumn, and, so, when we come to choose our trees for planting, everything else being equal, why not give a preference to the species which afford a pleasing aspect in both spring and fall.

In considering this question it is well to remember that, while certain species generally show the same color each fall, there is apt to be some variation in this respect. Occasionally some individual will exhibit an entirely different tint from the prevailing one of that species, while frequently several tints, and at times two or more distinct colors, will be found on the same tree. The Red Maple is noted for the scarlet hue of its leaves in early fall; but here and there a tree of this species will display a yellow foliage at that season. Then, again, the other Soft Maple, the White or Silver Maple, which generally turns yellow, will in some places present a single tree with leaves showing a red color to considerable extent.

Most of our Oaks are a brilliant red or scarlet in October, but some of them change each autumn from green to russet without the usual intermediate bright tints that generally precede the russet. The Hard, or Sugar Maple, cannot be classified under any one particular color, for it not only displays various ones on the same tree, but green, yellow, and red are often found on the same leaf. The leaves on some species, the White Ash for instance, show three or four successive tints during their transition, passing from yellow to a beautiful shade of brown. On some trees, noticeably the Red Maple, a single branch will assume a brilliant color, generally red in August, while the rest of the foliage is still green. This may be attributed to some lack of vitality in the particular branch thus affected.

It has been observed that when a tree shows a distinctive sport of this kind the peculiarity is a persistent one, and its recurrence may be looked for each year. If a Red Maple displays one highly colored branch in early August, while all the rest of its foliage is green, it may be depended upon to exhibit the same phenomenon next season. The White Maple, as a rule, has yellow leaves in autumn; but if some one tree of this species shows a mixture of red and yellow in its leaves it will surely do the same through each successive year. On some Oaks the leaves, instead of turn-



HARD MAPLE  
 $\frac{1}{2}$  NATURAL SIZE



RED OAK  
 $\frac{1}{3}$  NATURAL SIZE





CHESTNUT  
 $\frac{2}{3}$  NATURAL SIZE



WHITE MAPLE  
 $\frac{2}{3}$  NATURAL SIZE





SCARLET OAK

SWEET GUM  
 $\frac{1}{2}$  NATURAL SIZE

TULIP TREE





SASSAFRAS  
2 NATURAL SIZE



PEPPERIDGE  
3 NATURAL SIZE





RED MAPLE

TAMARACK  
3 NATURAL SIZE

WHITE PINE





BASSWOOD

WHITE CEDAR

FLOWERING DOGWOOD

SHAGBARK HICKORY

↑ NATURAL SIZE





WHITE ELM

RED SPRUCE

BEECH

WHITE ASH

$\frac{1}{2}$  NATURAL SIZE





WHITE WILLOW

YELLOW BIRCH

BALSAM FIR

§ NATURAL SIZE

WHITE OAK

ASPEN



ing red, change from green to yellow or russet ; but, whatever the peculiarity in this respect, each individual will retain it in a marked degree year after year. The persistency of this abnormal variation in color has been observed so often that the reasonable suggestion is made that horticulturists and nurserymen might be able, by using cuttings or grafts from trees or branches that exhibit a constant color, to propagate trees of desirable autumn tints and furnish stock to their customers, warranted to display certain attractive features in this respect. The Purple or Copper Beech, used so extensively in lawn planting, was propagated in this way from a single tree, which showed an abnormal color in its foliage.\*

There seems to be a popular impression that the period in which our forests display their autumnal beauty is of brief duration. A little thought and observation will show that this is hardly the case. By the first of August, throughout New England and the Middle States, many of our soft maples display their scarlet standards of approaching fall ; in September the forests on our mountain slopes and upland plateaus are at their best ; in October the woodlands along our valleys, and the trees that line our village streets, present their most brilliant effects ; and even in November the persistent russet leaves of the oaks are still in pleasing evidence, while here and there on some late maturing trees may be seen a faint glow befitting this twilight season of the year. Thus we have four months in which to study this pleasing exhibition of Nature, a period nearly as long as that in which the vernal foliage retains its uniformity of green. It would seem, however, that the annual recurrence of this lavish display is not appreciated as it should be, that little attention is paid to it aside from the few who delight in Nature study. Thoreau very justly remarks that "If such a phenomenon occurred but once it would be handed down by tradition to posterity, and get into the mythology at last."

Like the procession of the seasons the various tree species assume their autumn garb in a regular order. In some localities it may be early or late ; but, then, our spring or fall does not always arrive in accordance with the almanac. Here and there individual trees may be slow in donning their gay livery ; and there are spots where winter lingers, though all around the land is warm with returning spring.

To give the exact order in which the trees turn color would require too many exceptions and explanations. As the maturing of the foliage occupies a period of

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\* "Most of the purple beeches now in cultivation are probably derived from a tree of this variety, discovered in the last century in the Hanleiter Forest, near Sondershausen, in Thuringia, which is supposed to be about two hundred years old, and is still alive." (Prof. Charles S. Sargent. *Silva of North America*, Vol. IX, p. 24.) See, also, "The Origin of the Purple Beech." *Garden and Forest*, VII, 2.

about three months the species may be divided into three groups showing their order in this respect, although no group can be assigned with accuracy to any one month. Their succession is approximately as follows:

GROUP ONE — THE EARLIEST.

Red Maples, White Elm, Sumach, Yellow Locust, Sour Gum, Horse Chestnut, White Maple, Yellow Birch, Hickories, Tulip Tree, Sassafras, Butternut, Black Walnut, Cucumber Tree, Kentucky Coffee Tree.

GROUP TWO — THE INTERMEDIATE.

Hard or Sugar Maple, Sweet Gum, Chestnut, Yellow Wood, Red Oak, Pin Oak, Beech, White Birch, Black Birch, Aspens, White Ash, Hop Hornbeam, Blue Beech, Carolina Poplar, Basswood, Black Ash.

GROUP THREE — THE LATEST.

Scarlet Oak, Dogwood, Honey Locust, Lombardy Poplar, White Oak, Larch, Black Cherry, Sycamore, Sycamore Maple, Norway Maple, Ailanthus, Dutch Linden, Ginkgo, Willows, English Elm.

It would, undoubtedly, be interesting to state here the month and, approximately, the day of the month on which each species might be expected to display its ripened hues. This might not be so very difficult as regards any particular locality; for continued observations of individual trees show that they vary but a few days each year, both in the vernal unfolding and the autumnal ripening of the leaves. But, as the time of the process varies greatly with latitude and situation, no one schedule of dates would fulfill the purpose; and so each student must construct his almanac in accordance with the dates noted in his own vicinity. If a person who keeps a diary faithfully will note in spring the first day on which each species may be said to be in leaf, and in fall when these same trees have fairly changed color, such memoranda will prove valuable for future reference. For many years the writer has thus timed the late and early springs by a clock of the seasons constructed from just such notes.\*

Although, as previously shown, some species may exhibit two or more colors, there are certain prevailing tints which may be looked for in connection with each.

\* "The illustrious Linnaeus, in the most earnest manner, exhorted his countrymen to observe with all care and diligence at what time each tree expands its buds and unfolds its leaves; imagining, and not without reason, that his country would, some time or other, reap some new and perhaps unexpected benefit from observations of this kind made in different places." [Harold Barck. *Foliation of Trees*. Amaen. Acad. Vol. III.]

Observers may differ some as to the shades noted, and it must be conceded that no classification can be made that will be absolutely comprehensive and correct. The following schedule is submitted as tentative rather than final:

### Prevailing Colors.

*Pure Yellow.* Tulip Tree, Yellow and Canoe Birches, White Maple, Yellow Locust, Honey Locust, Yellow Wood, Norway and Sycamore Maples, Beech, Willow, Cucumber, Ailanthus.

*Yellow Ochre.* Larch, Poplar, Aspen.

*Lemon Yellow.* Hickories, Black Walnut.

*Dull Yellow.* White Elm, Chestnut, White Birch, Basswood, Butternut, Catalpa, Cottonwood, Bur Oak.

*Vandyke Brown.* Sycamore or Buttonwood.

*Orange.* Black Birch, Horse Chestnut, Ginkgo.

*Red.* Scarlet Oak, Sumach, Dogwood, Hornbeam.

*Scarlet, Crimson and Yellow.* Red Maple.

*Red, Yellow and Green.* Hard Maple, Sassafras.

*Scarlet, Crimson and Purple.* Sour Gum.

*Purplish Red.* Red Oak.

*Red and Russet.* Black Oak, White Oak.

*Red, Yellow and Brown.* Sweet Gum.

*Brown, Purple and Salmon.* White Ash.

*Raw Umber.* Scrub Oak.

The collector of specimens will find it difficult to secure perfect leaves of a straight color, ones in which the entire surface has turned to a uniform shade. There is apt to be some small area of green, spots of uneven color, or defacement of the surface. A careful search will occasionally reveal an unbroken leaf of pure unstained yellow; but the reds almost invariably retain some of the original green, or are uneven in color.

In noting the colors assumed by various species the observer should make a close distinction between ripe and dead leaves. There is both a ripening and decaying process in leaves as well as fruit. The ripening stage proceeds until a separating tissue or film forms between the petiole and the twig, and then, the supply of nourishment having been cut off, the leaf dies and falls. The yellow ones soon fade or turn brown after they drop; the red ones retain their color longer, and when prop-

erly pressed undergo little change in this respect. A ripe leaf while on the tree is still soft and flexible, whatever its color may be; a dead one is faded and sear, generally crisp and of a dull brown.

Bright colored specimens can be preserved by placing them immediately between sheets of blotting paper on which heavy weights, books, for instance, should be placed. Mr. Justus W. Folsom in an article on "Autumnal Changes in Leaves" (*Garden and Forest*, Vol. VIII, p. 383), says that they are best preserved by covering them with a sheet of paper, pressing with a hot iron upon which paraffine has been rubbed, and flattening and drying between papers afterward. Leaves thus prepared will retain flexibility and color for years; but if pressed without paraffine they will soon become dull and brittle.

The colors mentioned in connection with the different species are the ones which the trees may be expected to show in autumn. But on some there will be various exceptional tints, especially the Maples, among which may be found individuals bearing parti-colored leaves, some of them figured, striped or mottled like the wing of a gay butterfly. The White Ash leaf in ripening passes successively from a yellow to a dark bronze, violet, and chocolate brown, while here and there a leaf will display a lilac hue during this transition.

Still, the most of our trees show only some shade of yellow, and if we had to look to them alone the autumn would lose much of its brilliant beauty. Fortunately, the reds and scarlets which add so much to the glory of our woods and landscapes in September and October, are furnished in profusion by the larger shrubs that, in the openings along the country lanes and by the water courses, display their masses of flaming color. While yellow is the predominating autumn color of the trees, red prevails in the foliage of our shrubs and bushes.

A careful observer will note that much of the autumnal brilliancy seen in fields and on wooded slopes is due to humble species of our minor flora that are seldom mentioned in connection with this subject. Early in August the Hobble Bush displays its purple harbinger of fall, while along the roads and waste places the Sumachs show a profusion of leaves that look as if they had been "dipped in blood." By September the Poke Weed decks the rocky hillsides with the flaming mass of color afforded by fruit and foliage and stem. A score of minor species, shrubs and briers, together with the underlying mass of humbler weeds and purple grasses, add their varied hues, until the landscape exhibits all the warm colors of a Persian rug.

It is well to remember that some of our poisonous shrubs also assume bright, fascinating colors. The Poison Ivy, clinging to some tree, attracts the eye with the brilliant hues of its leaflets, crimson, scarlet or purple, while, more dangerous

still, the pinnate leaves of the Poison Sumach entrap the fingers of the unwary with all the brightest colors seen in autumn. Hence the collector of bright specimen leaves should become familiar with the appearance and dangerous character of these shrubs.

There are some seasons in which the autumnal coloring of the foliage seems especially brilliant, although it is doubtful if there is as great a difference in this respect as might be inferred from the oft-heard remarks on this particular point. Opinions as to the comparative vividness of the tints in any year may vary according to the conditions under which chance observations are made. If a person journeys through a region in which, owing to the prevalence of certain species, only the yellow shades are seen, the absence of the red and scarlet tints may readily induce the opinion that the woods are not at their best this season; and, on the other hand, if the observations are made in places where the Oaks, Maples, and Gums light up the woods with their blazing colors, the natural conclusion is that the trees look unusually fine that fall.

The sportsman whose fall hunting is done in the vast *brulé* of the Ottawa valley will see little aside from yellow on the trees, with no reds except on an occasional Maple or clump of Sumachs; while the tourist, looking from his car window at the Berkshire slopes or Short Hills of New Jersey would note with pleasure the scarlet foliage which the Oaks and various other species display annually throughout those places. Careful observations made each year of the mountain slopes in the Adirondacks and Alleghanies show no marked difference in the annual tinting of the forests. There may be some fall in which the maturing leaves seem to show a brighter color; but if the observation is made at the same place and on the same recurring date it would require a critical eye and good memory to distinguish the alleged variation.

It must be remembered, also, that these color effects are far more brilliant and impressive when observed on a bright, sunny day and in a dry, clear atmosphere; and that the autumn foliage loses much of its attractive appearance when viewed under cloudy skies or with the air obscured by haze or dampness. One beautiful effect of the sunlight in enhancing leaf colors may be obtained by standing under a White Oak, or any tree with red leaves, and looking towards the sun. With the transmitted light the leaves assume a far brighter color and a different hue than in reflected light; the dull, solid red changes into a fiery glow or rich wine color of marvellous beauty. In the Bronx park, near the path on the west side of the Beaver pond, stands a large White Oak which, on any bright afternoon in late October, will afford the visitor a good opportunity to study this charming revelation of

nature. Still, there is a widespread belief that the autumn foliage is much brighter some years than in others, and it is conceded that this may be true to some extent.

In European countries the autumn foliage is generally inferior in brilliancy and pleasing effects to that in America. There is a lack of red, and even the yellow which predominates so largely there is dull as compared with that seen in our American forests. The Maples and Oaks are not so common, or of so great a variety. Furthermore, the American species planted there lose the brightness which they display at home, and, on the other hand, European trees grown in America fail to develop the brilliant colors of our native trees.

The inferiority of color so noticeable abroad has been attributed to a more moist condition of the atmosphere. This might apply with good reason to the British Isles and Netherlands, but hardly to sunny France, or to the South of Europe, famed for its clear Italian skies. A better reason may be found in the "greater transparency of our atmosphere, and the consequent greater intensity of light."

In his work on *Autumnal Leaves*,\* Mr. Francis George Heath, of London, exhibits a series of twelve colored plates, in which he shows the tints of leaves collected by him in autumn from various leading species in England. The drawings are finely executed in both form and color; but, if the leaf tints have been correctly reproduced, their inferiority to the autumnal foliage in America is apparent at a glance. A comparison of the colored plates in Mr. Heath's book, with the pictures of autumn leaves shown in connection with this article, indicates plainly that, as to England at least, the leaves on American trees have colors far more brilliant, and in a greater variety.

The English botanist Hunter, in his notes on Evelyn's *Silva*, describes the September foliage in his vicinity as: "Plane Tree, tawny; Oak, yellowish green; Hazel, yellow; Sycamore, dirty brown; Maple, pale yellow; Ash, fine lemon; Elm, orange; Hawthorn, tawny yellow; Cherry, red; Hornbeam, bright yellow."

Having mentioned the inferior appearance of the autumn foliage in Europe, as compared with that in certain American latitudes, it should be further noted that this difference applies to trees, and that it is not wholly true of the minor flora. In the Alps of Central Europe the shrubs and herbaceous growths above the timber line display ripened colors that, in variety and brilliancy, are unsurpassed in any country.

The direct influence of sunlight on the development of leaf color is apparent to the most casual observer. The outer leaves on a tree are the first to turn, while a

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\* *Autumnal Leaves*: By Francis George Heath. London: Sampson, Low & Co. 1881.

leaf that is thickly shaded by others is apt to remain green until it withers and dies. Where a twig or branch presses constantly on the surface of a leaf the part thus covered remains green after the rest has turned yellow or red. If you cut your initials from tin foil or thick paper and paste them on a large leaf the letters will in time be sharply defined in green on a background of yellow or red.

Why leaves should change color is as hard to explain or understand as why the hair turns gray. The scientists who have written on the subject admit that there is much to learn about the process and its cause. The leaf cells contain rounded granules of green matter known as chlorophyll, a substance—or mixture of substances—to which the pure green color of ordinary healthy leaves is due. The appearance of any other color, such as red, yellow or purple, would indicate the presence of some substance accompanying the chlorophyll and disguising its color, or even replacing it entirely.\*

The leaf cells contain, also, xanthophyll, a peculiar yellow coloring matter, which remains after the decomposition or absorption of chlorophyll; and erythrophyll, which supplies the red or crimson shades found in matured leaves.

Most of the scientific explanations of the change of color are so technical that they are of little use to the general reader. The following extract from an article in the *Botanical Gazette* for April, 1887, entitled, "The Autumnal Changes in Maple Leaves," by W. K. Martin and S. B. Thomas, is instructive and interesting:

"Chlorophyll, manufactured constantly under the influence of light, is constantly undergoing decomposition by the metabolism of the cell. Under ordinary conditions, the manufacture of chlorophyll is sufficient to cover up its decomposition, and the leaf retains its green color. Under certain changed conditions, however, such as intense light or diminished vitality, the decomposition of chlorophyll exceeds its manufacture, and xanthophyll (probably one of the products of decomposition) appears. In other words, xanthophyll is being formed all the time, but only becomes apparent when the manufacture of chlorophyll is checked. The condition of intense sunlight gives us the occasional summer yellowness, while to lowered vitality must be attributed the failure of chlorophyll manufacture in the autumn. This lower vitality is brought about by diminution of light, lowering of temperature, and probably causes in the plant itself. Xanthophyll then stains the chlorophyll masses yellow, which were before stained green by chlorophyll. The red coloration is brought about in a very different way, as erythrophyll is manufactured in the leaf, and stains the cell sap, leaving the chlorophyll masses untouched. This red coloring matter cannot be discovered in any of the crude materials brought into the plant, or in any other part of the leaves, except sometimes in the phloëum regions

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\* Webb's Dictionary of Chemistry.

of the petioles. When the leaf falls and the cell sap evaporates, and the chlorophyll bodies die, the erythrophyll lays hold of the cell wall and solid contents and stains them. In this way dried leaves retain their red color. As erythrophyll is soluble in water, however, contact with moisture will soon cause the most of it to disappear."

An English writer, Mr. Alfred Russell Wallace, notes that chlorophyll is not a simple green pigment, but that it really consists of at least seven distinct substances, varying in color from blue to yellow and orange; and that they differ in their proportions in the chlorophyll of different plants, have different chemical reactions, are differently affected by light, and give distinct spectra. He suggests the collective name chromophyll as a proper one for designating the presence of these various pigments.

Kerner and Oliver in their *Natural History of Plants* state that "The chemical composition of colouring matters is yet little known, and it is possible that at present a whole group of them is collected together under the name anthocyanin,"\* and that this substance "appears red in the cell sap in the presence of acids, blue when no acids are present, and violet when the amount of free acids is but small. If there is an abundance of yellow granules together with the acid, red anthocyanin, the leaf assumes an orange color."

Mr. Justus Watson Folsom, in an article on "Autumnal Changes in Leaves" (*Garden and Forest*, Vol. VIII, p. 392), says:

"A green leaf, or an alcoholic extract of one, viewed through a spectroscope, shows a band of light, or spectrum, which is very characteristic; its dark intervals or absorption bands, resembling those of no other substance. If, now, we mix benzine with our green solution of chlorophyll which we have obtained by soaking, say, elm leaves in alcohol, the liquid separates into two layers, the upper of *bluish-green* benzine, and the lower of *yellow* alcohol. These two solutions give different spectra, proving them different substances. Our chlorophyll, then, was a mixture of at least two substances, or, more likely, a chemical compound which broke into two of its constituent compounds, the yellow one being called xanthophyll. Now, this separation presumably occurs when green leaves turn yellow, as is suggested by a simple experiment. If our alcoholic extraction from elm leaves has not been kept in darkness and sealed from the oxygen of the air, it has rapidly decomposed, turning from green to yellow—that is, the green constituent fades away first, gradually revealing the yellow one, which, by the way, some consider the equivalent of the etiolin that always precedes the first formation of the green pigment."

\*From the Greek words meaning flower and blue.

Mr. Joseph Wharton, in an article, "Observations upon Autumnal Foliage" (*American Journal of Science*, Vol. 47, p. 253), says that the distinguished French chemist Frémy "separates chlorophyll, when dissolved in alcohol, into two coloring matters, by submitting it to a mixture of ether and chlorohydric acid; the former takes up the *yellow* matter (phylloxanthin), the latter the *blue* matter (phyllocyanin), each liquid having distinctly the *yellow* and the *blue* color respectively, which being mixed by shaking together form a leaf green. The yellow coloring matter of new sprouts and of etiolated leaves contains phylloxanthin, capable of being developed into chlorophyll; in autumnal yellow leaves the phyllocyanin has been destroyed. The yellow matter, Frémy supposes to be more stable than the blue."

Mention is also made in scientific works of chemists who succeeded in extracting from green leaves pigments of various colors in the form of dried, powdery substances.

All these explanations, simply stated and divested of technical phrases, might read something like this: The substance in a live leaf contains blue and yellow pigments, and, as is well known, these colors when mixed form green. When, through failing vitality the action of these pigments is no longer restrained by the presence of chlorophyll, their colors become apparent. True, no one ever saw a blue leaf; but this color, under the action of the acid remaining in the cell-sap of the leaf, will be stained red. If the yellow substance alone remains the leaf will display that color; and with acids, orange. If the pigmentary substances are absorbed before the leaf falls, the brown walls of the empty cells will give it a russet tint. This explanation is not scientific, and it may not be entirely accurate; but it is fairly deducible from the various and varying statements of the botanists and chemists who have made this subject a matter of scientific research.

### Influence of Frost.

There is a popular impression that the autumnal change of leaf color is due to the action of frost; and that early frosts conduce to a more vivid tinting of the foliage. This, however, is an error that a little thought and observation will correct. Some of our trees display red and yellow leaves in August, long before cold weather comes. The brightest red shown in all our autumn foliage is that of a Red Maple on which the leaves turn color in August.

Conceding that the intensity of color differs with the seasons, it may be said that the most brilliant coloring of our forests occurs when a rainy summer is followed by a cool, dry August and September in which there is no frost. Undoubt-

edly, an early frost may precipitate a change by prematurely hastening the decay or death of the leaf; but the resultant color will be inferior, changing soon to the dull brown which characterizes sear, dead foliage. Moreover, when the fall months are cool and dry the leaves are persistent, and afford a longer display of autumnal tints.

Nor is frost necessary to the falling of the leaves.\* Throughout our Northern States much of the foliage of the trees falls before any frost occurs, while in the South the deciduous trees denude their branches without its aid. Frost can kill, but it cannot ripen vegetation. It has been noted also by close observers that while an early frost will check the development of bright leaf colors, a hot, sunny day, about the first of October, will have the same result and loosen the leaves so that they will fall in showers when stirred by the first gentle breeze.

In preparing the colored illustrations of autumn leaves, shown in the accompanying plates, great care was taken to place the specimens as soon as possible in the hands of the artist on whom devolved the task of reproducing the exact tints. This was found to be especially necessary with the yellow leaves, as this class when taken from the tree faded quickly to some extent. With the reds there was not so much need of haste, these colors being more persistent. In order to avoid delay in this respect as far as possible, the specimens were collected mostly in Bronx Park and Northern New Jersey, although excursions for the same purpose were made to the Berkshires and Catskills.

No attempt was made at scientific research; it was sought rather to offer in connection with the text some illustrations showing the typical color assumed in autumn by the leaves of our most common trees, illustrations which might furnish a convenient reference for naturalists if ever needed.

The collection was made by Mr. Abraham Knechtel, F. E., a forester in the employ of this Department, whose scientific attainments and love of nature-study rendered him well qualified for the work. Ample acknowledgment is also due to Mr. William E. Bruchhauser, of New York City, the artist whose skill and enthusiastic co-operation made the accurate reproduction of colors possible.

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\*Kerner and Oliver. *Natural History of Plants*. Vol. II, p. 355.

## Common and Botanical Names of Trees Mentioned in this Article.

So much confusion exists in the use of the common names of our trees that it may be well to append here a list of the species mentioned in the foregoing pages, with the botanical name of each for the purpose of further identification.

Cucumber Tree, Mountain Magnolia,	<i>Magnolia acuminata</i> L.
Tulip Tree, Yellow Poplar, Whitewood,	<i>Liriodendron tulipifera</i> L.
Basswood, American Linden, Lime,	<i>Tilia americana</i> L.
Ailanthus, Tree of Heaven,	<i>Ailanthus glandulosa</i> Desf.
Horse Chestnut,	<i>Aesculus hippocastanum</i> L.
Red Flowering Horse Chestnut,	<i>Aesculus rubicunda</i> .
White, Silver, Water or Soft Maple,	<i>Acer dasycarpum</i> Ehrh.
Red, Scarlet, Swamp or Soft Maple,	<i>Acer rubrum</i> L.
Sycamore Maple,	<i>Acer pseudoplatanus</i> L.
Hard, Rock or Sugar Maple,	<i>Acer saccharum</i> Marsh.
Norway Maple,	<i>Acer platanoides</i> L.
Schwedler's Maple, Purple Norway,	<i>Acer platanoides schwedleri</i> .
Ash-leaved Maple, Box Elder,	<i>Acer negundo</i> L.
Staghorn Sumach, Velvet Sumach,	<i>Rhus typhina</i> L.
Poison Sumach, Poison Dogwood,	<i>Rhus vernix</i> L.
Yellow, Black, or Common Locust,	<i>Robinia pseudacacia</i> L.
Kentucky Coffee Tree,	<i>Gymnocladus dioicus</i> C. Koch.
Honey Locust, Three Thorned Acacia,	<i>Gleditschia triacanthos</i> L.
Black or Wild Cherry,	<i>Prunus serotina</i> Ehrh.
Mountain Ash,	<i>Pyrus americana</i> de C.
Sweet Gum, Bilsted, Liquidambar,	<i>Liquidambar styraciflua</i> L.
Flowering Dogwood,	<i>Cornus florida</i> L.
Pepperidge, Sour Gum, Tupelo,	<i>Nyssa sylvatica</i> Marsh.
White Ash,	<i>Fraxinus americana</i> L.
Black or Swamp Ash,	<i>Fraxinus nigra</i> Marsh.
Western or Hardy Catalpa,	<i>Catalpa speciosa</i> Warder.
Sassafras,	<i>Sassafras sassafras</i> Karst.
English Elm,	<i>Ulmus campestris</i> L.
American or White Elm,	<i>Ulmus americana</i> L.
Hackberry, Sugarberry, Nettle Tree,	<i>Celtis occidentalis</i> L.

Sycamore, Plane Tree, Buttonwood, Buttonball,	<i>Platanus occidentalis</i> L.
European Sycamore, Oriental Plane Tree,	<i>Platanus orientalis</i> L.
Butternut, White Walnut,	<i>Juglans cinerea</i> L.
Black Walnut,	<i>Juglans nigra</i> L.
Shellbark or Shagbark Hickory,	<i>Hicoria ovata</i> Britt.
White Birch,	<i>Betula populifolia</i> Marsh.
Canoe or Paper Birch,	<i>Betula papyrifera</i> Marsh.
Black, Sweet or Cherry Birch,	<i>Betula lenta</i> L.
Yellow or Gray Birch,	<i>Betula lutea</i> Michx. f.
European Birch, Cut-leaved Birch,	<i>Betula alba</i> var. <i>laciniata</i> .
Hop Hornbeam, Ironwood, Leverwood, Hardhack,	<i>Ostrya virginiana</i> K. Koch.
Blue or Water Beech, Ironwood, Leverwood,	<i>Carpinus caroliniana</i> Walt.
White Oak,	<i>Quercus alba</i> L.
Red Oak,	<i>Quercus rubra</i> L.
Scarlet Oak,	<i>Quercus coccinea</i> Wang.
Black or Yellow-barked Oak,	<i>Quercus velutina</i> Lam.
Pin Oak, Swamp Spanish Oak,	<i>Quercus palustris</i> Muench.
Scrub Oak,	<i>Quercus nigra</i>
Chestnut,	<i>Castanea dentata</i> Borkh.
Beech,	<i>Fagus americana</i> Sweet.
Purple or Copper Beech,	<i>Fagus sylvatica</i> var. <i>purpurea</i> .
Bay Willow,	<i>Salix pentandra</i> L.
Small American Aspen, Poplar, "Popple,"	<i>Populus tremuloides</i> Michx.
Large American Aspen, Saw-tooth Poplar,	<i>Populus grandidentata</i> Michx.
Lombardy Poplar,	<i>Populus dilatata</i> L.
Cottonwood, Carolina Poplar, Necklace Poplar,	<i>Populus deltoides</i> Marsh.
White Pine,	<i>Pinus strobus</i> L.
Tamarack, Hackmatack, American Larch,	<i>Larix americana</i> Michx.
Ginkgo,	<i>Salisburia adiantifolia</i> Sm.

# Moose.

BY MADISON GRANT.

THE Scandinavian elk, which is closely related to the American moose, was known to classical antiquity as a strange and ungainly beast of the far north; especially as an inhabitant of the great Teutoborgian Forest, which spread across Germany from the Rhine to the Danube. The half mythical character which has always clung to this animal is well illustrated in the following quotation from Pliny's Natural History, Book 8, chapter 16:

“There is also the achlis, which is produced in the island of Scandinavia. It has never been seen in this city, although we have had descriptions of it from many persons; it is not unlike the elk but has no joints in the hind leg. Hence it never lies down, but reclines against a tree while it sleeps; it can only be taken by previously cutting into the tree, and thus laying a trap for it, as, otherwise, it would escape through its swiftness. Its upper lip is so extremely large, for which reason it is obliged to go backwards when grazing; otherwise by moving onwards, the lip would get doubled up.”

The elk and Pliny's achlis are evidently the same animal. Absurd as this description is, similar tales appear in modern natural histories about the habits of other animals, as little known as was the elk in Pliny's time. The age of child-like credulity in matters pertaining to zoology, which began long before Pliny, did not end with the nineteenth century. The tales told by hunters and trappers around the campfire to-day show as fervid an imagination and as naïve a disregard for facts.

The strange stiffness of joint and general ungainliness of the elk, however, were matters of such general observation as to apparently have become embodied in the German name *cland*, sufferer. Curiously enough this name *cland* was taken by the Dutch to South Africa, and there applied to the largest and handsomest of the bovine antelopes, *Oreas canna*.

In mediæval times there are many references in hunting tales to the elk, notably in the passage in the Nibelungen Lied describing Siegfried's great hunt on the upper Rhine, in which he killed an elk. Among the animals slain by the hero is the

"schelk," described as a powerful and dangerous beast. This name has been a stumbling block to scholars for years, and opinions vary as to whether it was a wild stallion,—at all times a savage animal,—or a lone survivor of the *Megaceros*, or Irish elk. In this connection it may be well to remark that the Irish elk and the true elk were not closely related beyond the fact that both were members of the Deer Family. The Irish elk, which was common in Europe throughout the glacial and post-glacial periods, living down nearly or quite to the historic period, was nothing more than a gigantic fallow deer, as can be readily seen by a comparison of the antlers of the two species.

The Old World elk is still found in some of the large game preserves of eastern Germany, where the Emperor, with his somewhat remarkable ideas of sportsmanship, annually adds several to his list of slaughtered game. They are comparatively abundant in Scandinavia, especially in Norway, where they are preserved with great care. They still survive in considerable numbers in Russia and Siberia as far east as Amurland.

Without going into a detailed description of the anatomical differences between the European elk and the American moose (and in fact we greatly need a series of European and Siberian specimens for comparison with the American forms), it is sufficient to say that the Old World animal is much smaller in size and lighter in color. The antlers, also, are less elaborate and smaller in the European animal, and correspond to the stage of development reached by the average three-year-old bull of Eastern Canada. There is a marked separation of the main antler and the brow antlers. That this deterioration of both body and antler is due partly to long continued elimination of the best bulls, and partly to inbreeding, is most probable. We know that the decline of the European red deer is due to these causes, and also that a similar process of deterioration is showing among certain outlying sections of the eastern moose. It was long considered by European naturalists that the type species of this group, known as *Alces machlis*, was uniform throughout its circum-polar distribution, in the north of both hemispheres.

The American view that nearly all animals in this country represent species distinct from their European congeners is now generally accepted, and the name *Alces americanus* has been given to the American form.

The comparatively slight divergence of the two types at the extreme east and west limits of their range, namely, Norway and eastern Canada, would indicate that the period of separation of the various members of the genus is not, geologically speaking, of great antiquity.

The name *Moose* is an Algonquin name, meaning a wood eater or browser, and is

most appropriate, since the animal is pre-eminently a creature of the thick woods. The Old World term elk was applied by the English settlers, probably in Virginia, to the wapiti deer, an animal very closely related to the red deer of Europe. In Canada one sometimes hears the moose spoken of as the elk, and even in the Rocky Mountain region one sometimes hears of the "flat-horned elk." We are fortunate in possessing a native name for this animal and it can only create confusion to call it by any other name than moose.

Until recent years it was the misfortune of Americans to have only foreign-made literature on zoology, and much confusion has resulted in the names of our common animals. A safe rule to follow would be, in my opinion, to use native names, such as moose or caribou, when available, but to respect well-established usage in regard to the names of other animals. In literature designed for more than local use the name wapiti or American elk should be used; but in ordinary use in the United States or Canada the word elk must suffice for the animal.

One of the results of this confusion of names would be ludicrous were not the results so serious. The Order of Elks is by origin an European society, and the "elk" referred to, of course, was the European form of the moose. In this country, however, the name was supposed to relate to the wapiti deer, and the canine tooth or tusk on the upper jaw of the wapiti has consequently become the emblem of the order and used as a watch charm or cuff stud. No member of the genus *Alces* has any canine teeth, this feature being confined to the genus *Cervus* and some closely related genera. The possession of these tusks has been a great misfortune to the wapiti, and thousands of them have been killed in the last few years solely for these teeth. To butcher so fine an animal merely for two teeth is a crime worse than killing him for his hide, and the Order of Elks has much to answer for. I am glad to say, however, that, at a recent convention, action was taken to abolish the use of elk tusks as emblems. It is not often that giving an animal a wrong name has fatal results; but the unfortunate wapiti and his teeth have suffered in consequence of this error in nomenclature.

The range of the moose in North America is of enormous extent, from Nova Scotia in the extreme east, throughout Canada and portions of the northern United States, to the limits of tree growth in the west and north of Alaska. Throughout this vast extent of territory but two species are recognized, the common moose, *Alces americanus*, and the Alaska moose, *Alces gigas*, of the Kenai peninsula; but it is probable that further exploration will bring to light another species near the headwaters of the Liard River and the Cassiar Mountains of British Columbia; and, still another farther north in the neighborhood of the Colville River.

Taking up this range in detail, the Nova Scotia moose are to-day distinctly smaller than their kin in Ontario, but are very numerous when the settled character of the country is taken into consideration. I have seen very few good antlers come from this district, and in my opinion the race there is showing decided signs of deterioration.

These remarks apply, but with less force, to New Brunswick and to Maine, where the moose, though larger than the Nova Scotia animal, are distinctly inferior to those of the region north of the Great Lakes. This is probably due to killing off the big bulls, thus leaving the breeding to be done by the smaller and weaker bulls; and, also, to inbreeding.

In Maine the moose originally abounded, but by the middle of the last century they were so reduced in numbers as to be almost rare. Thanks to very efficient game laws, backed by an intelligent public opinion, moose have greatly increased during the last few years in Maine and also in New Brunswick. Their habits have been modified, as will be seen later on, but as far as the number of moose and deer are concerned, the protection of game in Maine has been a brilliant example to the rest of the country. During the same period, however, caribou have nearly vanished.

Moose were found by the first settlers in New Hampshire and Vermont, appearing occasionally, as migrants only, in the Berkshire hills of Massachusetts. In the State of New York the Catskills appear to have been their extreme southern limit in the east; but they disappeared from this district more than a century ago. In the Adirondacks, or the North Woods, as they were formerly called, moose abounded among the hard wood ridges and lakes. This was the great hunting country of the Six Nations. Here, too, many of the Canadian Indians came for their winter supply of moose meat and hides. The rival tribes fought over these hunting grounds much in the same manner as the northern and southern Indians warred for the control of Kentucky.

Going westward in the United States we find no moose until we reach the northern peninsula of Michigan and northern Wisconsin, where moose were once numerous. They are still abundant in northern Minnesota, where the country is extremely well suited to their habits. Then there is a break, caused by the great plains, until we reach the Rocky Mountains. They are found along the mountains of western Montana and Idaho as far south as the northwest corner of Wyoming in the neighborhood of the Yellowstone Park, the Tetons and the Wind River Mountains being their southern limit in this section.

The moose of the western mountains are relatively small animals with simple



MOOSE KILLED 1892, WITH UNUSUAL DEVELOPMENT OF BROW ANTLERS.  
UPPER OTTAWA RIVER, CANADA.



PROBABLY LARGEST KNOWN ALASKA MOOSE HEAD—KENAI PENINSULA, 1899.  
EXTREME SPREAD, 78½ INCHES—WEIGHT OF SKULL AND ANTLERS, 93 LBS.  
Kindness of the Field Columbian Museum, Chicago.



antlers, as compared with the Ontario moose. Western moose have adapted themselves to mountain living in striking contrast to their brethren in the East, and are considered by the western hunters to be typical rock animals, in places nearly as much so as the big horn.

North of the Canadian boundary we may start with the curious fact that the great peninsula of Labrador, which seems to be in every way a suitable locality for moose, has always been devoid of them. There is no record of their ever appearing east of the Saguenay River, and this fact accounts for their absence from Newfoundland, which received its fauna from the north by way of Labrador, and not from the west by way of Cape Breton. Newfoundland is well adapted as a moose range, and a number of individuals have been turned loose there, without as yet any apparent results. Systematic and persistent effort, however, in this direction should be successful.

South of the St. Lawrence River, the peninsula of Gaspé was once a favorite range, but they were nearly killed off in the early '60s by hide hunters. Further west they are found in small numbers on both banks of the St. Lawrence well back from the settlements, until on the north shore we reach Trois Rivières, west of which they become more numerous.

The upper Ottawa and Lake Kippewa region has been a grand moose country in recent years, so far as the size of the antlers is concerned, but the moose are now rapidly pushing further north. Twenty-five years ago they first appeared, coming from the south, probably from the Muskoka Lake country, into which they may have migrated in turn from the Adirondacks. This northern movement has been going on steadily within the personal knowledge of the writer. Ten years ago the moose were practically all south and east of Lake Kippewa, now they are nearly all north of that lake, and extend nearly, if not quite, to the shores of James Bay. How far to the west of that they have spread we do not know; but it is probable that they are reoccupying the range lying between the shores of Lake Superior and James Bay, which was long abandoned. Northwest of Lake Superior, throughout Manitoba and far to the north, is a region heavily wooded and studded with lakes constituting a practically untouched moose country.

No moose, of course, are found in the plains country of Assiniboia, Saskatchewan, and Alberta; but east in Keewatin, and to the north in Athabaska, Northern British Columbia, and northwest into Alaska we have an unbroken range, in which moose are scattered everywhere. They are increasing wherever their ancient foe, the Indian, is dying off, and where white hunters do not pursue too persistently. In this entire region, from the Ottawa in the east to the Kenai peninsula in the far

northwest, moose are retiring toward the north before the advance of civilization, and are everywhere occupying new country.

Wary and keen, with his great muscular strength and hardihood, the moose is pitting his acute senses against the encroaching rifleman in the struggle for survival. His habits are being constantly modified, and it is fair to believe that this superb member of the deer family will continue to be an inhabitant of the forest long after most other members of the deer family have disappeared.

The moose of Maine and the maritime provinces occupy a relatively small area, surrounded on all sides by settlements, which prevent the animals from leaving the country when civilization encroaches. In this district their habits have been greatly modified. They do not show the same fear of the sound of rifle, or the smell of fire, or even the scent of human footsteps as in the wilder portions of the country. In consequence of this change of habit, it is difficult for a hunter, whose experience is limited to Maine or the maritime provinces, to appreciate how very shy and wary a moose can be.

In the upper Ottawa country, when they first began to be hunted by sportsmen, the writer remembers alighting from his canoe on the bank of a small stream, and walking around a marsh a few acres in extent to look at the moose tracks. Fresh signs, made that morning, were everywhere in evidence, and it had apparently been a favorite resort all summer. Snow fell that night and remained continuously on the ground for two weeks, when the writer again passed by this swamp and found that during the interval it had not been visited by a single moose. The moccasin tracks had been scented, and the moose had left the neighborhood. A moose with a nose as sensitive as this would find existence unendurable in New Brunswick or Maine.

In Maine and New Brunswick the animals answer the birch horn, under the impression that it is the call of the cow. This calling is usually done in the evening by lake or marsh; but in Nova Scotia, daybreak on a barren is the favorite hour and place. Personally I have not much confidence in calling, and rely generally on trailing; but bulls certainly are killed in this manner, although it seems that the young bulls are much more apt to answer the call than the larger and more wary animals. In Nova Scotia it seems to be a well-authenticated fact that bear have been shot by moose callers, the bear apparently sneaking up to seize the supposed cow. If this be true it must be a very rare occurrence, and is certainly the only time I have ever heard that adult moose are attacked by bears. In the deep snow of the northwest moose are sometimes killed by wolves hunting in packs, but the price of such an attack must be high, because there are few, if any, animals in the American woods more formidable than a moose at bay.

In the Ottawa district moose calling, while practiced, is not apt to be successful, and in the western mountains it is practically unknown, although a substitute is found by making any unusual noise, such as produced by rapping a tree twice with an axe in imitation of the double cough or short call of the bull, or by beating alders with a stick to imitate the antlers threshing in the bushes. These contrivances sometimes attract the attention of a bull who is close at hand, and bring him out into the open. Calling in Maine, however, will always be a popular but unsportsmanlike means of hunting the moose; unsportsmanlike, because everything depends upon the guide and nothing on the hunter, the only skill required of the hunter being the ability to sit still on a very wet log or on very cold ground. Whatever shooting is done is at close range and in the dusk.

It is too much, however, to ask of the average sportsman, who escapes from his desk for a couple of weeks in the woods, to show the skill and endurance necessary to even follow the guide while the latter trails hour after hour through wet leaves or soft snow, to say nothing of camping on the tracks. In fact, few men do it, and it not infrequently happens that the actual killing is done by the guide. No true sportsman, of course, allows his guide to carry a rifle; but even then many moose have been killed by the sportsman's rifle in the guide's hands.

There is much dispute at present as to how far a moose is actually deceived by the birch horn, and the treatment of the subject appears to depend a good deal upon the locality in which the writer has hunted. Those who have hunted moose in Canada and the west very properly attach little or no importance to calling, and sometimes almost deny its possibility. Those, however, who have hunted in the extreme east know little of any other method.

All the members of the deer family, especially the moose, do very foolish things during the rutting season, when the bulls frequently become quite reckless. This may explain many of the stories of the peculiarities of this animal, and these stories, while true, would relate to exceptional cases rather than the normal habits of the animal.

I have already referred to the relative size of the antlers of the moose from different localities, and called attention to the inferiority of the heads from the extreme east. Large heads have, however, come from this section, and even now one hears of several heads being taken annually in New Brunswick running to five feet and a little over in spread. The test of the value of a moose head is the width of its antlers between the extreme points. The antlers of a young individual show but few points, but these are long and the webbing on the main blade is narrow. The brow antlers usually show two points. As the moose grows larger the palma-

tion becomes wider, but the points fewer in number and shorter, until in a very old specimen the upper part of the antler is merely scalloped along the edge, and the web is of great breadth. In the older and finer specimens the brow antlers are more complex, and show three points instead of two.

A similar change takes place in the bell. This pendulous gland is long and narrow in the young bull, but as he ages it shortens and widens, becoming eventually a sort of dewlap under the throat.

One of the best heads from Maine that I can recall, was in the possession of the late Albert Bierstadt. The extreme spread of these antlers was  $64\frac{1}{4}$  inches. This bull was killed in New Brunswick, near the Maine line, some twenty years ago; another famous Maine head was presented to President Cleveland during his first term. Photographs of both of these heads appear herewith. Many very handsome heads have been taken in the Ottawa district, the best one that I remember being nearly six feet in extreme breadth. It is safe to assume that a little short of six feet is the extreme width of an eastern head.

The moose of the American Rockies are much smaller in body, and their antlers are not very large, a four-foot head being decidedly rare.

As we go north into British Columbia, through the head waters of the Peace and Liard Rivers, the animal becomes very large in size, perhaps larger than anywhere else in the world as far as his body is concerned; but the antlers, while very large and handsome, are not so massive as those of the great Alaskan moose. In fact, all the moose of the Rocky Mountains from Wyoming to the Alaskan boundary have relatively small antlers.

In the Kenai peninsula and the country around Cook Inlet, Alaska, we find a distinct species recently described as *Alces gigas*. The animal itself has great bulk, but perhaps not more so than the animals of the Cassiar Mountains. The antlers of these Alaskan moose are simply huge, running, on the average, very much larger and more complex than even picked heads from the east. These antlers, in addition to their size, have a certain peculiarity in the position of the brow antlers, the plane of which is more often turned at nearly right angles to the plane of the palmation of the main beam than in the eastern moose. In a high percentage of the larger heads there is on one or both antlers an additional and secondary palmation. In the arrangement and complexity of the brow antlers, and in the complexity produced by this doubling of the beam, a startling resemblance is shown to the extinct *Cerv-alces*, a moose-like deer of Pleistocene times, possibly ancestral to the genus *Alces*. If this resemblance indicates any close relationship we have in the Alaskan moose a survivor of the archaic type from which the true moose and Scandinavian elk have



"BIERSTADT" HEAD. KILLED 1880, BOUNDARY OF NEW BRUNSWICK AND MAINE.  
EXTREME SPREAD,  $64\frac{1}{4}$  INCHES.



MAINE MOOSE; ABOUT 1890.



somewhat degenerated. The photographs of the Alaskan moose shown herewith have this double palmation.

All the members of the genus *Alces* are distinctly ancient forms, in the same sense that the rhinoceros, the giraffe and the camel are remnants of long past eras. No one who has ever seen the moose, living or dead in his native forest, can fail to appreciate this fact.

Several heads from the Kenai peninsula ranging over six feet are authentic; a photograph of the largest known moose head in the world is published herewith. This head is in the possession of the Field Columbian Museum at Chicago, and measures  $78\frac{1}{2}$  inches spread. The animal that bore it stood about seven feet at the shoulders, but this height is not infrequently equaled by Eastern moose. The weight of the dried skull and antlers was ninety-three pounds, the palmations being in places two and one-eighth inches thick.

There are several large heads in the possession of American taxidermists, which, if properly authenticated, would prove of interest. No head, however, is of much value as a record, unless its history is well known, and unless it has been in the hands of responsible persons. The measurements of antler spread can be considered authentic only when the skull is intact. If the skull is split an almost imperceptible paring of the skull bones at the joints would suffice to drop the antlers either laterally out of their proper plane, or else pitch the main beam backward. By either of these devices a couple of inches can be gained on each side, making a difference of several inches in the aggregate. But the possession of an unbroken skull is by no means a guarantee of the exact size of the head when killed. Since large antlers of any species of deer command a price among those who desire to pose as sportsmen, and have not the strength or skill to hunt themselves, it has become a regular business for dealers to buy up unusual heads. The temptation to tamper with such a head and increase its size is very great, and the head passing through the hands of such dealers must be discarded as of much scientific value. A favorite device is to take a green head, force the antlers apart with a board and a wedge every few days during the winter. By spring the skull and antlers are dry and the plank can be removed. The spread of antlers has meantime gained several inches since the death of the animal that bore them. Such a device is almost beyond detection.

It is an exceedingly difficult matter to formulate a code of hunting ethics, still harder to give them legal force; but public opinion should condemn the kind of sportsmanship which puts a price on antlers. As trophies of the chase, hard won through the endurance and skill of the hunter, they are legitimate records of

achievement. The higher the trophy ranks in size and symmetry, so much the greater should be its value as an evidence of patient and persistent chase. To slay a full grown bull moose or wapiti in fair hunt is an achievement, for there is no royal road to success with the rifle, nor do the Happy Hunting Grounds exist to-day; but to kill them by proxy, or buy the mounted heads for decorative purposes in a dining-room, in feeble imitation of the trophies of the baronial banquet hall, is not only vulgar taste, but is helping along the extermination of these ancient types. An animal like the moose or the prong-horn represents a line of unbroken descent of vast antiquity, and the destruction of the finest members of the race to decorate a hallway cannot be too strongly condemned.

### Adirondack Moose.

The history of the moose in the Adirondacks has a melancholy interest. They were numerous in this State as late as the '40s, and the following notes are republished from an article on this subject by the writer, which appeared in the *Century Magazine* of January, 1894.

“John Constable, a well-known sportsman and hunter, killed two moose near Independence Creek, Herkimer County, in 1851, and in the winter of 1852-53 shot his last one west of Charley Pond. That same season Alonzo Wood and Edward Arnold shot two moose, and found another dead, in the forest back of Seventh Lake Mountain in Hamilton County. In the summer of 1855 the last moose captured alive was taken by Charles L. Phelps, who killed a cow moose in Brown's Tract and brought her calf out of the woods with him. It died the following year. A moose was killed at Mud Lake in 1856, and Edward Arnold at Nick's Lake in the same year killed another. The next year a man named Baker shot one in the same vicinity.

“It was long thought that Governor Horatio Seymour had killed the last moose in the Adirondacks, but several others have better claims to that honor, if honor it be. Governor Seymour did shoot a fine bull in 1859, just north of Jock's Lake, not far from West Canada Creek, Herkimer County. The horns were kept for years at his farm at Deerfield, near Utica.

“In 1860, however, Alva Dunning killed several on West Canada Creek, and Reuben Howard, an old moose-hunter, killed his last the same year. Howard states that he heard of two being shot a little later, which may refer to the two that Chauncey Hawthorne claims to have killed about this time. The year 1861 saw at Raquette Lake the destruction of the last family of moose, and, in all probability,

of the last individual in the State. In July a Mr. Blossom killed a cow moose on the south inlet of Raquette Lake, and later in the same month his companion, Mr. Tait, while jacking on Marion River, wounded a young moose, but lost him in the dark. Early in August a bull calf was killed near the same place by a guide named William Wood. It had been wounded, and was unquestionably the one hit by Mr. Tait. Marks of a bull were seen in the neighborhood.

“The last authentic moose in the Adirondacks was killed in the autumn of the same year, on the east inlet of Raquette Lake. A party of sportsmen, guided by Palmer of Long Lake, was canoeing down Marion River toward the lake. On turning a bend in the river they were surprised to see a huge creature start up among the lily-pads and plunge wildly toward the shore. Several charges of shot were fired with no visible effect, when Palmer took deliberate aim with his rifle, and killed the animal on the spot. It proved to be a cow moose, the last known native of its race in New York State.”

As to the question of restocking the Adirondacks, the State is greatly to be congratulated on the efforts now being made in that direction. I wish the promoters of this undertaking the greatest success, but I think the difficulties will prove greater than they anticipate. In my opinion at least one hundred individuals, scattered in small bunches of five or ten in different sections of the woods, must be turned loose, and an intelligent public sentiment must be aroused for their protection. The first offender, who through stupidity or malice shoots a moose under the alleged impression that it is a domestic cow, should be very severely punished. One conviction involving imprisonment of the offender, if only for a short period, will go a long way toward the enforcement of the law.

Owners of private parks in the Adirondacks, notably Mr. Edward H. Litchfield, are doing great public service in their efforts to reintroduce moose, and I am inclined to think that it will be in these large parks that the first successful restocking will take place. Mr. Litchfield has set a noble example in his efforts to allow Nature to reassert herself in her own way, by removing the scars of the axe in the forest and filling the gaps caused by the rifle and the steel trap among the native animals.

None but animals native to the Adirondacks should be introduced there, and these animals are sufficiently interesting and varied. Of the Deer Family, the moose, the wapiti and the Virginia deer are all that belong in the Adirondacks, and if restored in their pristine numbers would take all the available supply of food. Among the larger carnivora, the wolf and the panther, we shall have to get along without; but the bear is a harmless and interesting feature of the wilderness. He

does but little destruction among the animals beyond levying a slight tribute from stray cows or sheep, a process not particularly injurious to the landscape. The bear should be protected by law, and will be just as soon as the guides in the Adirondacks appreciate that the value of a skin of a dead bear is a trifle beside the value of the living animal in the interest it excites among the summer visitors. That they can easily be seen by tourists close to hotels has been clearly demonstrated in the Yellowstone Park, where the bear have become quite indifferent to man's presence through long continued immunity from persecution. The lynx is a scarce animal everywhere, and is only destructive to rabbits and partridges; and he too can be left undisturbed, to furnish bloodcurdling tales for the camp fire in summer and mysterious tracks in the winter's snow. The fox is abundantly able to take care of himself, and does not need the protection of law. There is a strong hatred among Adirondack guides to the porcupine, dating back to the still recent period when dogs were used for running deer. In New Brunswick or Nova Scotia among the Indians it is a high crime to wantonly destroy a porcupine, as it is the only animal that can be easily killed with a club, and it has thus been the means of saving many a lost and starving man.

All the fur-bearing animals, fisher and martin and mink, but above all the beaver, should enjoy an absolutely close season. If this could be done, and the great northern diver and blue heron, the bittern and the wild ducks could be left undisturbed, the value of the North Woods as a tourist resort would be infinitely enhanced. The day will come when a guide or nursing sportsman who wantonly kills any of these animals will be branded as a social outlaw, as is to-day the professional hide hunter or market hunter.

The State is engaged in replacing at great expense the moose which were destroyed fifty years ago. The other animals, such as the beaver, will have to be restored in the future in the same manner.

It is a fortunate thing for the lovers of wild life that few animals other than those native to the Adirondacks are suitable for introduction there. Attempts will be made to introduce animals like the black tail deer from the west and the caribou from the north. Both of these attempts, in my opinion, will fail. There have never been caribou in the Adirondacks. The chance of success is even less in the efforts which will surely be made to introduce the game of Europe, such as the wild boar or the fallow deer. They are uninteresting, and why any one should want to introduce them is a mystery; but it has been tried and will be tried again, just as carp is being introduced into American waters, although it is a fish entirely devoid



ALASKA MOOSE HEAD SHOWING UNUSUAL DEVELOPMENT OF ANTLERS—KENAI PENINSULA.  
Kindness American Museum of Natural History, New York.



YEARLING MOOSE.



of game qualities, ill suited for food, unsightly to the eye, and very destructive to the spawn of game fish.

Any animal native to a country can be restored if the proper stock is obtained; but the chances are always against the acclimatization of animals from other countries. That this is particularly true of all of the American hoofed animals is a melancholy fact. The wapiti thrives in the east, but we all know that it was once native to the Adirondacks. The buffalo lives and breeds fairly well in the east, but not as well as might be expected when we remember that the buffalo once ranged to tidewater in Virginia.

We are as yet in ignorance of the causes which limit the distribution of animals, but the questions at issue are of far greater moment than even the perpetuation of the animals themselves. One of the political problems of the immediate future is the acclimatization of the white races in the tropics. It may be done, but only through the discovery of the laws that affect the distribution of animals, as the laws governing men and governing animals are in all cases the same. The New York Zoological Society is earnestly trying to solve the problem in the case of the moose, the caribou and the western deer.

In the New York Zoological Park the moose were given a large paddock five or six acres in extent, furnished with a pond for bathing, shade trees against the sun, and a shelter barn for the storms of winter. They were tempted with every kind of food, from rolled oats to browse. Bark, leaves and twigs of hemlock, alder, birch and willow were supplied them in quantities. They ate freely, lived a few months and then died suddenly of gastro-enteritis. It may be that an animal accustomed to roam daily over many miles of forest for its food, nipping a bud of moose wood here, tearing off a piece of spruce bark there, requires an amount of exercise to keep him in condition which no fenced inclosure can provide. If the animal could be made to run fifteen or twenty miles a day without dashing himself against the fence and injuring himself, something might be done; meanwhile we must go on experimenting.

In the case of the moose, which originally ranged comparatively close to the city of New York, and which in Maine and Nova Scotia still comes down to tidewater, a solution of the problem should be found. The buffalo suffer from the same dread disease, but in their case the stock is already weakened by inbreeding, and the day of their final extinction is not far off.

The mule deer and the Columbia black tail deer die in the same way; but in their case climate probably plays a considerable part. For some unknown reason

the tropical deer show an unexpected ability to survive in the north, a fact most suggestive of the northern origin of the whole deer family.

The problems briefly outlined above are too far reaching for further discussion in this article, but sufficient has been said to show the importance of restoring the lost members of the Adirondack fauna, above all the mighty moose, largest and grandest of the deer, wary, brave, deep of chest and strong of limb. May the shadow of his dark form once more fall upon our northern lakes, and the gleam of his great antlers be seen in the sombre recesses of the North Woods.

NOTE.—The writer desires to express his thanks for photographs and information used in this article to Dr. J. A. Allen, of the American Museum of Natural History, New York City; Dr. Daniel Giraud Elliot, of the Field Columbian Museum, Chicago; and to Mr. Andrew J. Stone, the explorer.



A GOOD SHOT.

# The Wapiti (*Cervus canadensis*).

By W. A. WADSWORTH.



THESE is no animal left on earth that compares in majesty and beauty with the American stag, which I shall speak of as the elk "because every one else does it" (an excuse for wrongdoing since the beginning of sin), and if he can be successfully introduced into the Adirondacks he will be the greatest addition that can be made to their attractiveness. He is really most at home among the grassy slopes and forest glades of the real mountains, and may hardly take kindly to the rolling, thickly timbered country of which our State forest is principally composed. He wants open spaces over which he can roam, and succulent grasses on which he can feed, and the leaves, sprouts, marsh growths and lily pads, so loved by the moose and deer, are not natural to him.

It is true they were found all along the Alleghanies from Virginia upward, and the hat rack in our house in the Genesee Valley is made of elk antlers killed there some sixty years ago. But Western New York contained more glades and open spaces in its forests, and the underbrush was less dense than in the North Woods. They are all gone now, not only from our own State, but from all the vast expanse between there and the Rocky Mountains, and the great droves of thousands which many living men have seen, have been so broken up that elk practically exist in any quantity only at the Yellowstone Park, where they are preserved by the National Government but slaughtered whenever they get outside of its limits, which do not extend far enough to the southward to fully take in their winter range.

There is a great local pretense that they are killed off by "Eastern dudes," "Toorsts," "Indians," etc.; but the majority are taken late in the season by men who go into the mountains for "meat" for winter use, and by pot hunters wanting

the hides or teeth. The former have little value, but the two small tusks called the "ivories," found in the upper jaw, have by a strange perversion, and without the approval of its officers, become fashionable as a badge among some of the members of a well-known society.

So, many a noble beast has died in the snow, leaving head, hide and carcass to rot untouched, to furnish a foolish ornament to some fat and worthy clubman who never saw forest, mountain, or camp fire, and is so ignorant of the lore of his own fraternity as not to know the difference between the great prehistoric Irish Elk, from which it derives its name, and the American Wapiti, which is technically no elk at all.

We have heard so much of the SPORT of elk hunting from all sorts of writers from the President down, that it seems ungracious to find fault with it. But they are a very large animal, a naturally tame and stupid animal, and a gregarious animal. With the wind in my favor and by keeping absolutely still I have had a herd browse up so close that I could have touched them with my hand; and during the rutting season the bulls will, if alone, come trotting up to even a very poor imitation of their "whistle," or keep on answering it if with the herd.

I do hope that if introduced here it will be as a "beast of ornament," not as a "beast of the chase." One live elk is worth more to any forest than a ton of his meat, and neither are worth failing to welcome all our fellow-citizens to our beautiful State, and making them forget its advantages by vexatious game laws founded on local prejudice and petty spite.\*

The wapiti is a large dun or slate colored deer with slender legs, a black face, pointed nose, and a curious looking light colored patch on the rump. The males weigh about eight hundred pounds or more, and their fine antlers are too well known to need description. They formerly inhabited the slopes of the Alleghanies, and roamed in vast bands over the broken prairies of the upper Missouri. To-day they are found only in the western mountains, and I can but describe their habits as I know them there. It is the common usage to speak of bull, cow and calf elks; but there is nothing bovine in their ways and habits, the young especially being far more like colts than calves in their play, and having the same trick of working their lips when trying to make friends with an older or stronger animal.

They are born in May or June and stay with their mothers during the summer, but they are foolish, trusting little beasts, and will come whinnying at a gallop toward

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\*The laws of Wyoming require every non-resident of that State to pay a license of forty dollars, which allows him to kill two elk only; and also that *he shall not go hunting unless accompanied by a hired "guide,"* who will act as a spy on his actions. No one but a resident of Wyoming can be a guide; but any resident can by paying one dollar, whether he knows anything about the mountains or not.



WESTERN "ELK."

(COURTESY OF THE PAGE WOVEN WIRE FENCE CO.)



A. B. STROUGH, PHOTO.

YOUNG COW ELK,

ON PRESERVE OF HON. WM. C. WHITNEY, HAMILTON CO., N. Y.





A. B. STROUGH, PHOTO.

ALERT.



A. B. STROUGH, PHOTO.

ALARMED.

BAND OF ELK ON LITTLE UPPER LAKE, ADIRONDACKS,



a stranger if separated from their dams. Toward the end of August the females begin to get together and are soon joined by the males, over whom, as well as their young, they seem to keep watch, being continually on the lookout while feeding, and moving ahead on the march, the big bull usually bringing up the rear.

The male drops his horns in early spring, and in early summer retires high up the mountains so as not to be bothered by flies during the slow process of growing new ones. On the spot from which the old horns fell, there appears a spongy growth seemingly all blood vessels, which increases at the rate of nearly an inch a day, gradually hardening around a central core until the full size is reached. Then when fully hardened, the outer skin, or "velvet," dries up, splits, and seems to itch, for they are continually rubbing it off against small trees, "shaking" (them) as it is called, during which time of course they are making so much noise and so occupied that they are easily approached. About the first of September, fat, sleek, and with branching antlers, they come down to join the herd.

Might makes right among deer as well as among men, and dispositions vary as with us. There certainly is some fighting; and it really would seem hard to spend so much time and labor growing such glorious things to butt one's enemies with and never use them. But I have rarely seen a drove, however small, in which there were not several bulls, and they are usually feeding quietly together. If a stranger comes whistling through the timber saying he is "the best man" the statement is not taken on faith by the head of the herd, and there is trouble immediately; but one curious fact is that the young bulls, instead of staying and watching the fun, as men would, flee in a panic of terror.

On the whole they seem a peaceful animal when undisturbed, browsing in bands along the mountain side and walking every now and then out on some jutting crag or promontory where they seem to enjoy the broad outlook, and make superb pictures against the sky line. When frightened they go off at a long, lumbering trot, taking naturally to the most difficult ground, over which they seem to travel as easily as if it were smooth.

The elk "whistle" varies very much, so that it doubtless has different meanings; but it is assuredly not a sign of fear or signal of danger as is often stated. It is a defiance, and is promptly answered by any other bull that hears it. If he is with his herd he usually stays there waiting for the stranger; but if alone he is apt to start toward the sound to investigate, and he will come up pretty close before deciding what to do; I have seen them come within fifty feet of a pack train in answer to an imitation of it, and then, notwithstanding the noise and talking, follow along abreast for a mile or so, challenging at intervals, and never over one hundred yards away.

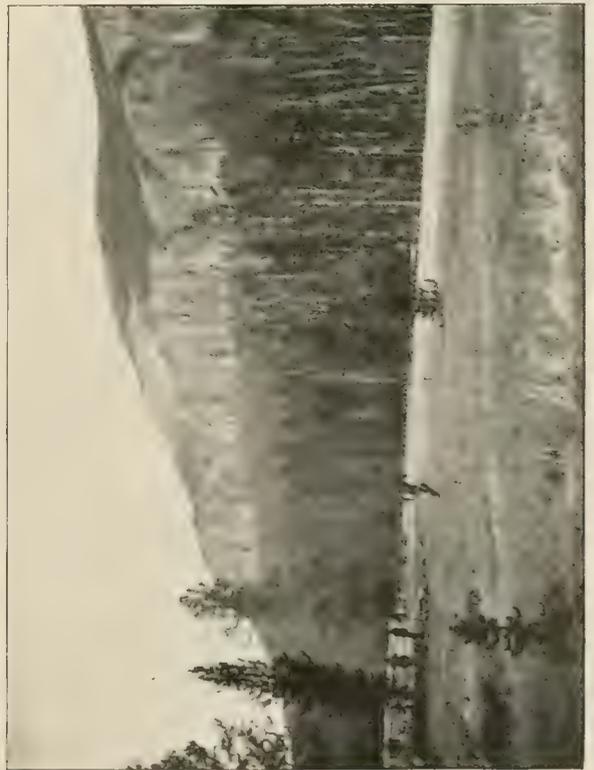
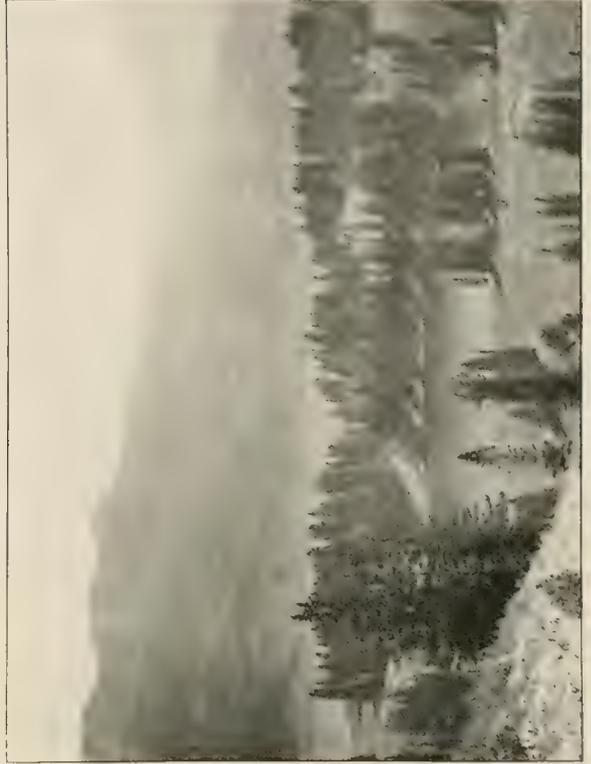
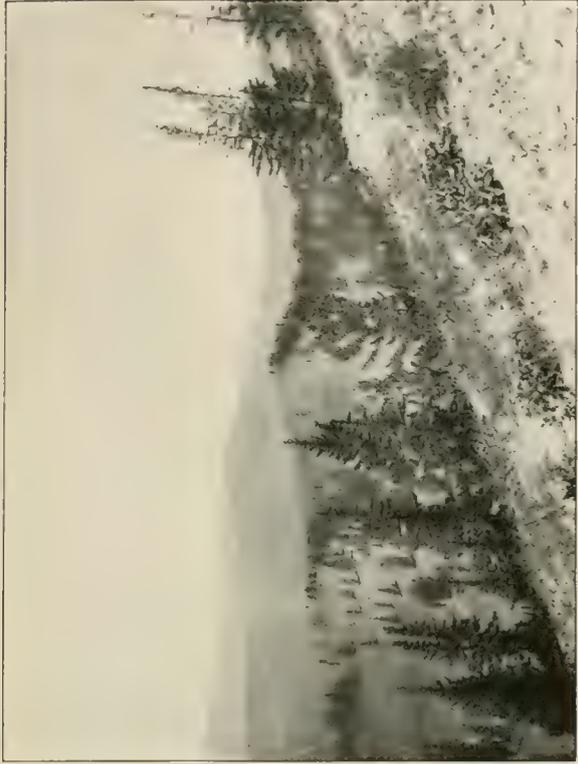
The sound itself is at times a series of gasping grunts, resembling the beginning of an ass' bray followed by a distant steam "siren." At other times there is a musical whistle running through several notes, which, rising clear and sweet through some lonely mountain glen, can neither be forgotten, imitated or described.

It may interest some whose hunting yarns have been questioned to know that among the early settlers there was a story that elk fell down in a fit when startled, which may account for the numberless persons who say they have shot them, seen them fall, and never found them, for strange as it may seem even such a big beast can be missed with a modern rifle, as I personally know. And they are said to like horses and dislike sheep, though they have the sheep trick of traveling in single file; and I have seen a yearling bighorn ram walking solemnly along a mountain trail after a big bull elk.

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THE HABITAT OF THE WAPITI.



# The Adirondack Black Bear.

By GEORGE CHAHOON.



THE Bear family is large, widely distributed, and contains about fifteen species. They are classed by the naturalists among the Carnivora; but they are really omnivorous, feeding more largely on vegetable than animal food. They are considered savage animals; but it is probable that their ferocity is exaggerated, for they are seldom aggressive, though they show much courage in defending themselves, and are generally ready to fight for the protection of their young. Their walk is plantigrade,—that is, they place the whole sole of the foot on the ground, and their track in the snow or soft earth bears a marked resemblance to the imprint of a man's hand. When attacked they stand

upright and strike with their forepaws, which are armed with long, sharp claws.

The twelve species which constitute the genus *Ursus* are found in all the northern regions of the globe; but it is probable that the Black Bear, *Ursus americanus*, is the only species ever found in the State of New York. They were once common throughout the State, but their habitat is now restricted to the Adirondacks and the Catskills. Grown bears of this species vary in weight from 150 to 400 pounds; but the young are surprisingly small. Merriam, in his "Mammals of the Adirondacks," says: "The diminutive size, premature appearance and helpless condition of the young of this species at birth cannot fail to excite surprise. They are not six inches in length, weigh less than a pound, and are not yet covered with hair. Their eyes do not open for more than a month. I know of no other mammal,

except among the marsupials, whose young are so disproportionately small, or are born in such an undeveloped condition."

Although the white man kills the bear without any remorse of conscience, the Indians had such respect for his intellect and cunning that they endeavored to appease his departed spirit with various time honored ceremonies, in which an orator extolled his courage, regretted the necessity of his killing, and paid a tribute to the valor of the surviving members of his family.

In comparatively recent years there were a good many of the larger game animals in the Adirondack forests,—of which the moose, the panther and the wolf have become practically extinct. Excepting the recent importations for restocking there is now no wild moose in the North Woods. It has been years since I have known a well-authenticated story of a wolf; and while it is possible the panther is not entirely extinct, if he still exists his numbers are few and his end near.

Practically speaking, of the larger mammals in our forest the red deer and the black bear alone remain. There seems to be a law, higher even than an act of the New York Legislature, that the wild beast must disappear before the advance of civilization; and while the development of the Adirondacks by the railroad, the summer hotel, and the pulp mill has added many to our school houses and churches, it has done much towards the destruction of our wild animals. Modern science tells us that all life is dependent upon its environment, and the repeating rifle loaded with smokeless powder does not make a favorable environment for large game.

Deer are quite plentiful, but in some respects the bear seems to have withstood the hand of man more successfully than the deer. Much has been done by our lawmakers to protect the deer, and the sentiment of man is against his destruction; but the bear has no man for his friend. No legislature has ever put any restriction upon his murder, while in some counties he is regarded as an outlaw and a reward is placed upon his head. Many thousands of dollars have been paid as bounties for his extermination; still he survives, and occasionally takes a sheep or a calf from some mountain farmer as a forced restitution for the wrongs inflicted on his race.

People who know the bear only in captivity do not understand him in his wild state. This sluggish, awkward animal will lead a dog in a wild chase over the highest peaks and most inaccessible places in our mountains, and when finally overtaken will turn upon his pursuers and, with one stroke of his powerful arm, send any dog within his reach howling away or lying bleeding and dying at his feet.

The wild bear is not only fleet of foot, but has great sagacity, is very alert and is seldom overcome in a fair field, even by our most experienced woodsmen. When taken in the summer or autumn he usually falls a victim to the large steel trap set



THE BLACK BEAR—*URSUS AMERICANUS*.



cunningly by man for his undoing. Some close observer of human nature says "Cupid catches more with traps than he kills with arrows." I am not an expert on this subject; but to the bear I am sure the trap is more fatal than the rifle.

During the summer and fall they eat enormously and take on a great deal of fat; and when the cold weather comes they crawl into holes or caves, roll themselves up and lie dormant until the warm winds of spring carry away the snows. During this time a curious phenomenon takes place in the animal's digestive organs, which gives it the capacity of remaining through the entire winter in a state of lethargy without food while slowly consuming the surplus fat acquired in the autumn. As the stomach is no longer supplied with food it soon becomes quite empty, and, together with the intestines, is contracted into a very small space. No food can now pass through the system, for a mechanical obstruction, technically called the "tappen," blocks up the passage and remains in its position all winter. The "tappen" is composed of leaves and other woody substances. This habit of hibernation is a great protection, for if the bear roamed around all winter he would be easily tracked and overtaken in the deep snows; but once in his den, which is usually in some almost inaccessible mountain, it is nearly impossible to find him, and the drifting snows soon cover the entrance to his hiding place.

Like our National Weather Bureau, the bear sometimes makes a mistake about the storms; and occasionally snow falls before he retires for the winter, in which event he usually begins at once to hunt his hole. This is unfortunate for him; for whenever an early snow comes every bear hunter takes his rifle and tramps through the rough mountains looking for tracks, which if he finds he follows to the den where there is frequently a family of mother and cubs which, in their semi-torpid condition, are easily killed.

The early snows and the large steel traps are the means of getting most of the bears killed in the Adirondacks. Occasionally a bear passing a runway where a man is watching for a deer gets killed. Sometimes a man comes upon one while "still-hunting," and gets near enough for a successful shot; but instances of this kind are rare.

The bear is an omnivorous eater. I have seen his marks along streams where he had been looking for fish. He is known to rob bees' nests for honey; but in the summer and fall he lives largely upon berries and fruits of forest trees,—acorns and beech nuts,—and when wild cherries are ripe one frequently finds small trees and limbs he has broken down for the fruit. He has a great liking for ants, and in places where he is common, many of the half rotten stumps and old logs have been pulled apart by him while looking for ants and their eggs. This work can be easily

determined, for his strong, sharp claws leave clearly marked scratches. They have a habit of biting and scratching the trunks of living trees for no reason I know; and it is not uncommon to find trees marked with the imprint of their teeth and claws.

Bears do not like to come into even as much of an opening as a mountain sheep range, and consequently they destroy but few domestic animals; but I have seen the remains of several sheep killed by them. It seems to be the general opinion of people who live in the Adirondacks that when a bear kills a sheep he eats all he can and returns in a night or two for another good meal on the remains. I have known of three instances where steel traps and strychnine have been cunningly prepared for his expected return, but he did not come back in either case.

The bear is hunted largely for sport. He is classed as "big game," and most hunters like to be the hero of a bear story. In addition to this his hide makes a fine rug, or it will fetch a good price from the fur dealer; his meat is eaten, but to my taste it is too fat to be coveted; and there is still another incentive for killing in the counties where bounties are paid.

The bear is far more sagacious and alert than the deer, and if he had the same protection he would rapidly increase. His destruction of domestic animals is trifling, and if his trapping were prohibited and the bounty on his killing removed, we might safely rely on the hunters' love of sport to prevent his becoming so numerous and bold as to be a cause of any real annoyance to our farmers. If instead of the bounty on his death the farmers were paid by the county for the sheep he destroyed, a more equitable arrangement would be made at a small percentage of cost to the taxpayer. This fall (1902) Essex County paid two hundred and eighty dollars for the killing of twenty-eight bears, and I very much doubt the killing of one sheep in this county by bears during the past year.

As illustrating the endurance and tenacity of life of the black bear I will mention an incident in the experience of one of the most successful hunters ever in the Adirondacks. Some years ago Mr. George A. Stevens, of Lake Placid, found a bear track in an early snow, near his home, and taking his friend, Mr. Frank B. Stickney, after supplying themselves with their rifles and a knapsack of food, they followed the track over the rough mountains and through the thick swamps until dark overtook them, when they camped in the snow beside the track to renew the chase at daylight. During the following day Mr. Stevens had two shots, one breaking the lower jaw, the other passing through the animal's kidneys. The next or third day the snow melted so the track could be followed no longer, and after over forty miles of hard travel the chase was reluctantly abandoned. The following spring Mr. Charles Martin, of Saranac Lake, killed the bear swimming the lake,



G. H. RISON, PHOTO.

ADIRONDACK BEAR.



where Mr. Stevens went to see and identify it. The animal was reduced almost to skin and bones.

In the Southern States the black bear is hunted with dogs, who chase, bark at him, and bite his hind legs, and, being more spry of foot than he, manage to avoid the stroke of his paws. This torment is kept up until the bear in his desperation and desire to escape his tormenters climbs a tree, where the dogs bark and keep his attention until the hunter comes up and shoots him. I have never known bears successfully hunted with dogs in the Adirondacks, and I have never known them to climb trees to escape their pursuers, nor have I known dogs to follow them successfully; they either lead over some cliff where dogs cannot follow, or they successfully turn and drive them off.

The bear is a good swimmer, and does not hesitate to cross a lake several miles wide when it lies in his course. It is probable that the habit of hibernating is undergoing a change among these animals in the Adirondacks.

When I began to take an interest in this species, hunters used to tell me that the practice of "holing" during the winter was far from universal; that it was common to find bear tracks in the woods during the whole winter; and that they were frequently followed on snowshoes and killed. Merriam in his "Mammals of the Adirondacks" says that bears frequently roam around all winter, or only retire for a short time when food fails, this being particularly true of the old males. It has been many years since I have seen a bear track after the cold weather really began; and hunters and men who spend a great deal of time in the woods tell me they never see bear tracks in the winter. My experience has been limited entirely to Clinton, Essex, and part of Franklin Counties, and it is possible the hibernating habit may differ as we get farther into the woods, where the bears have not been compelled to contend with man for so long a time, or as severely as has been the case in the territory covered by my observation.

Under the now accepted theory of "the survival of the fittest" we must expect changes tending to the preservation of the animal; and while these changes are generally slow, they are sometimes quite rapid. Since I can remember, the partridge around Ausable Forks has largely changed his habit of alighting in a nearby tree when flushed; and it is certain that the chimney swallow did not build its nest in chimneys until the Europeans erected houses with these suitable nesting places. I know several instances where birds have changed their habits, and it would not be strange if so intelligent an animal as the bear found it safer to den than to be out during times of deep snows. Really, a change of habit requires no particular intelligence on the part of the animal. We have only to assume with Darwin "that there

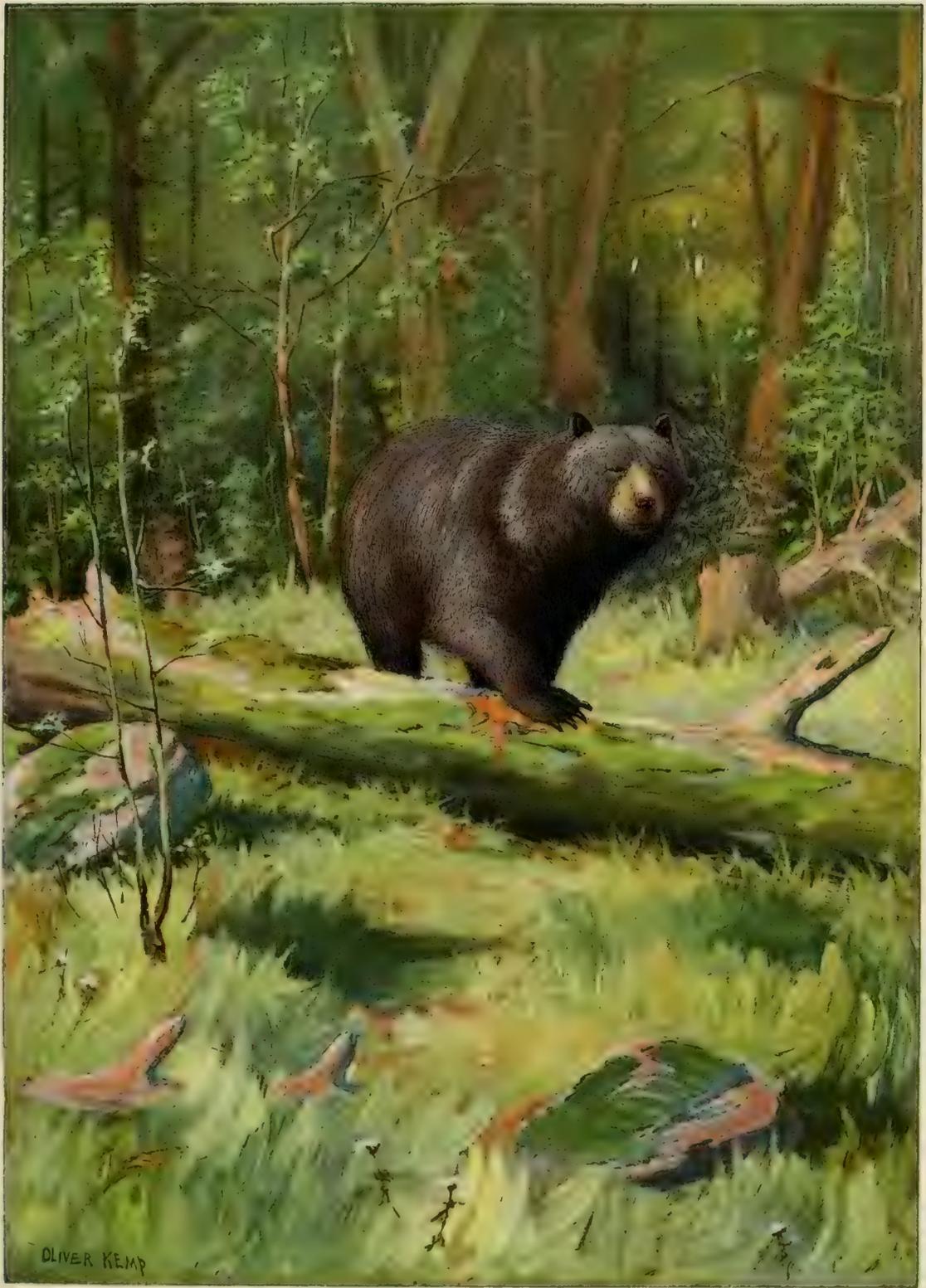
is a tendency on the part of the offspring to inherit the peculiarities of the parent." Under this theory the bears that stay out are killed, while the ones that hole are left to become the parents of the next generation. In this way a tendency that proves protective is soon developed into an instinct that becomes universal.

Bears are great travelers. During the autumn they roam over large tracts of country, and are frequently seen and sometimes killed when on these expeditions. The family to which the following incident refers were evidently on such a trip. On September 9, 1899, Mrs. Chahoon and I went for a little drive, hoping to get a couple of partridges ere returning. We left our home in Ausable Forks in a single carriage, taking with us our little bird dog "Bounce," and a 12-gauge shot gun. While going through a swamp near the Middle Kilns on the road to Saranac Lake,



BOUNCE, THE BEAR DOG.

Mrs. Chahoon driving and I holding the gun cocked and ready for a quick shot at a bird, about thirty yards in front of us four bears came into the road, looked at us for an instant and then ran on ahead. Bounce, the dog, gave chase and was close to the bears as they turned to enter the woods on the opposite side of the road. This was fun for Bounce, and we sat laughing at his audacity, when soon we saw a procession of dog and bears coming towards us, the dog leading and the larger, older bear in close pursuit and clearly shortening the distance between them as they neared us. Don, our horse, not liking this style of a hunt, started to go home backwards; but fortunately did not succeed in overturning us, only so placed the carriage as to give the dog and bears a narrow passage as they ran by. The dog had



ADIRONDACK BLACK BEAR



about six feet of lead, and as they passed I fired both barrels of No. 8 bird shot into the first bear at a range of about ten feet. She showed no evidence of having been hit, and kept on her chase for some twenty yards, when she turned into the woods, the other three bears taking to the woods when opposite our carriage. The dog quickly turned and followed them, and when about thirty yards from the road he stopped and began to bark furiously. I jumped from the carriage and started to go to the dog, and when nearly to him Mrs. Chahoon called excitedly for me to come to her. On getting back I found that another very large bear had come into the road and stood on his hind legs in front of the horse, while the horse rose on his hind legs and looked at Bruin. As soon as our horse was quiet enough to be hitched, Mrs. Chahoon and I went to the dog, which was still barking at the bear where it had fallen.

We tried to drag it to the road; but two hundred pounds was more than our hands alone could manage. While thus engaged Mr. Edmund Roberts came along with the stage, and with his help the dead captive was put into his wagon and carried back to our home, where its hide now makes a fine rug on our floor. The ground where the bear was shot showed no blood or other evidence of the animal having been hit. Both charges struck near the shoulder and were driven downward, and part of them went entirely through the body. The shot was not bunched, but had separated so as to form a pattern resembling the top of a large pepper box. There was nothing to indicate a struggle, and doubtless she fell perfectly dead where she lay when we reached her. In all she must have run 50 or 60 yards with her heart riddled with shot.

It would be interesting if some fairly correct estimate could be made of the number of black bears now in the State. Realizing that any man's guess would be of little value, and with the knowledge that my data is far from exhaustive, I mention the following in the hope that it may prove something better than a mere guess.

The year 1894 was the last one in which the State paid bounties on bears, and that year we paid for the killing of 359 in the Adirondacks. With not very full data for a guide, and the record complete in only a few counties, I am of the opinion that the year 1894 may be taken as a fair average.

If bears have young every two years, and have two or three at a time, and half of them are females, with any reasonable allowance for deaths, other than by man, it would require a thousand mature individuals to sustain this annual loss of 359 without extermination; and I believe it is safe to assume there are more than one thousand in the Adirondacks, as a large allowance should be made for loss and failure of young. The same rule would make the number in the Catskills about five hundred.



97. THE CRAPPIE.

# Food and Game Fishes of New York.

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## Introductory Chapter.

THE most recent catalogue of New York fishes includes 375 species, but this is to some extent a compilation, and the number is liable to change after systematic investigations of the inland waters have been made.

The food and game fishes mentioned in this article number 149 species. These belong to 36 families, of which the most important in the number of species represented are the Catfish, the Sucker, the Minnow, the Herring, the Salmon, the Pike, the Mackerel, the Sunfish, the Weakfish, the Cod, and Flatfish families.

The State is greatly diversified in contour and has an extensive water area. Its drainage systems are the Great Lakes, Lake Champlain, the St. Lawrence, the Ohio Basin, the Susquehanna, the Delaware, the Hudson, with such adjacent small streams as the Passaic, Hackensack, Walkill and Bronx, and the great inland lakes, nearly all of which communicate with Lake Ontario.

Long Island is richer in fishes than the rest of the State, but its species are chiefly marine; its fresh waters contain few kinds and of those about one-half are recent introductions.

The only extended systematic series of observations upon the occurrence of the fishes in any part of the State appears to be recorded by the writer in the Bulletin of the American Museum of Natural History, volume IX, 1897, pages 374 to 375. This is the record of Mr. W. I. DeNyse at Gravesend Beach, Long Island, for 1895 to 1897. The following table is copied from the publication referred to as far as it relates to the food and game fishes of the present article :

## W. I. DENYSE'S RECORD OF SHIPMENTS OF FISH FROM GRAVESEND BAY TO THE N. Y. AQUARIUM, 1895-97, SHOWING THE MONTHS WHEN THE SPECIES WERE CAUGHT.

	JANUARY.	FEBRUARY.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPTEMBER.	OCTOBER.	NOVEMBER.	DECEMBER.
Sea Lamprey, - - -			x	x		x						
Common Skate, - - -			eggs x								x	
Barn Door Skate, - - -										x		
Common Sturgeon, - - -				x	x						x	x
Short-nosed Sturgeon, - - -					x							
Eel, - - - - -			x			x	x					x
Conger, - - - - -												x
Sea Herring, - - - -	x							x	x	x	x	x
Alewife, - - - - -					x	x	x	x	x	x	x	
Shad, - - - - -										x	x	
Menhaden, - - - - -							x	x	x	x		
Smelt, - - - - -	x			x								x
Silversides, - - - - -			x								x	x
Striped Mullet, - - - -										x		
Mackerel, - - - - -					x							
Bonito, - - - - -									x			
Yellow Mackerel, - - - -									x	x		
Crevallé, - - - - -									x	x		
Common Pompano, - - - -								x	x	x		
Bluefish, - - - - -									x	x		
Butter Fish, - - - - -					x				x	x		
Striped Bass, - - - - -				x		x			x		x	x
White Perch, - - - - -	x			x						x	x	x
Sea Bass, - - - - -				x	x	x	x	x	x	x	x	x
Scup, - - - - -				x	x	x		x	x	x	x	
Sheepshead, - - - - -									x			
Weakfish, - - - - -						x			x	x	x	
Yellowtail, - - - - -									x	x	x	
Spot, - - - - -							x		x	x	x	x

W. I. DENYSE'S RECORD—*Continued.*

	JANUARY.	FEBRUARY.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPTEMBER.	OCTOBER.	NOVEMBER.	DECEMBER.
Kingfish, - - - -					x			x		x		
Drum, - - - - -					x					x	x	x
Bergall, - - - -							x		x			
Blackfish, - - - -				x	x		x	x	x			x
Whiting, - - - -										x		
Tomcod, - - - -	x		x	x	x					x	x	x
Cod, - - - - -										x	x	
Common Hake, - - -				x	x					x	x	x
Squirrel Hake, - - -										x		
Flatfish, - - - -	x			x			x		x		x	x

The above record is not intended to show the full period during which the species are present in Gravesend Bay, as a glance at its contents will indicate. Any one familiar with the habits of the migratory and resident fishes will observe this fact. It is important, however, in the respect that it marks the duration of the stay of many valuable fishes in that body of water. It is interesting to note how many of them are present in the early winter months.

Mr. Eugene Smith of Hoboken has given me a list of fishes observed by him in Wawayanda Creek, small streams at Warwick, Greenwood Lake, Ramapo River, head streams of Saddle River and Hackensack streams. The food and game fishes obtained in these waters by Mr. Smith are: Horned Pout, Common Sucker, Chub Sucker, Brook Trout, Chain Pickerel, Eel, Rock Bass (introduced), Long-eared Sunfish, Common Sunfish, Small-mouth Black Bass, Large-mouth Black Bass and Yellow Perch.

The general distribution of the food and game fishes of New York is shown in the following table, which is based chiefly upon recent investigations, but partly upon records which have not lately been verified:

## RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK.

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
1. Great Sea Lamprey, -											x	x
2. Common Skate, -											x	
3. Spotted Skate, - -											x	
4. Clear-nosed Skate, -											x	
5. Barn Door Skate, - -											x	
6. Paddle-fish, - -	x					x						
7. Common Sturgeon, -			x								x	x
8. Lake Sturgeon, - -	x		x		x							
9. Short-nosed Sturgeon, -			x								x	x
10. Channel Cat, - -	x											
11. Lake Catfish, - -	x		x		x							
12. Yellow Cat, - -	x	x										
13. Long-jawed Catfish, -	x	x			x							
14. White Cat, - -							x	x	x			
15. Horned Pout, - -	x		x		x	x	x		x	x		
16. Marbled Cat, - -									x			
17. Black Bullhead, - -	x		x			x						
18. Stone Cat, - -	x											
19. Lake Carp, - - -	x		x		x							
20. Long-nosed Sucker, -	x	x	x		x							
21. Common Sucker,* - -	x	x	x		x	x	x	x	x			
22. Hog Sucker, - -	x					x	x	x				
23. Southern Chub Sucker,†									x			
24. Northern Chub Sucker,	x	x	x				x	x	x			
25. Striped Sucker, - -	x					x						

\* Recorded also from the Walkill, Passaic and Hackensack.

† Recorded also from the Passaic and Hackensack.

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK—*Continued.*

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
26. White-nosed Sucker, -	x		x									
27. Red Horse, - - -	x	x	x		x	x			x			
28. Fallfish, - - -	x		x		x		x	x	x			
29. Horned Dace, - - -	x		x		x	x	x	x	x			
30. Tench, - - -										x		
31. Lake Minnow, - - -	x											
32. Horned Chub, - - -	x	x				x	x		x			
33. Cutlips, - - -	x	x	x		x		x	x	x			
34. Goldfish, - - -									x	x		
35. Carp, - - -	x	x				x			x	x		
36. Eel.* - - -	x	x	x		x		x	x	x	x		
37. Conger, - - -											x	
38. Moon-Eye, - - -	x		x		x	x						
39. Northern Moon-Eye, -	x					x						
40. Gizzard Shad, - - -	x					x						
41. Sea Herring, - - -			x								x	
42. Skipjack, - - -	x					x						
43. Hickory Shad, - - -												x
44. Branch Herring, - - -	x	x	x				x	x	x			x
45. Glut Herring, - - -												x
46. Shad, - - -	x		x									x
47. Menhaden, - - -											x	
48. Striped Anchovy, - -											x	
49. Mitchill's Anchovy, -											x	
50. Round Whitefish, - -	x		x	x	x							
51. Common Whitefish, - -	x	x	x	x	x							
52. Smelt, New York Lakes,		x										

\*Recorded also from the Walkill, Passaic and Hackensack.

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK — *Continued.*

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
53. Lake Herring, - - -	x	x										
54. Moon-Eye Cisco, -		x										
55. Long Jaw, - - -	x											
56. Tullibee, - - -		x										
57. King Salmon, - - -	x											
58. Atlantic Salmon, -	x		x		x				x			
59. Landlocked Salmon, -				x	x					x		
60. Lake Tahoe Trout, -				x								
61. Steelhead, - - -	x											
62. Brown Trout,* - - -										x		
63. Hybrid Trout, - - -										x		
64. Lochleven Trout, -										x		
65. Rainbow Trout,† - -		x		x						x		
66. Swiss Lake Trout,† -				x								
67. Lake Trout, - - -	x	x	x	x	x							
68. Brook Trout,‡ - - -		x	x	x	x	x		x		x		
69. Saibling,§ - - -												
70. Sunapee Trout.† -												
71. Smelt, - - -											x	x
72. Banded Pickerel, -								x	x	x		
73. Little Pickerel, - -	x					x						
74. Chain Pickerel,‡ -	x	x	x		x				x	x		
75. Common Pike, - - -	x	x	x		x							
76. Mascalonge, - - -	x		x		x							

\* Introduced into many trout waters.  
 † Introduced into Lake George.  
 ‡ Recorded also in the Walkill and Passaic.  
 § Introduced into Sterling Lake.

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK — *Continued.*

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
77. Northern Mascalonge, -	x		x		x							
78. Barred Mascalonge, -						x						
79. Silversides, - - -											x	
80. Striped Mullet, - -											x	
81. White Mullet, - -											x	
82. Common Mackerel, -											x	
83. Chub Mackerel, - -											x	
84. Tunny, - - -											x	
85. Bonito, - - - -											x	
86. Spanish Mackerel, -											x	
87. Cero, - - - -											x	
88. King Fish; Sierra, -											x	
89. Sword Fish, - - -											x	
90. Yellow Mackerel, -											x	
91. Crevallé, - - -											x	
92. Common Pompano, -											x	
93. Bluefish, - - -									x		x	
94. Crab-eater, - -									x		x	
95. Harvest Fish, - -											x	
96. Butter Fish, - -											x	
97. Crappie, - - -	x											
98. Calico Bass, - -	x	x										
99. Rock Bass, - - -	x	x	x		x	x				x		
100. Warmouth, - -	x											
101. Green Sunfish, - -	x	x										
102. Long-eared Sunfish, -									x			
103. Blue-gill, - - -	x	x				x						

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK—*Continued.*

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
104. Sunfish,* - - -	x	x	x	x	x	x	x	x	x	x		
105. Small-mouth Black Bass,†	x	x	x	x	x	x	x	x	x	x		
106. Large-mouth Black Bass,‡	x	x	x	x	x	x	x	x	x	x		
107. Pike Perch, - - -	x	x	x		x	x	x	x				
108. Sauger, - - -	x	x	x		x							
109. Gray Pike, - - -	x	x										
110. Yellow Perch,§ - -	x	x	x	x	x	x	x	x	x	x		
111. White Bass,   - - -	x					x						
112. Striped Bass, - - -			x				x	x	x	x		x
113. White Perch, - - -									x	x		x
114. Sea Bass, - - -											x	
115. Flasher, - - -											x	
116. Red Snapper, - - -											x	
117. Pig Fish, - - -											x	
118. Scup, - - -											x	
119. Sailor's Choice, - -											x	
120. Sheepshead, - - -											x	
121. Weakfish, - - -											x	
122. Spotted Weakfish, -											x	
123. Yellowtail, - - -											x	
124. Red Drum, - - -											x	
125. Spot, - - -											x	
126. Croaker, - - -											x	
127. Kingfish, - - -											x	

\* Recorded also from the Walkill, Passaic and Hackensack.

† Introduced into the Passaic.

‡ Recorded from the Walkill, Passaic and Bronx.

§ Recorded also from the Passaic and Hackensack.

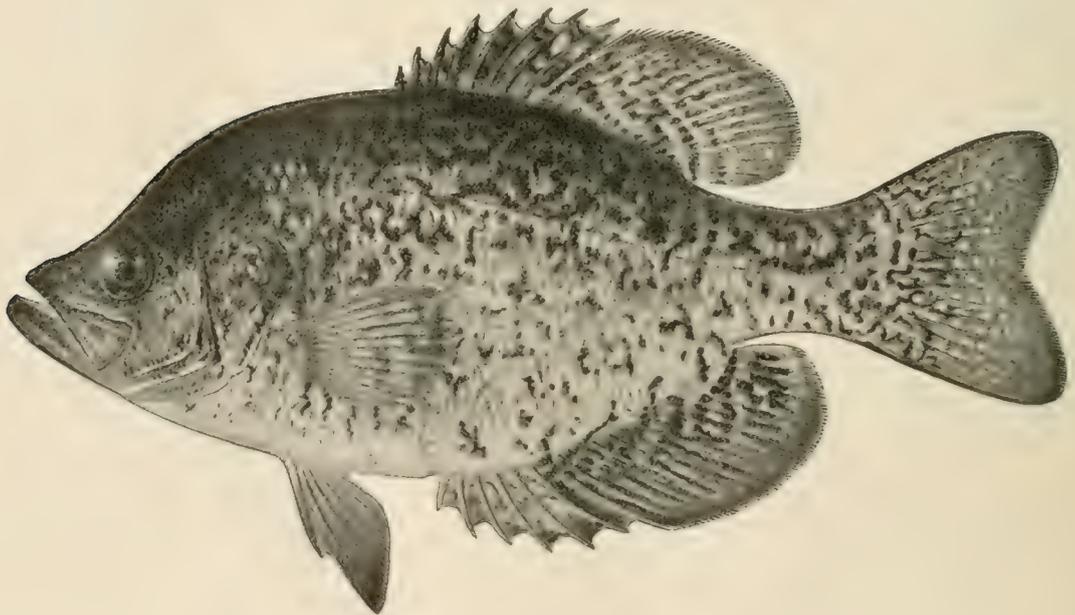
|| Introduced into Greenwood Lake.



The names employed in this catalogue are essentially the same as those used in "Fishes of North and Middle America" by Jordan & Evermann. Some of the specific names differ from those given by Jordan & Evermann for reasons which are fully explained in the author's "Catalogue of the Fishes of New York," forming Bulletin 60 of the New York State Museum.

The references to the literature are purposely limited to the writings of Mitchill, DeKay, and a few more recent authors who have written especially about the fishes of the State, or whose works contain descriptions of all the species.

Illustrations of the fishes have been freely introduced in order to furnish the easiest method of identification by the non-scientific reader. The use of these illustrations was made possible by the courtesy of Hon. George M. Bowers, U. S. Commissioner of Fish and Fisheries.



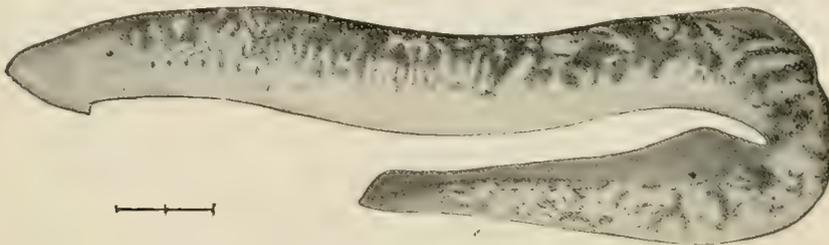
98. THE CALICO BASS.

# Notes on Common Names, Distribution, Habits and Capture of New York Fishes.

## I. Great Sea Lamprey (*Petromyzon marinus* Linnæus).

*Petromyzon marinus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 461, 1815; DEKAY, N. Y. Fauna, Fishes, 379, pl. LXVI, fig. 216, 1842; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 10, 1896, pl. I, fig. 3, 1900.

The Sea Lamprey, or Lamprey Eel, inhabits the North Atlantic, ascending streams to spawn. The species ranges southward on our coast to Virginia. In the Delaware, Susquehanna, and their tributaries, this is a common fish. Its larval form, which is blind and toothless, is extremely abundant in muddy sandflats near the mouths of small streams and is a very important bait for hook and line fishing.



GREAT SEA LAMPREY.

The Sea Lamprey grows to a length of 3 feet. It is dark brown in color, mottled with black and white. In the breeding season, in spring, the males have a high fleshy ridge in front of the dorsal. The spawning is believed to take place in May or June. The eels cling to the rocks by means of their suckorial mouths and the eggs are deposited in shallow water on a rough bottom where the current is swift. Some observers state that they make nests by heaping up stones in a circle and deposit the eggs under the stones. The ovaries are large, but the eggs are very small.

The food of the Lamprey is chiefly animal matter and the fish is somewhat of a parasite, burrowing into the side of shad, sturgeon and some other species. The teeth are adapted for this method of feeding. The tooth bearing bone of the upper side of the mouth contains two teeth which are placed close together. On the bone corresponding with the lower jaw there are seven or nine stout cusps. There are numerous teeth around the disk; the first row on the side of the mouth containing

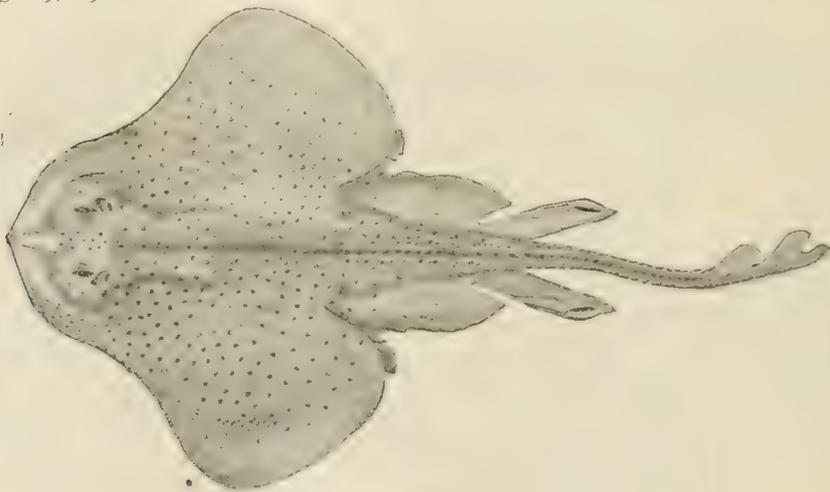
bicuspid teeth; the others are simple. The tooth on the front of the tongue has a deep median groove. The species is adapted for fastening itself to other fishes and extracting from them their blood.

The Lamprey is considered a good food fish in some localities, but in other places it is rarely eaten. In Connecticut and Massachusetts the species is highly esteemed. It is preserved by salting for several weeks before using. The fish are sometimes caught with the hands or by means of a pole armed with a hook in the end. As it is found in shallow water and will not usually relinquish its hold on the bottom, its capture is easily effected.

## 2. Common Skate (*Raja crinacea* Mitchill).

*Raja crinaccus* MITCHILL, Am. Jour. Sci. Arts, IX, 290, pl. 6 (male), 1825; DEKAY, N. Y. Fauna, Fishes, 372, pl. LXXVIII, fig. 246, 1842.

*Raja crinacea* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 68, 1896, pl. IX, fig. 29, 1900.



COMMON SKATE.

A very common species on our coast, from Maine to Virginia. It is one of the small rays and is not much valued for food. Eggs of this Skate have been obtained in Gravesend Bay in March. In captivity eggs have been deposited in winter. The species will endure captivity during the spring, fall, and part of the winter, but not at all in summer.

Mitchill had the ray from Barnegat and from off Sandy Hook. DeKay did not see the fish, but copied the description and figure of Mitchill. Smith refers to it as the "Summer Skate" or "Bonnet Skate." It is found at Woods Hole from June to October. The names "Hedgehog Ray" and "Bonnet Skate" are given in

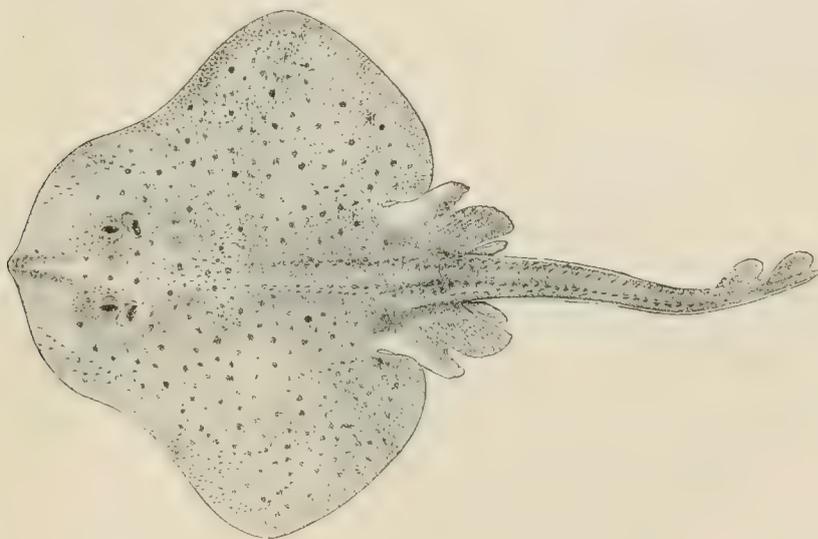
allusion to its habit of rolling itself up when caught. At Southampton, L. I., this species was taken in small numbers August 3, 1898.

### 3. Spotted Skate (*Raja ocellata* Mitchill).

*Raja ocellata* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 477, 1815.

*Raia ocellata* DEKAY, N. Y. Fauna, Fishes, 369, 1842 (not pl. 65, fig. 212).

The Spotted Skate reaches a length of nearly 3 feet; its egg cases are more than twice as large as those of *R. crinacca*. The species is found from New York to Massachusetts and northward.



SPOTTED SKATE.

Dr. Mitchill described a specimen which was 30 inches long and 19 inches wide. Dr. DeKay calls this species the Spotted Ray. He found the stomach of one filled with rock crabs (*Cancer irroratus*). To the fishermen this and allied species are known as Skate. It has no commercial value in Great South Bay. In the traps at Islip Skates reappear on October 1 on their fall migration. A female was caught near the inlet, at Fire Island, September 29, 1898. The species was more abundant later in the fall.

At Woods Hole, according to Dr. Smith, this is the Big Skate or Winter Skate. It is common from February to June and from October 15 to the end of the trap fishing; it is absent or very rare in summer.

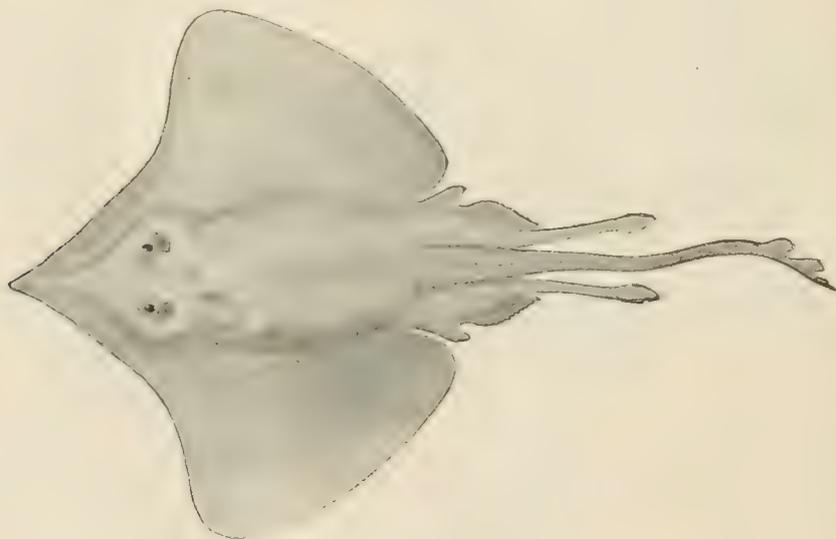
4. **Clear-nosed Skate** (*Raja eglanteria* Bosc).

*Raja eglanteria* BOSC in LACÉPÈDE, Hist. Nat. Poiss., II, 104, 109, 1800; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 71, 1896.

*Raja diaphanes* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., 478, 1815.

The Clear-nosed Skate, sometimes called Briar Ray, reaches a length of 2 feet or more. It inhabits the Eastern Coast of the United States from Cape Cod to Florida; it has been found moderately common in Great South Bay in and near Fire Island Inlet. Early in September both males and females were caught at Fire Island Inlet and Wigo Inlet, but in October the species appeared to be scarce. It has no commercial value in the bay and is usually thrown away.

At Woods Hole, Mass., it is not common. A few are taken every year in traps at Menemsha, Martha's Vineyard.



BARN DOOR SKATE.

5. **Barn Door Skate** (*Raja laevis* Mitchill).

*Raja laevis* MITCHILL, Am. Month. Mag., II, 327, 1818.

*Raja laevis* DEKAY, N. Y. Fauna, Fishes, 370, 1842.

The Barn Door Skate reaches a length exceeding 4 feet; it is used to some extent for food. The species has been taken in Gravesend Bay in October. It suffers in captivity for the want of sand and mud and because of the lack of suitable food, its average duration of life being 3 or 4 months.

Mitchill described an individual measuring 49 inches which was caught at a

wharf in the East River, November 5, 1815. At Woods Hole, Mass., it is common in spring and fall, rare in summer.

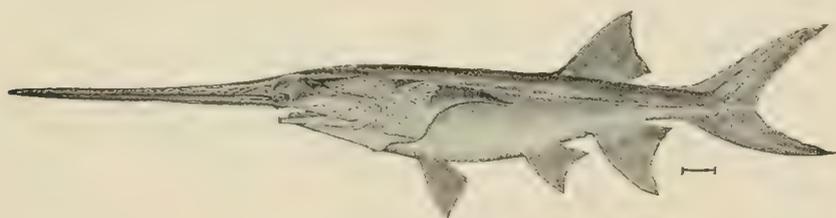
#### 6. Paddle-Fish (*Polyodon spathula* Walbaum).

*Polyodon folium* MITCHILL, Am. Jour. Sci. Arts, XII, 201, 1827.

*Polyodon spathula* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 101, 1896.

This is known as the Paddle-fish, Spoonbill or Spoon-billed Sturgeon, Shovel Fish, Bill Fish, and Duck-billed Cat. It is called "Salmon" in some Western hotels. The names are derived from the remarkable snout, which is produced into a long spatula-shaped process, covered above and below with an intricate network and with very thin flexible edges. The head and snout form nearly half of the entire length of the fish. The fish cannot be confounded with anything else in the waters of the United States. There is in China a similar fish, which, however, belongs to a different genus.

The Paddle-fish is usually confined to the Mississippi Valley, but it has been



PADDLE-FISH.

recorded in Chautauqua Lake, and it is common in the Alleghany and the Monongahela Rivers. It grows to a length of 6 feet, and a weight of 30 pounds or more. The species frequents muddy bottoms, but does not feed on the mud and slime, as many persons have supposed. The long snout is useful in procuring its food, which consists chiefly of entomostraca, water worms, aquatic plants, leeches, beetles and insect larvæ.

Prof. S. A. Forbes, director of the Illinois Laboratory of Natural History, has published the first and most satisfactory account of the feeding habits of this shark-like fish. He found very little mud mixed with the food. Prof. Forbes was informed by the fishermen that the Paddle-fish plows up the mud in feeding with its spatula-like snout and then swims slowly backward through the water.

"The remarkably developed gill-rakers of this species are very numerous and fine, in a double row on each gill-arch, and they are twice as long as the filaments of the gill. By their interlacing they form a strainer scarcely less effective than the

fringes of the baleen plates of the whale, and probably allow the passage of the fine silt of the river bed when this is thrown into the water by the shovel of the fish, but arrest everything as large as the *Cyclops*. I have not found anything recorded as to the spawning habits of the Paddle-fish. The young have the jaws and palate filled with minute teeth, which disappear with age."

The flesh of the Paddle-fish is frequently considered tough and shark-like, but individuals of 8 or 10 pounds are skinned, and sold in some of the western markets freely, and are thought by some persons to be fairly good for the table.

#### 7. Common Sturgeon (*Acipenser sturio* Linnæus).

*Acipenser sturio* LINNÆUS, Syst. Nat., ed. x, I, 237, 1758; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 105, 1896.

*Acipenser oxyrhincus* DEKAY, N. Y. Fauna, Fishes, 346, pl. 58, fig. 189 (young), 1842.

The range of the Common Sturgeon includes the Atlantic Ocean southward to Africa and the West Indies. The northern limit on our east coast appears to be Cape Cod. In the Delaware River the fish has rarely ascended as far as Port Jarvis.



COMMON STURGEON.

Dr. Mitchill was the first to call attention to the similarity between the American Sharp-nosed Sturgeon and the *sturio* of Europe. The fish attains a length of 12 feet in America, and it is stated that European examples measuring 18 feet have been taken.

The sturgeon ascends the large rivers from the sea in spring and early summer. It is very common in the lower part of the Delaware River, where it forms the object of an important fishery. This is the species concerning which so many stories have been related as to its leaping into boats and injuring the occupants.

The mouth of the sturgeon is furnished with a very protractile roundish tube having powerful muscles and intended for withdrawing from the mud the various small shellfish and crustaceans on which the animal subsists. The mouth is surrounded also with numerous tentacles, with tactile properties, which are utilized in procuring food.

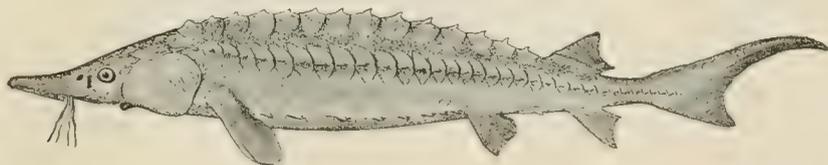
The reproductive habits of the sturgeon and the embryology of the species have been made the subject of an exhaustive study by the late Prof. John A. Ryder

of the University of Pennsylvania, whose monograph forms a part of the Bulletin of the U. S. Fish Commission for 1888. The eggs have been fertilized and developed artificially by Seth Green and others many years ago, and in some parts of Europe the hatching of the species has been carried on successfully. The U. S. Fish Commission has also recently taken up the culture both of the marine and the lake sturgeon, and these valuable fish may soon be reared on an extensive scale.

The utilization of the flesh, the skin and air-bladder and the eggs of the sturgeon is so well known as to require little more than passing mention in this place. The smoking of the flesh and the manufacture of caviare from the eggs are very important industries along our eastern coast.

The sturgeons are easily taken in gill nets and pounds, but the great strength of the fish frequently entails considerable loss of apparatus.

The Common Sturgeon appears every spring in Gravesend Bay, and sometimes in the fall. It is hardy in captivity. A female 8 feet long was brought from the mouth of the Delaware River, May 20, 1897, to the New York Aquarium. It seemed to take no food till December 1, when it began to feed freely on opened hard clams.



LAKE STURGEON.

### 8. Lake Sturgeon (*Acipenser rubicundus* LeSueur).

*Acipenser rubicundus* DEKAY, N. Y. Fauna, Fishes, 344, pl. 58, fig. 191, 1842; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 106, 1896.

This is known as the Lake Sturgeon, Ohio River Sturgeon, Rock Sturgeon, Bony Sturgeon, Red Sturgeon and Ruddy Sturgeon. It inhabits the Mississippi and Ohio Rivers and the Great Lakes, and is abundant in the Alleghany. From the lakes it ascends the streams in spring for the purpose of spawning. Dr. Richardson states that the northern limit of the sturgeon in North America is about the 55th parallel of latitude.

The Lake Sturgeon is smaller than the common marine sturgeon, the average adult being less than 5 feet in length. The average weight of 14,000 mature sturgeon taken at Sandusky, O., was about 50 pounds. It frequently reaches a length of 6 feet.

In the Lakes the species, according to observations of James W. Milner, inhabits

comparatively shoal waters. The food of this sturgeon is made up chiefly of shellfish, including the genera *Limnæa*, *Melantho*, *Physa*, *Planorbis* and *Valvata*. Eggs of fishes are also to be found in its stomach.

In Lake Erie the species spawns in June, for which purpose it ascends the rivers in large schools till stopped by obstructions or insufficient depth of water. The breaching of the sturgeon is a well-known habit. Instances are recorded of serious injury to persons by sturgeons throwing themselves into boats. The sturgeon will occasionally take a baited hook, but its great strength and unwieldiness make it an undesirable fish for the angler.

Large numbers of sturgeon have been destroyed by fishermen during the whitefish season simply on account of the annoyance caused by their presence in the nets. Now that the flesh is esteemed for smoking, and the demand for caviare made from the eggs has largely increased, the wanton waste of this fish has been checked. A troublesome parasite of the sturgeon is the lamprey eel (*Petromyzon concolor* Kirt.) which attaches itself to the skin presumably for the purpose of feeding on the mucus which is exuded from the pores in great abundance, and remains fixed in one position so long as to penetrate to the flesh and produce a deep ulcerous sore.

The Lake Sturgeon was formerly not very much prized, but is rapidly growing in favor. The flesh is eaten in the fresh condition or after boiling in vinegar or curing by smoking. Smoked sturgeon is now considered almost if not quite equal to smoked halibut, and the demand for it is increasing. From the eggs of the sturgeon a good grade of caviare is produced. "The caviare is made by pressing the ova through sieves, leaving the membranes of the ovaries remaining in the sieve, and the eggs fall through into a tub. This is continued until the eggs are entirely free from particles of membrane, when they are put into salt pickle and allowed to remain for some time."

A large specimen now in the museum of Cornell University is reported as being from Cayuga Lake. Seth Green informed Dr. Meek that sturgeons had occasionally been taken in that lake; but so far as he knew, they had never been found in any other of the small lakes of Central New York.

H. V. Kipp, of Montezuma, N. Y., wrote Dr. Meek as follows: "There have not been any sturgeons taken from Cayuga Lake since 1880, but quite a number before that date, and the largest known weighed 35 pounds."

### 9. Short-nosed Sturgeon (*Acipenser brevirostrum* LeSueur).

*Acipenser brevirostrum* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I. 106, 1896.

This little sturgeon has not been positively recognized anywhere except in the Delaware and in Gravesend Bay; only a few specimens have been obtained in the river, and it is rare in Gravesend Bay. Prof. Ryder collected five examples at Delaware City in the spring of 1888, and has published a description of the species in the Bulletin of the U. S. Fish Commission for that year.

The largest specimen known was 33 inches long; individuals 20 inches long are capable of reproducing the species.

At the present time the Short-nosed Sturgeon probably never comes into the markets on account of its small size, which prevents its capture in the nets used for taking the common sturgeon. About 1817, however, it was brought in the shad season to Philadelphia and sold for 25c. to 75c. each.

Spawning takes place in the Delaware during May. The eggs are deposited in depths of 1 to 5 fathoms on hard bottom in brackish or nearly fresh water. Prof.



SHORT-NOSED STURGEON.

Ryder states that the eggs are extruded by rubbing the belly either against hard places on the river bed or against the rough bodies of the males, two or more of which accompany each female. The gravid roe fish are larger than the males. Prof. Ryder found the ova more or less adhesive immediately after their removal from the abdomen, but the sticky mucus covering is soluble in water. The period of hatching varies from four to six days.

Up to the third month of its life the young sturgeon has minute conical teeth in its jaws, and at this age it is believed to subsist on "rhizopods, unicellular algæ, infusoria, minute larvæ of insects and worms, crustaceans, etc." Still following the observations of Prof. Ryder, we learn that the sturgeon, when it has reached a length of 1 inch to 1½ inches, has minute teeth on the floor of the pharynx and feeds on small water fleas, and probably algæ, worms, embryo fishes, insects and fresh-water copepods. Later in life the fish seeks larger crustaceans, and the adults occasionally contain fragments of mussel shells. The young fish have been caught under the ice in midwinter and are known to pass most of the year in fresh water.

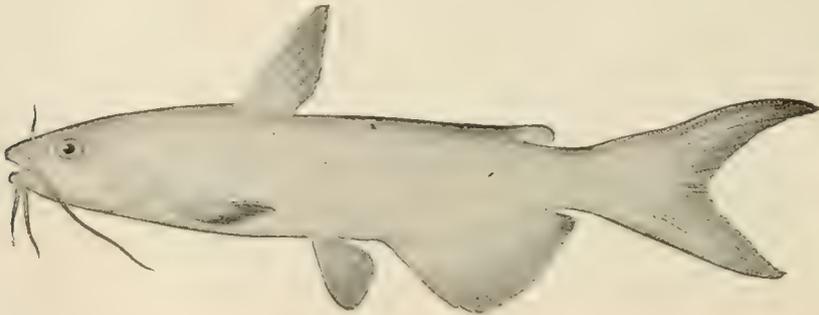
A single small example of this sturgeon was brought to the New York Aquarium from Gravesend Bay, May 13, 1896, and was alive and in good condition in November, 1898.

Dr. Smith records the occurrence of the species along with the common sturgeon at Woods Hole, Mass., but says it is less numerous. It is captured in the traps.

10. **Channel Cat** (*Ictalurus punctatus* Rafinesque).

*Ictalurus punctatus* JORDAN, Bull. Buffalo Soc. Nat. Hist., 95, 1876 ; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 108, 1883 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 134, 1896, pl. XXV, fig. 58, 1900.

This species is variously styled the Channel Cat, White Cat, Silver Cat, Blue Cat and Spotted Cat. It is found over a vast extent of country, including the



CHANNEL CAT.

Mississippi and Ohio Valleys and the Great Lakes region. In the Eastern States it is absent from streams tributary to the Atlantic, but occurs from Vermont south to Georgia, westward to Montana, and southwestward to Mexico. In Pennsylvania it is limited to the Ohio and its affluents.

The adults of this species are bluish silvery, and the young are spotted with olive. It is one of the handsomest of the family of catfishes and an excellent food fish. The Spotted Cat grows to a length of 3 feet and a weight of 25 pounds. It is extremely variable in color and in number of fin rays, and has consequently been described under more than 20 different names. It is most abundant in large clear streams. The species is less hardy than most of the other catfishes.

## II. Lake Catfish (*Ameiurus lacustris* Walbaum).

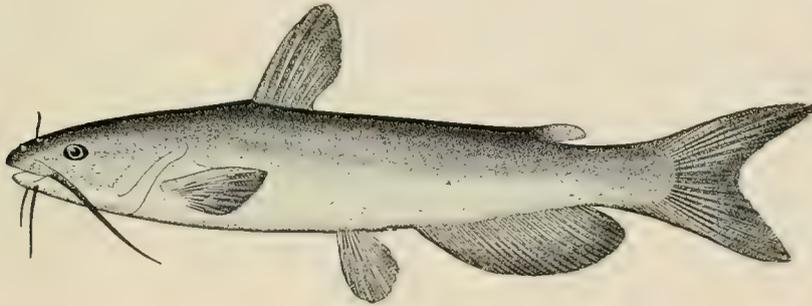
*Ictalurus nigricans* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 108, 1883.

*Pimelodus nigricans* DEKAY, N. Y. Fauna, Fishes, 180, pl. 52, fig. 170, 1842.

*Ameiurus lacustris* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1, 137, 1896.

This is the Great Fork-tailed Cat, Florida Cat, Flannel-mouth Cat, and Great Blue Cat of various writers. It is also called Mud Cat in the St. John's River, Fla. The species is highly variable, as we would suppose from its wide distribution.

In 1879, Prof. Spencer F. Baird received from Dr. Steedman of St. Louis, a Mississippi River Catfish weighing 150 pounds and measuring 5 feet in length. The writer described this fish as a new species related to the Great Black Catfish of the Mississippi Valley, *Ameiurus nigricans*. At the present time it is somewhat doubtful whether or not this is merely an overgrown individual of the species under consideration and the matter must remain in doubt till smaller examples of *Ameiurus ponderosus* have been obtained.



LAKE CATFISH.

The Great Fork-tailed Cat is a native of the Ohio and Mississippi Valleys, and in the Southern States its range extends southward to Florida; northward it ranges to Ontario.

This Catfish reaches a weight of 100 pounds or more, and, if it includes the giant form above referred to, we may place the maximum weight at more than 150 pounds. Dr. Steedman was informed by an old fisherman that the heaviest one he had ever seen weighed 198 pounds, but it is doubtful that such large individuals are to be taken at the present time. In Lake Erie this species usually weighs from 5 to 15 pounds, and the largest specimens reach 40 pounds.

The habits of this fish are presumably about the same as those of other species of the family. On account of the great size of the fish it naturally prefers lakes and large rivers. It is a bottom feeder and will take almost any kind of bait. This species is wonderfully tenacious of life. It spawns in the spring and protects its

young, which follow the parent fish in great schools. Dr. Theodore Gill has reviewed in *Forest and Stream* the subject of the Catfishes' care of their young.

This is a valued food species, though not a choice fish. In Lake Erie, according to a Review of the Fisheries of the Great Lakes, published by the U. S. Fish Commission, the Catfish rank next to Whitefish in number of pounds taken.

In Lake Erie Catfish are taken chiefly by means of set lines, and the fishing is best during the months of June, July, and August. The method of fishing is thus described in the Review just referred to: "The apparatus consists of from 200 to 400 hooks attached by short lines to a main line, which is from 5 to 27 fathoms long, according to place in which set, and is held in place by poles or stakes pushed into the mud. The lines are usually set in the lake, but occasionally short ones are fished in the bayous and marshes. Catfish are taken with a bait of herring, *Coregonus artedi*, or grasshoppers, and are mostly used in the families of the fishermen and their neighbors or sold to peddlers. \* \* \* The size of the Catfish ranges from 5 to 25 pounds, averaging 8 or 10 pounds." In some parts of Lake Erie the set line fishery for Catfish begins April 15. Some of these lines have as many as 2,000 hooks. The pound nets also take a good many Catfish in the spring and fall. In Toledo these fish bring 4½ cents a pound. Erie receives its supply of Catfish from fishermen who operate in the lake from Erie to Elk Creek with set lines during the summer months. DeKay had the species from Buffalo, where he saw specimens weighing from 25 to 30 pounds, and heard of individuals weighing 80 pounds. He states that it is usually captured by the spear.

## 12. Yellow Cat (*Ameiurus natalis* LeSueur).

*Pimelodus cupreus* DEKAY, N. Y. Fauna, Fishes, 187, 1842 (Name only).

*Ameiurus natalis* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 139, 1896.

The Yellow Cat, or Chubby Cat, is found from the Great Lakes to Virginia and Texas. It has many varieties, three of which are mentioned by Prof. Cope as occurring in Pennsylvania, two of them in the Ohio River and its tributaries and the third in Lake Erie. The species is not credited to the region east of the Alleghanies. Dr. Meek saw only a single specimen from Cayuga Lake.

The length of the Yellow Cat sometimes reaches 2 feet, but averages much less.

Nothing special is recorded about the habits of this species. It is most abundant in sluggish streams.

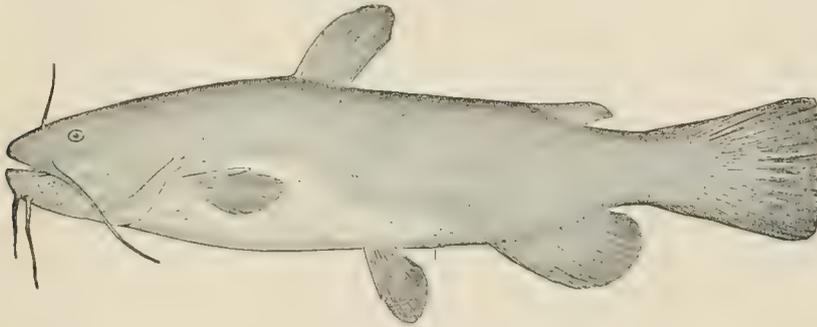
### 13. Long-jawed Catfish (*Amiurus vulgaris* Thompson).

*Amiurus dekayi* BEAN, Fishes Penna., 15, pl. 18, fig. 24, 1893.

*Amiurus vulgaris* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 140, 1896.

The Long-jawed Catfish is found in the Great Lakes region and westward to Manitoba. It is believed to be very nearly related to the common catfish, *A. nebulosus*, but its projecting lower jaw will serve to distinguish it. This character, however, we know by experience is not so satisfactory as it might be.

The species reaches the length of 18 inches and the weight of 4 pounds. It is occasionally taken in the Ohio River, but is more abundant in Lake Erie. Jordan & Evermann state its range to be from Vermont to Minnesota and Illinois, chiefly northward. The U. S. National Museum has it from Manitoba. Dr. Meek found a single specimen which was caught near Ithaca among more than 100 of the common bullheads. It seems to be rare in that basin. Thompson, who described the fish, had specimens from Lake Champlain. The Long-jawed Catfish is similar



LONG-JAWED CATFISH.

in all respects except its projecting lower jaw to the common catfish, *A. nebulosus*, and may be found identical with it.

### 14. White Cat (*Amiurus catus* Linnæus).

*Pimelodus atrarius* DEKAY, N. Y. Fishes. 185, pl. 36, fig. 116, 1842.

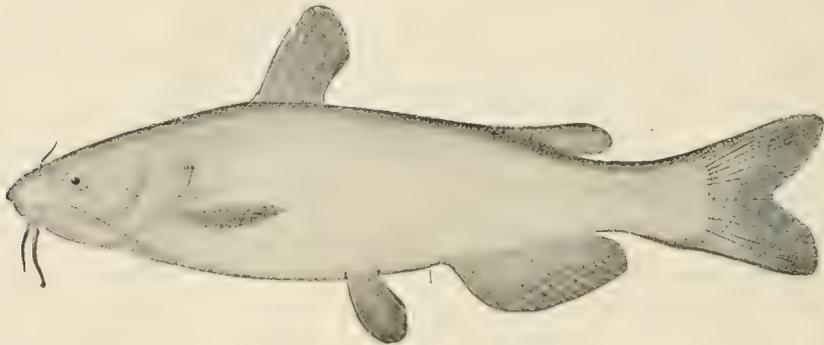
*Amiurus albidus* JORDAN, Bull. 10, U. S. Nat. Mus. 84, 1877, figs. 15 & 16, 1877; BEAN, Fishes Penna., 14, pl. 18, fig. 23, 1893.

This is the White Cat or Channel Cat, in Philadelphia distinguished as the Schuylkill Cat. The Channel Cat is one of the most abundant of its family in the Potomac River. It is abundant in the Susquehanna and common in the Schuylkill. This species reaches a length of 2 feet and a weight of 5 pounds. It is extremely variable with age. Old examples have the mouth so much wider than it is in the young that they have been described as a distinct species. The Big-mouthed

Cat of Cope is now considered to be the old form of the White Cat. The habits of this species agree with those of other species already mentioned. The name Channel Cat suggests a favorite haunt of the fish. As a food it is highly prized.

Eugene Smith says this catfish occurs in all the larger streams subject to the tide in the vicinity of New York City.

It is frequently caught on set lines with liver or killy bait and bites best at night. The flesh is much better flavored than that of *A. nebulosus*.



WHITE CAT

15. **Horned Pout** (*Amiurus nebulosus* LeSueur).

*Pimelodus catus* DEKAY, N. Y. Fauna, Fishes, 182, pl. 37, fig. 119, 1842.

*Amiurus nebulosus* BEAN, Fishes Penna., 16, pl. 19, fig. 25, 1893.

This is known as the Common Catfish, Bullhead, Horned Pout, and Minister.

This species has a wider distribution than the White Cat, its range including New England and extending southward to South Carolina, west to Wisconsin and southwest to Texas. It has also been transferred from the Schuylkill to the Sacramento and San Joaquin Rivers, Cal., where it has multiplied so rapidly that it is now one of the most common fishes of those streams. This is the most abundant catfish in Lake Erie and its tributaries. The species reaches a maximum length of 18 inches and a weight of 4 pounds, but the average size of market specimens is much smaller. In the lower waters of the Susquehanna color varieties of this species are not uncommon. One of them appears to be the same as the *Amiurus marmoratus* of Holbrook; this supposed color variety is found also from Illinois to Florida. The lower Susquehanna has furnished also some singularly colored examples of this fish, distinguished by large areas of jet black with lemon and white. These freaks are among the most interesting and beautiful observed in this family of fishes.

From Jordan's Manual of the Vertebrates I quote Thoreau's account of the habits of this species:

The horned pout are "dull and blundering fellows," fond of the mud, and growing best in weedy ponds and rivers without current. They stay near the bottom, moving slowly about with their barbels widely spread, watching for anything eatable. They will take any kind of bait, from an angleworm to a piece of tin tomato can, without coquetry, and they seldom fail to swallow the hook. They are very tenacious of life, "opening and shutting their mouths for half an hour after their heads have been cut off." They spawn in spring, and the old fishes lead the young in great schools near the shore, seemingly caring for them as a hen for her chickens.

The species was obtained in Swan River at Patchogue, N. Y., August 12, 1898. Young were seined in Bronx River in August. Larger individuals were sent from Canandaigua Lake and Saranac Lake in November. Several albinos were obtained from the Hackensack Meadows, N. J., in August, 1897. In three months they grew from 3 inches to 6 inches in length. In captivity the fish feed freely on chopped hard clams and earthworms and, occasionally, liver.



HORNED POUT.

The following notes are from Eugene Smith, in Proc. Linn. Soc. N. Y., 1897, p. 11-12.

Very variable in color, from blackish and olive to brown and yellowish above, becoming lighter below, and often clouded on the sides. Those from tidal or running water are lighter colored than those from stagnant places or ponds. The largest specimen found by me in the near vicinity of New York measured  $13\frac{1}{2}$  inches in length and weighed 1 pound 2 ounces.

At the end of the third year this fish is perhaps fully matured. The ripe eggs are of the size of large pin heads, and are of an orange color; the very young fishes look like little black toad tadpoles. The spines are strongly developed at an early age. The old fish accompanies the brood for a certain time, always swimming around the swarm of young in order to keep them together. When alarmed the parent dashes off, followed by the whole swarm.

16. Marbled Cat (*Ameiurus nebulosus marmoratus* Holbrook).

*Ameiurus marmoratus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 104, 1883.

*Ameiurus nebulosus marmoratus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 141, 1896.

Body moderately elongate, its depth about one-fourth total length to caudal base; slope of profile very steep; jaws equal or subequal; dorsal fin high, its spine more than one-half as long as head, and nearer to adipose fin than to tip of snout; head long, three and one-fourth times in total length to caudal base; barbels long; anal rays 21; body much mottled with brown, greenish and whitish. Lowland streams and swamps from New York to Southern Indiana and Florida. The type of the *marmoratus* of Holbrook was from South Carolina.



BLACK BULLHEAD.

17. Black Bullhead (*Ameiurus melas* Rafinesque).

*Pimelodus pullus* DEKAY, N. Y. Fauna, Fishes, 184, pl. 37, fig. 117, 1842.

*Ameiurus pullus* BEAN, Fishes Penna., 16, 1893.

The Black Bullhead reaches the length of 1 foot. It is found in the Great Lakes region and in the Mississippi Valley, westward to Kansas and southward to Texas.

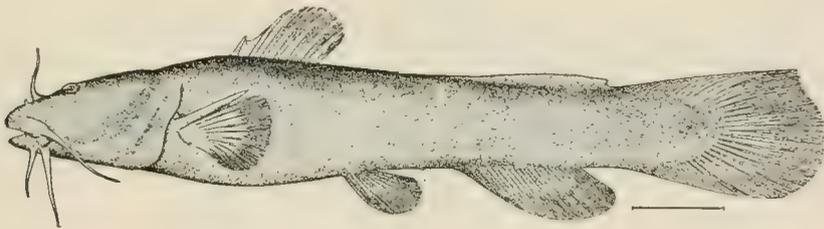
This species was known to DeKay as the Brown Catfish. His specimens were taken from Lake Pleasant and Lake Janet, N. Y., and he states that it is also very common in many other lakes of Northern New York, where its principal use is to serve as bait for the lake trout. Dr. Jordan had it from the Genesee River. Dr. Evermann obtained a specimen in Mill Creek, at Sacket Harbor, N. Y., July 2, 1894, and doubtfully referred to this species a young individual collected in Sandy Creek, at North Hamlin, N. Y., August 20, 1894.

**18. Stone Cat** (*Noturus flavus* Rafinesque).

*Noturus flavus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus. 100, 1883; BEAN, Fishes Penna., 18, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 144, 1896, pl. 27, fig. 63, 1900.

The Stone Cat is found from Ontario, throughout the Great Lakes region, south to Virginia and Texas, west to Montana and Wyoming. It inhabits the larger streams. Dr. Evermann obtained two specimens at Nine Mile Point, in the Lake Ontario region, June 11, 1893.

The species has very little value as food on account of its small size. It seldom exceeds 12 inches in length, but it is a very good bait for Black Bass. The Stone Cats are much dreaded by fishermen because of the painful wounds sometimes produced by their pectoral spines. There is a minute pore in the axil of the pectoral, which is the outlet of a noxious liquid secreted by a poison gland. When this poison is discharged into a wound, it causes an extremely painful sore.



STONE CAT.

**19. Lake Carp** (*Carpiodes thompsoni* Agassiz.)

*Carpiodes thompsoni* JORDAN, Bull. 12, U. S. Nat. Mus. 198, 1878; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 119, 1883.

Abundant in the Great Lakes region. Found in Lake Champlain.

**20. Long-nosed Sucker** (*Catostomus catostomus* Forster).

*Catostomus longirostris* JORDAN, Bull. 12, U. S. Nat. Mus. 175, 1878; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus. 126, 1883.

*Catostomus catostomus*, BEAN, Fishes Penna., 25, pl. 20, fig. 30, 1893.

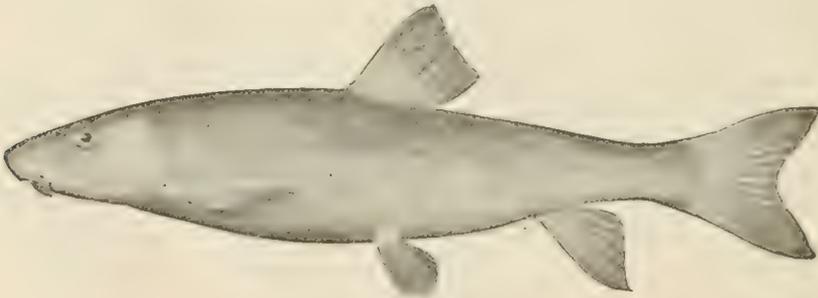
The Northern Sucker, Long-nosed Sucker, or Red-sided Sucker, as the above species is styled, occurs in the Great Lakes and northwest to Alaska in clear, cold waters. It is very common in Lake Erie. It grows to a length of 2 feet and is

largest and most abundant northward, in Alaska reaching a weight of 5 pounds. As a food fish the Long-nosed Sucker is little esteemed; but in cold countries the head and roe are used in making a palatable soup.

The males in the breeding season, in spring, are profusely covered with tubercles on the head and fins and have a broad rosy band along the middle of the body. In the Yukon River, Alaska, Dr. Dall found the fish filled with spawn in April. The eggs are of moderate size and yellow in color. Nelson has seen this species seined by Eskimo in brackish estuaries of streams flowing into Kotzebue Sound. W. J. Fisher has collected specimens on the peninsula of Alaska.

This was not found in Cayuga Lake basin by Dr. Meek, but it occurs in the Adirondack region, and Dr. Meek believes it is a member of the Cayuga Lake fauna. Dr. Evermann obtained five specimens at Grenadier Island, N. Y., June 28, 1894.

The small race found by Fred Mather in the Adirondacks is the ordinary dwarf form characteristic of mountain regions. He discovered four individuals, only  $4\frac{1}{4}$



LONG-NOSED SUCKER.

inches long, "but mature and breeding" in a little mountain brook emptying into Big Moose nearly north of the Big Moose Club House, by a bark shanty known as "Pancake Hall." The fish were spawning, and he discovered many eggs under the stones. The females were brown with white on belly, the male with red stripe on the side.

## 21. Common Sucker (*Catostomus commersonii* Lacépède).

*Catostomus teres* BEAN, Fishes Penna., 25, 1893.

*Catostomus pallidus* DEKAY, N. Y. Fauna, Fishes, 200, pl. 33, fig. 104, 1842.

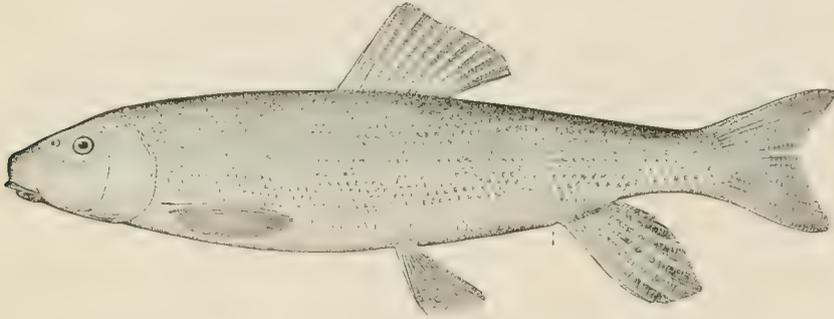
*Catostomus commersonii* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 178, 1896, pl. 34, fig. 83, 1900.

The Common Sucker is also known as the Pale Sucker, White Sucker, Gray Sucker, Brook Sucker, and, among the Canadian French, as *carpe blanche*. It is the commonest member of its genus in waters east of the Rocky Mountains. It is

found from Canada to Florida and westward to Montana. Covering such a wide range of territory, the species is naturally variable, and has been described over and over again by many authorities under a great variety of names. The male of this sucker in spring has a faint rosy stripe along the middle of the side. The young are brownish in color and somewhat mottled and have a dark median band or a series of large blotches. The adults are light olive varying to paler and sometimes darker; sides silvery.

The species reaches a length of 22 inches, and a weight of 5 pounds. It is a very common inhabitant of ponds and streams of the lowlands, and a small race occurs in certain cold mountain streams in the Adirondack region, where it is dwarfed in size and changed in color, but does not differ in essential characters. Dr. Rothrock also obtained a mountain race of this sucker in Twin Lakes, Col., at an elevation of 9,500 feet above the sea level.

The Common Sucker is a very indifferent food fish in the estimation of most



COMMON SUCKER.

people, but, when taken from cold waters and in its best condition, its flesh is very palatable. It takes the hook readily when baited with common earth worms.

Dr. Richardson says:

“Its food consists chiefly of soft insects, but in one I found the fragments of a fresh-water shell. It is singularly tenacious of life, and may be frozen and thawed again without being killed.”

Dr. Meek found this species abundant throughout the entire Cayuga Lake basin, where it is known as the Common White Sucker.

Dr. Evermann in his catalogues of the fishes of Lake Ontario, taken in 1894, mentions this sucker from the following localities: Stony Creek, Black River, Mud Creek, Cape Vincent, mouth Salmon River, Chaumont River, creek at Pultneyville, mouth Little Salmon Creek, Sandy Creek, Long Pond, Stony Island, Lakeview Hotel, 7 miles northeast of Oswego, and Marsh Creek. In the St. Lawrence River basin he and Barton A. Bean obtained the young in Racket River, Norfolk, N. Y., July 18,

and in the St. Lawrence River, 3 miles below Ogdensburg, July 17. In the Lake Champlain basin these two collectors secured young and half grown specimens in the Saranac River, at Plattsburg, July 28, 1894.

The writer received specimens from Canandaigua Lake in November of 1896 and 1897, and seined the young in Bronx River in August, 1897. The small mountain form was secured from Saranac Lake in November, 1897. It is conspicuous for its small size and its red color. The Canandaigua lake suckers, received in November, 1896, thrive in captivity till July, 1897, when the warm water killed them.

Eugene Smith writes of this species :

“Color brownish, olivaceous above, silvery below; the young are much blotched and marked on sides and back. It is occasionally caught on the hook. Young ones, in captivity, though they always grub about, and though they take food offered them, do not thrive and gradually starve. They remain wild and take alarm easily and often leap out of their tank. This species enters slightly brackish water.”

## 22. Hog Sucker (*Catostomus nigricans* LeSueur).

*Catostomus nigricans* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 130, 1883; BEAN, Fishes Penna., 26, pl. 21, fig. 31, 1893; DEKAY, N. Y. Fauna, Fishes, 202, 1842.

The Stone Roller has a wide distribution and a remarkable variety of common names. Among them are: Hammer Head, Stone Lugger, Stone Toter, Crawl-a-Bottom, Hog Molly, Hog Mullet, Mud Sucker, Hog Sucker, Banded Sucker, Large-scaled Sucker, and Black Sucker. The name Shoemaker was formerly applied to this species in Lake Erie, perhaps on account of the resemblance of its color to that of shoemaker's pitch.

Prof. Cope says that this species in Pennsylvania is most abundant in tributaries of the Ohio and in the Susquehanna, while in the Delaware it is uncommon. It ranges from Western New York to North Carolina and westward to Kansas. It is the most remarkable looking of all the suckers of New York, and may always easily be distinguished by the shape of its head. The species grows very large, reaching a length of 2 feet. It delights in rapid streams of cold clear water. Its habit is to rest quietly on the bottom, where its color protects it from observation. It is sometimes found in small schools. The spawning season is in spring, and the young are abundant in small creeks, as well as in the rivers. The food consists of insect larvæ and small shells, and it is specially fitted for securing its prey under stones in the rapids. As a food fish this sucker has little value.

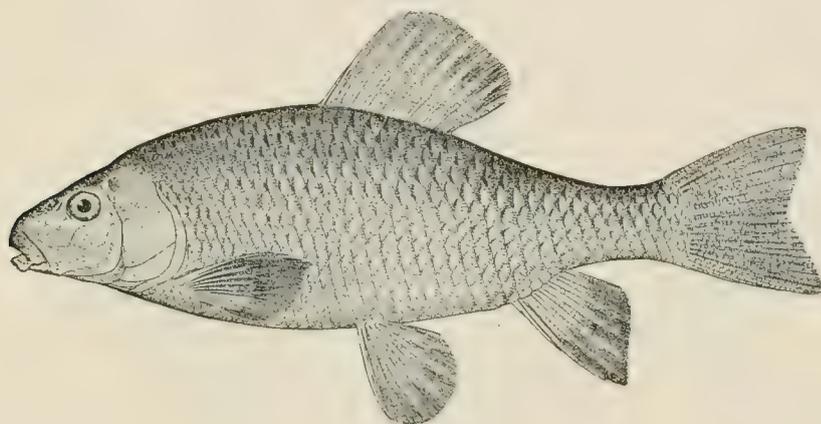
23. **Chub Sucker** (*Erimyzon sucetta* Lacépède).

*Labeo gibbosus* DEKAY, N. Y. Fauna, Fishes, 194, pl. 32, fig. 101, 1842.

*Erimyzon sucetta* BEAN, Fishes Penna., 27, 1893 (part).

The Chub Sucker here described is the southern form which was first made known by Lacépède from an individual received from Charleston, S. C. Jordan and Evermann now give the distribution of this form as extending from Virginia to Texas. It appears to reach a little farther northward if the references to DeKay are properly made. His *Labeo gibbosus* and *esopus* and the *Catostomus tuberculatus* seem to indicate the southern Chub Sucker.

The species reaches the length of 1 foot. It has very little value as food, but the



CHUB SUCKER.

young furnish excellent food for the larger fishes and are very interesting for aquarium purposes.

24. **Chub Sucker** (*Erimyzon sucetta oblongus* Mitchill).

*Labeo elegans* DEKAY, N. Y. Fauna, Fishes, 192, pl. 31, fig. 100, 1842.

*Erimyzon sucetta* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 133, 1883; BEAN, Fishes Penna., 27, 1893 (part).

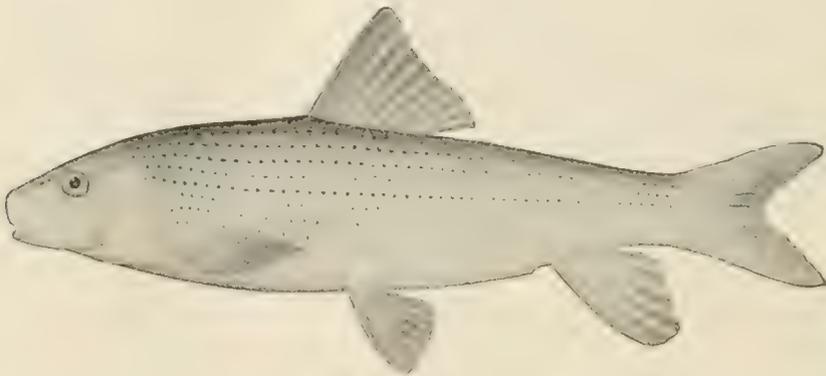
This is known as the Chub Sucker, Sweet Sucker, Rounded Sucker, Creek Fish, and Mullet. It has a wide range, practically including all the waters of the United States east of the Rocky Mountains.

The Chub Sucker grows to a length of about 1 foot. It is very tenacious of life and is a ready biter, but has little value for food. The young up to the length of several inches have a very distinct lateral band. They are often found in the shelter of water lilies and other aquatic plants close to brackish waters.

Dr. Evermann collected two specimens in Black Creek, tributary of Oswego River, at Scriba Corners, N. Y., July 17, 1894. Dr. Meek found it very common about Cayuga and Montezuma, N. Y., but did not observe it near Ithaca. In the market of New York, according to DeKay, the Chub Sucker makes its appearance in October, November and December. Specimens were seined in Bronx River in August, 1897.

A young example sent from near Princeton, N. J., by Prof. Ulric Dahlgren in September, 1897, showed the following voluntary change of color: When it arrived, it had the broad, longitudinal median band well developed and the vertical bands obsolete; but soon after it was placed in a tank it obscured the longitudinal band entirely and developed the vertical bands.

The food of the Chub Sucker consists chiefly of minute crustaceans, insect larvæ and aquatic plants.



STRIPED SUCKER.

### 25. Striped Sucker (*Minytrema melanops* Rafinesque).

*Minytrema melanops* JORDAN, Bull. 12, U. S. Nat. Mus. 138, 1878; BEAN, Fishes Penna., 28, pl. 21, fig. 32, 1893.

The Striped Sucker, also called Soft Sucker, Sand Sucker, and Black-nosed Sucker, is found in the Great Lakes and south to South Carolina and Texas. In Pennsylvania it is limited to Lake Erie and the Ohio Valley. In New York it is to be expected in Lake Ontario and its tributaries, and should also occur in Chautauqua Lake.

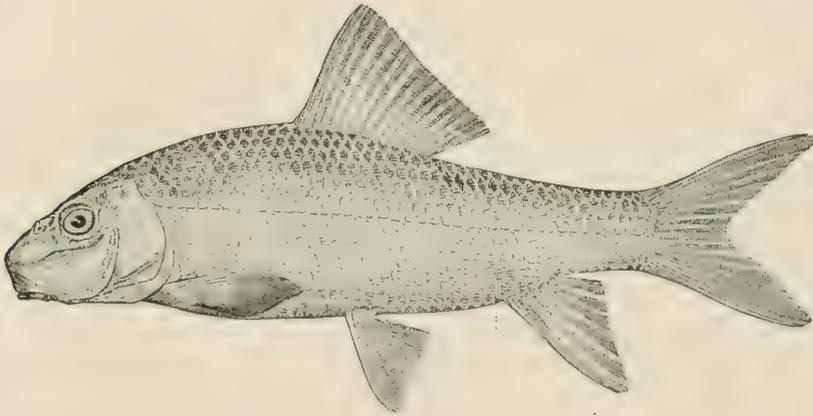
The Striped Sucker grows to a length of 18 inches. Old males have the head tuberculate in the breeding season in the spring. The species is very readily distinguished by the dark stripes along the sides produced by spots at the base of each scale. In the young of this sucker there is no lateral line but in adults it is almost entire. This sucker prefers clear, sluggish waters and grassy ponds. It

readily adapts itself to life in the aquarium. It feeds entirely on mollusks, insects and insect larvæ. The species is not much esteemed as a food fish, though it is sold in large numbers.

*Minytrema melanops* is normally without a lateral line, but this feature is occasionally partially developed and has caused some confusion in assigning certain individuals to their proper genus; indeed, one author has described and figured the Striped Sucker as two species, belonging to two different genera, having been misled by this undeveloped character.

26. **White-nosed Sucker** (*Moxostoma anisurum* Rafinesque).

*Moxostoma anisurum* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 141, 1883; BEAN, Fishes Penna., 28, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 190, 1896.



WHITE-NOSED SUCKER.

The White-nosed Sucker is found sparingly in the Ohio River and the Great Lakes region; widely distributed, but nowhere abundant. Cuvier and Valenciennes received from Milbert a specimen sent from Lake Ontario, measuring about 2 feet. Dr. Jordan says this is very closely related to the common Red Horse, from which it can hardly be distinguished except by its fins. Dr. Evermann collected a single specimen at Fox Island, N. Y., June 29, 1894; he also obtained a specimen 12 inches long at Point Breeze, N. Y., August 21, 1894, which he refers to this species, though indicating some characters in which it differs from the normal form of the White-nosed Sucker.

27. Red Horse (*Moxostoma aureolum* LeSueur).

*Catostomus aureolus* DEKAY, N. Y. Fauna, Fishes, 201, pl. 42, fig. 133, 1842.

*Moxostoma aureolum* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 140, 1883; BEAN, Fishes Penna., 30, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 192, 1896.

The Red Horse has the additional names of Golden Red Horse, Golden Sucker, Mullet, Golden Mullet, and Lake Mullet. It inhabits the Great Lakes and the region northward, also the Ohio Valley. It is common in Lake Erie, but not in Ohio.

This species grows to a length of 18 inches and is one of the handsomest of the suckers. Prof. Forbes records it from lakes of Northern Illinois, also abundantly in the central part of that State.

Dr. Evermann, in collecting fishes of the Lake Ontario region, secured it at the following localities: Lake Ontario, 4 miles off Nine Mile Point, N. Y., June 12, 1893; Lake Shore, 3 miles west of Oswego, July 17, 1894; mouth Salmon River, July 25, 1894; Long Pond, Charlotte, N. Y., Aug. 17, 1894; Sandy Creek, North Hamlin, N. Y., August 20, 1894.

Dr. Meek identified a single specimen of the so-called Common Red Horse of Cayuga Lake with *Moxostoma macrolepidotum*, and stated, on the authority of Mr. Kipp, that it is common at the northern end. Jordan & Evermann, however, do not extend the range of *macrolepidotum* so far north, and it is probable that the common *Moxostoma* of Cayuga Lake is *M. aureolum*.

DeKay records the species as very common in Lake Erie. In August and September he observed them to be full of worms. In his New York Fauna, Fishes, p. 198, he describes a sucker or mullet under the name Oneida Sucker. This he stated is common in Oneida Lake. The species is considered identical with *Moxostoma aureolum*. His description shows a very close agreement with that of *aureolum*.

The food of the Red Horse consists chiefly of mollusks and insects. It is not a choice food fish.

Eugene Smith records this form as occurring in the vicinity of New York City. Mention has already been made of the doubt concerning the northern limits of the range of *macrolepidotum*; but for the sake of comparison the brief description of *macrolepidotum* published by Jordan & Evermann is given herewith.

Head moderate, rather stout, its length four and three-fifths in body; eye one and two-thirds in snout; dorsal fin with its free edge concave; scales usually with dusky shade at base; lower fins pale. Streams about Chesapeake and Delaware

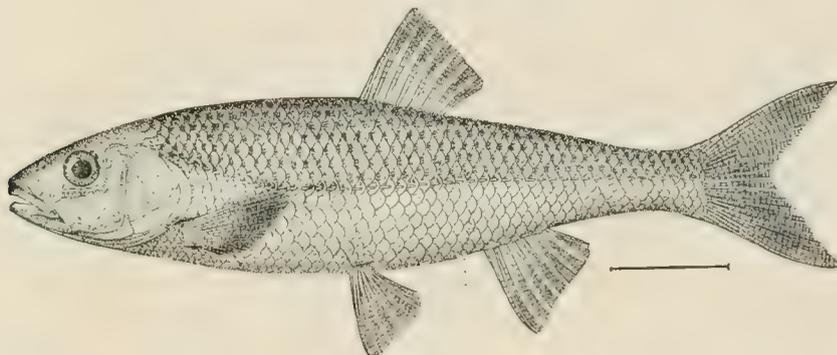
Bays and southward to North Carolina. It seems in some respects intermediate between *M. auricolum* and *M. crassilabre*; we cannot at present identify it with either.

28. **Fallfish** (*Semotilus bullaris* Rafinesque).

*Semotilus bullaris* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 222, 1883; BEAN, Fishes Penna., 50, pl. 24, fig. 41, 1893.

*Leuciscus nitidus* DEKAY, N. Y. Fauna, Fishes, 209, pl. 33, fig. 105, 1842, Lake Champlain.

The Fallfish or Dace is one of the largest of the minnow family in New York, reaching a length of 18 inches, and it is one of the most beautiful species as well as game in its qualities. As a food fish, however, this is not greatly esteemed. It is extremely common in the Delaware River and its tributaries and moderately abundant in the Susquehanna. The Fallfish is found from Quebec to Virginia. Mitchill



FALLFISH.

had it from the Wallkill River and knew of its occurrence in the Hudson, near Albany. Rafinesque recorded it from the Fishkill and other tributaries of the Hudson. DeKay knew it from Lake Champlain and from New York Harbor. Evermann and Bean collected it in Scioto Creek, at Coopersville, and in Saranac River, at Plattsburg, in July, 1894; also in Racket River, at Norfolk, and the St. Lawrence River, 3 miles below Ogdensburg, in the same month.

In the Lake Ontario basin the U. S. Fish Commission parties found it at Sacket Harbor, Centerville, Watertown, Oswego, Webster, Charlotte, Belleville, Henderson Bay, Henderson Harbor, and Salt Brook, near Nine Mile Point.

The Fallfish delights in rapid, rocky portions of large streams and in the deep channels. On being hooked it fights desperately for a short time, but its resistance is soon overcome. Thoreau describes it as a soft fish with a taste like brown paper salted, yet the boy fishermen will continue to covet and admire this handsome and

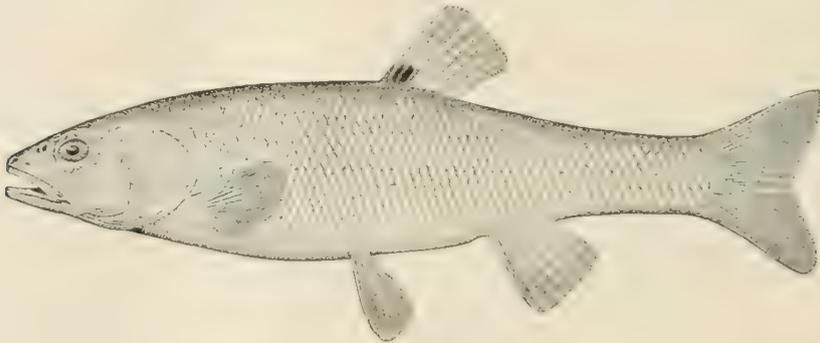
ubiquitous representative of the minnow family. A colored plate of the fish, natural size, appears in the Third Annual Report of the Commissioners of Fisheries, Game and Forest of the State of New York, 1898, facing page 146. There is also a good account of the fish by A. N. Cheney on pages 244 and 245 of the same report.

29. **Horned Dace** (*Semotilus atromaculatus* Mitchill).

*Leuciscus atromaculatus* DEKAY, N. Y. Fauna, Fishes, 210, pl. 32, fig. 102, 1842.

*Semotilus atromaculatus* BEAN, Fishes Penna., 51, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 222, 1896; pl. XL, fig. 100, 1900.

The Common Chub, Creek Club, smaller Fallfish or Horned Dace has a wider distribution than *S. bullaris*, but it does not grow quite so large, seldom exceeding 1 foot in length. Its range extends from New England to Missouri, southward to Georgia and Alabama. It is extremely common and ascends the small streams.



HORNED DACE.

The U. S. Fish Commission collectors in 1894 took numerous specimens at the following localities: Sacket's Harbor, July 2; Centerville, July 24; Watertown, July 5; Oswego, July 25; Webster, August 9; Charlotte, August 17; Belleville, July 12; Henderson Bay, July 4; Henderson Harbor, July 3; and Salt Brook, 1½ miles above Nine Mile Point, June 10 and 11, 1893.

Dr. Meek reported it as abundant throughout the Cayuga Lake basin. Large examples are found in Canandaigua Lake. One of them measured 14 inches in July, 1897. The fish is killed by warm water. The food in captivity includes hard clams, earthworms, and, occasionally, live killifish.

A. N. Cheney refers to this species on page 245 of the Third Annual Report of the Commissioners of Fisheries, Game and Forest of the State of New York.

In Pennsylvania it is the commonest minnow in the Alleghany and Susquehanna basins and is sufficiently common in the Delaware. According to Prof. Cope it reached 4 pounds in weight and is a fair food fish.

This species is more characteristic of the small streams and clear ponds and it takes the hook very freely; but its proper mission is to serve as bait for the larger and choicer fishes.

### 30. Tench (*Tinca tinca* Linnæus).

*Tinca vulgaris* CUVIER & VALENCIENNES, Hist. Nat. Poiss, XVI, 322, pl. 484, 1842;  
HECKEL & KNER, Süßw. Fische, 75, fig. 34, 1858.

The Tench has been introduced into the United States. An individual taken in the Potomac River near Washington, D. C., has a grinding surface well developed on the pharyngeal teeth, a character concerning which no mention is made in the current descriptions. The Tench now extends throughout the fresh waters of



TENCH.

Europe into those of Asia Minor. Its northern limit is said to be in Finland. It may or may not be native to England. The species prefers still waters in which aquatic plants abound. It is very tenacious of life and has been observed to live a whole day out of water. Its food consists of insects, larvæ, worms and vegetable substances.

Spawning takes place in June and July. The eggs are small and adhesive. The rate of growth is rather rapid under favorable circumstances, the young having attained to a weight of 1 pound in their first year. Individuals of the weight of 10 or 11 pounds are recorded, and Salvianus mentioned a Tench of 20 pounds. As for the quality of its flesh opinions differ, some persons considering it unpalatable, while others regard it as delicious and wholesome.

### 31. Lake Minnow (*Hybopsis storerianus* Kirtland).

*Ceratichthys lucens* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 213, 1883.

*Leuciscus storerianus* KIRTLAND, Bost. Jour. Nat. Hist., V, 30, pl. 9, fig. 2, 1847.

Kirtland found the Lake Minnow only in Lake Erie, where it was frequently taken with seines in fishing for other species. The U. S. Fish Commission recently added it to the fauna of the Lake Ontario basin, three specimens having been collected in Long Pond, Charlotte, August 17, 1894.

### 32. Horned Chub (*Hybopsis kentuckiensis* Rafinesque.)

*Leuciscus biguttatus* DEKAY, N. Y. Fauna, Fishes, 214 (extra-limital), 1842.

*Hybopsis kentuckiensis* BEAN, Fishes Penna., 49, pl. 24, fig. 40, 1893.

Rafinesque states that the fish is known as Indian Chub, Redtail and Shiner. Other names in eastern localities are Nigger Chub, River Chub, Jerker, Horned Dace and Horny-head.

The species ranges from Pennsylvania westward to Dakota and south to Alabama. In Pennsylvania it is common in the Susquehanna and the Ohio basin, but absent from the Delaware. Dr. Meek collected a few specimens at Montezuma, N. Y., and found none in any of the other localities investigated. Eugene Smith refers to this species two specimens of fish from the Passaic River. The flesh of his fish appeared to be very soft.

The Horned Chub abounds in large rivers and is rarely seen in small brooks. This minnow grows to a length of 10 inches and is good for food. As a bait for the Black Bass, because of its endurance on a hook, it cannot be excelled.

### 33. Cut-lips (*Exoglossum maxillingua* LeSueur).

*Exoglossum maxillingua* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 160, 1883; BEAN, Fishes Penna., 36, pl. 22, fig. 36, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1, 327, 1896, pl. LIV, fig. 14a, 1900, head below.

The Cut-lips may be readily distinguished by the three-lobed lower jaw, the dentary bones being closely united and the lower lip represented by a fleshy lobe on each side of the mandible.

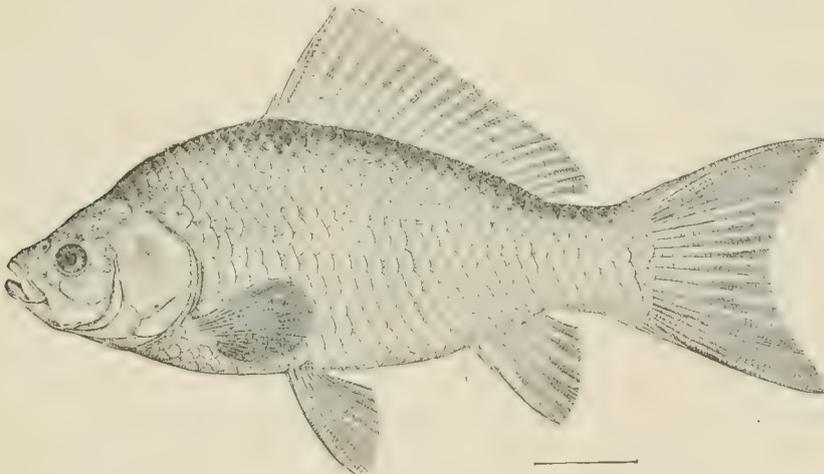
The Cut-lips is known as Chub, Butter Chub, Nigger Chub and Day Chub. It is a very common species in the Susquehanna and its tributaries. Its range is not extensive, reaching only from Western New York to Virginia. In New York it occurs in Lake Ontario, the St. Lawrence, Lake Champlain, Cayuga Lake and the

Hudson River. The U. S. Fish Commission has it from the following New York localities in the Lake Ontario basin: Mouth Salmon River, Selkirk; Big Sandy Creek, Belleville; Wart Creek, Buena Vista; Little Stony Creek, Henderson Bay; Big Stony Creek, Henderson Harbor; Spring Brook, Pulaski; Black River, Huntingtonville.

All of these were obtained in July, 1894. Evermann and Bean collected it also in the St. Lawrence, 3 miles below Ogdensburg, July 17, 1894, and Scioto Creek, Coopersville and Saranac River, Plattsburg, July 19, 1894.

Dr. Meek found it in small numbers in Six Mile Creek and Fall Creek, below the falls. It inhabits clear running water.

The fish grows to the length of 6 inches and may be at once distinguished from all of the other minnows by its three-lobed lower jaw. It is believed that this



GOLDFISH.

singular structure of the mouth enables the fish to scrape mollusks from their hold on rocks, as its stomach usually contains small shellfish. It takes the hook readily.

### 34. Goldfish (*Carassius auratus* Linnæus).

*Cyprinus auratus* DEKAY, N. Y. Fauna, Fishes, 190, 1842.

*Carassius auratus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 253, 1883; BEAN, Fishes Penna., 54, pl. 25, fig. 43, 1893.

The common Goldfish or Silverfish is a native of Asia, whence it was introduced into Europe and from there into America, where it is now one of the commonest aquarium fishes and is extremely abundant in many of our streams. In Pennsylvania it abounds in the Delaware and Schuylkill Rivers.

DeKay made the following remarks about the Goldfish, or Golden Carp, as he styled it:

"The Golden Carp, or Goldfish, as it is more generally called, was introduced from China into Europe in the early part of the 17th century, and probably shortly after found its way to this country. They breed freely in ponds in this and the adjoining States. They are of no use as an article of food, but are kept in glass vases as an ornament to the parlor or drawing room. They are said to display an attachment to their owners and a limited obedience to their commands."

They are introduced into lakes, ponds, fountains and reservoirs generally. An individual was kept in a fountain at 42d Street and 5th Avenue, New York, by Patrick Walsh nine years and was then presented to the aquarium.

At Cold Spring Harbor Hatchery, L. I., several varieties were hatched from the same lot of eggs. These included the normal form, the typical fan-tail, and one which was so deep bodied that it could scarcely balance itself in swimming.

The Goldfish in the New York Aquarium were never troubled by fungus parasites.

"In many of our streams and ponds, the Goldfish has run wild, and hundreds of the olivaceous type will be secured to one of a red color. In the fauna of the moraine ponds and in quarry holes, the Goldfish stands first. It will breed in foul water where only Catfish and Dogfish (*Umbra*) can be found." *Eugene Smith.*

The Goldfish is extremely variable in color and form. It is usually orange, or mottled with black and orange, yet in some streams and even in pond culture, silvery individuals are often more common than any of the mottled varieties. The species grows to the length of 12 inches. It spawns early in the spring and is subject to many dangers and is attacked by many enemies. The fish, however, is extremely hardy, prolific, and tenacious of life.

### 35. Carp (*Cyprinus carpio* Linnæus).

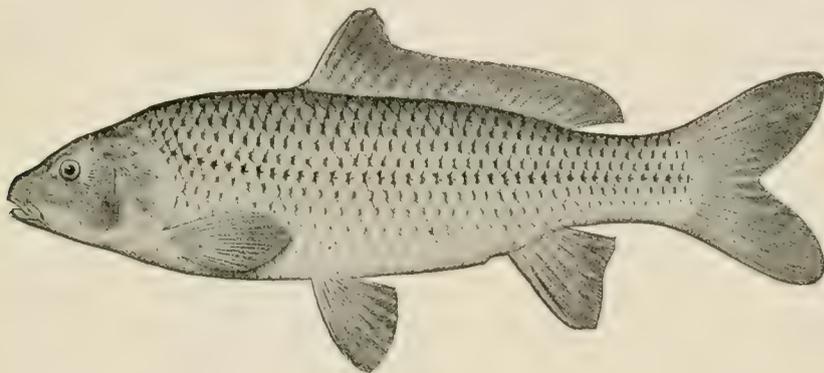
*Cyprinus carpio* DEKAY, N. Y. Fauna, Fishes, 188, 1842; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 254, 1883; BEAN, Fishes Penna., 55, pl. 1, colored, 1893.

The Carp is a native of Asia and has been introduced into Europe and America as a food fish, chiefly for pond culture. It thrives in all warm and temperate parts of the United States, and reaches its best condition in open waters. In Texas it has grown to a length of 23 inches in 11 months after planting. The leather variety is most hardy for transportation. Mr. Hessel has taken the Carp in the Black and Caspian Seas; salt water seems not to be objectionable to it, and it will live in stagnant pools, though its flesh will be decidedly inferior in such waters. The Carp

hibernates in winter except in warm latitudes, takes no food and does not grow; its increase in size in temperate latitudes occurs only from May to August.

The spawning season begins in May and continues in some localities till August. A Carp weighing 4 to 5 pounds, according to Mr. Hessel, yields from 400,000 to 500,000 eggs; the Scale Carp contains rather more than the other varieties. During the spawning the fish frequently rise to the surface, the female accompanied by two or three males. The female drops the eggs at intervals during a period of some days or weeks in shallow water on aquatic plants. The eggs adhere in lumps to plants, twigs and stones. The hatching period varies from 12 to 16 days.

According to Hessel the average weight of a Carp at 3 years is from 3 to  $3\frac{1}{2}$  pounds; with abundance of food it will increase more rapidly in weight. The Carp continues to add to its circumference till its thirty-fifth year, and in the southern parts of Europe Mr. Hessel has seen individuals weighing 40 pounds and measuring



CARP.

$3\frac{1}{2}$  feet in length, and  $2\frac{3}{4}$  feet in circumference. A carp weighing 67 pounds and with scales  $2\frac{1}{2}$  inches in diameter was killed in the Danube in 1853. There is a record of a giant specimen of 90 pounds from Lake Zug, in Switzerland. Examples weighing 24 pounds have been caught recently in the Potomac River at Washington, D. C.

The Carp lives principally on vegetable food, preferably the seeds of water plants such as the water lilies, wild rice and water oats. It will eat lettuce, cabbage soaked barley, wheat, rice, corn, insects and their larvæ, worms and meats of various kinds. It can readily be caught with dough, grains of barley or wheat, worms, maggots, wasp larvæ and sometimes with pieces of beef or fish.

During the summer of 1897 two female Leather Carp died in captivity as a result, of retention of the eggs.

Large individuals are found in Prospect Park Lake, Brooklyn, where the species was introduced. The food of the fish in captivity includes hard clams, earthworms,

wheat, corn, lettuce and cabbage. Its growth is remarkable. A Leather Carp has fully doubled its weight in one year.

Linnæus says the Carp was introduced into England about the year 1600. DeKay places the first introduction into New York waters in the year 1831, and publishes a letter of Henry Robinson, Newburgh, Orange Co., who brought them from France, reared and bred them successfully in his ponds, and planted from one dozen to two dozen at a time in the Hudson during the four years preceding his letter. Mr. Robinson stated that they increased greatly and were frequently taken by fishermen in their nets.

### 36. Eel (*Anguilla chrysypa* Rafinesque).

*Anguilla chrysypa* RAFINESQUE, Amer. Month. Mag., II, 120, Dec., 1817.

*Anguilla tenuirostris* DEKAY, N. Y. Fauna, Fishes, 310, pl. 53, fig. 173, 1842; BEAN, Fishes Penna., 95, pl. 30, fig. 58, 1893.

*Anguilla chrysypa* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 348 1896, pl. LV, fig. 143, 1900.



The Eel appears to have only one common name. It is one of the best known and most singular of our fishes, yet its breeding habits have only recently been observed. The species ascends the rivers of Eastern North America from the Gulf of St. Lawrence to Mexico, the former being the northern limit of the species on our coast. In the Ohio and Mississippi valleys it is extremely common and its range has been much extended by the opening of canals and by artificial introduction. It has been transferred to the Pacific coast.

The Eel has been known to exceed a length of 4 feet. The average length of individuals, however, is about 2 feet. The female is larger than the male, paler in color, and is different in certain other particulars, which are mentioned in the descriptions of the species.

This is a very important food fish. It is caught chiefly when descending the rivers in the fall. In 1869 about a ton of eels were caught in a single fish basket

above Harrisburg. At the present time this method of capture is illegal. Both adults and young eels ascend the streams in spring, the young coming in millions, but in the fall run small eels are seldom seen. Till a comparatively recent date it was not certainly known that the eels have eggs which are developed outside of the body. Even now the breeding habits are scarcely known, but it is supposed that spawning takes place late in the fall or during the winter near the mouths of rivers, on muddy bottoms. Dr. Jordan has expressed the belief that the eel sometimes breeds in fresh water, since he has found young eels less than an inch long in the headwaters of the Alabama River, about 500 miles from the sea. It is estimated that a large eel contains about 9,000,000 eggs. The eggs are very small, measuring about 80 to an inch, and can scarcely be seen by the naked eye.

The difference of size in the sexes has already been referred to. According to one writer the males are much smaller than the females, rarely exceeding 15 or 16 inches in length. The question whether eels will breed in fresh water has an important bearing on their introduction into places from which they cannot reach the sea. The generally accepted belief is that, while the eels will grow large and fat, they will not reproduce under such circumstances.

When the eels meet obstructions in streams they will leave the water and travel through wet grass or over moist rocks. They have not been able to surmount the Falls of Niagara. At the foot of this barrier hundreds of wagon loads of young eels have been seen crawling over the rocks in their efforts to reach the upper waters.

Dr. Mitchill heard of an eel which was caught in one of the south bays of Long Island that weighed 16½ pounds. He records the use of eelpots and the practice of bobbing, and also the winter fishing by spearing. Dr. Mitchill states distinctly that the ovaries of eels may be seen like those of other fish, but they are often mistaken for masses of fat. Dr. DeKay states that he had examined the silver eel of the fishermen and was disposed to consider it only a variety of the common eel. He characterizes it as "silvery gray above, with clear, satiny white abdomen, separated from the color above by the lateral line."

In captivity eels live many years. They delight to lie buried in the mud or sand with only their heads out, ready for anything edible to come within reach. Mussels and snails are picked out of the shells by them. (After Eugene Smith, Proc. Linn. Soc. N. Y. No. 9, p. 29, 1897.)

The eel in captivity is particularly liable to attacks of fungus, which do not always yield to treatment with salt or brackish water; but the parasite can be overcome by placing the eel in a poorly lighted tank.

In Cayuga Lake, N. Y., according to Dr. Meek, the eel' is not common, but is occasionally taken at the end of the lake.

W. H. Ballou makes the following remarks about the feeding habits:

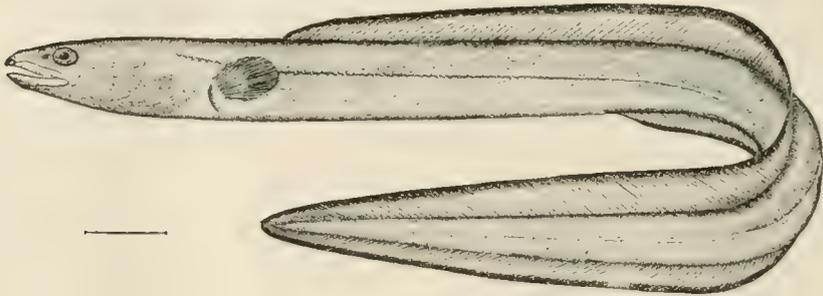
"They are among the most voracious and carnivorous fishes. They eat most inland fishes except the gar and the chub. They are particularly fond of game fishes, and show the delicate taste of a connoisseur in their selections from choice trout, bass, pickerel and shad. On their hunting excursions they overturn huge and small stones alike, working for hours if necessary, beneath which they find species of shrimp and crayfish, of which they are exceedingly fond. They are among the most powerful and rapid of swimmers. They attack the spawn of other fishes open-mouthed, and are even said to suck the eggs from an impaled female. They are owl-like in their habits, committing their depredations at night."

### 37. Conger (*Leptocephalus conger* Linnæus).

*Muræna conger* LINNÆUS, Syst. Nat., ed. X, I, 245, 1758.

*Conger occidentalis* DEKAY, N. Y. Fauna, Fishes, 314, pl. 53, fig. 172, 1842, very poor.

*Leptocephalus conger* GOODE, Fish & Fish. Ind. U. S., I, pl. 240, 1884; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 354, 1896, pl. VII, fig. 148, 1900.



CONGER.

The Conger Eel occurs on both coasts of the Atlantic, on our coast extending from Cape Cod to Brazil, but often coming into shallow bays. An exception is noted in Great Egg Harbor Bay, where the fish is not rare in summer. It is sometimes caught in Gravesend Bay also in summer, and occasional individuals are captured on hand lines off Southampton, L. I., by men fishing for sea bass and scup. The fishermen dislike to handle the species on account of its pugnacity and strength; it snaps viciously at everything near it when captured in our waters; yet, strangely enough, the writer has seen a hundred or more taken on trawl lines off the north coast of France, in a boat at one time, and not one gave evidence of ferocity.

In captivity in the aquarium the sea eel suffers severely from fungus attacks,

which are not relieved by changing the fish from salt water to fresh. Perhaps the salinity of the water in some localities is too low, and relief might be obtained by supplying sea water of normal ocean density.

The young and larval form of the Conger is a curious, elongate, transparent, band-like creature with a minute head, a very small mouth and with the lateral line, belly, and anal fin dotted with black points.

An individual nearly 3 feet long was captured with a hand line by A. P. Latto in the ocean, near Southampton, L. I., August 3, 1898, while fishing for sea bass and scup.

In the Woods Hole region, according to Dr. Smith, "it comes in July and remains until fall; very common for several years, but rather rare formerly. Fishermen as a rule do not distinguish it from the common eel. A few are taken in traps and with lines, but many large ones, weighing from 8 pounds upwards, are caught in lobster pots. A specimen in the collection weighs 10 pounds. One caught on a line at Falmouth, August 30, 1897, weighed 12 pounds. The smallest observed are 15 to 20 inches long."

Mitchill declared the flesh to be very dainty eating. DeKay said the flesh has a peculiar unsavory taste. He discovered that it is a vicious animal, snapping when captured at everything near it. In France the Conger Eel is among the cheapest and least esteemed of the food fishes.

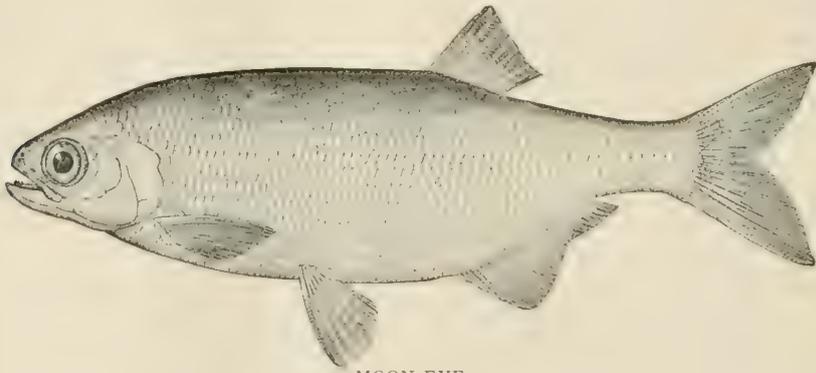
The observations of Dr. Otto Hermes, Director of the Berlin Aquarium, on the habits and the reproduction of the Conger Eel are of very great interest. Reference is made to them by Goode in *Fish and Fishery Industries of United States*, I, p. 657, and two figures copied from drawings of Dr. Hermes are given in the text. The ovary of the Conger, says Dr. Hermes, is developed in captivity, and this is often the cause of the death of the eel. In a Conger which died in the Berlin Aquarium the ovaries protruded very extensively, and a specimen in the Frankfort Aquarium burst on account of the extraordinary development of the ovaries. The ovaries of this eel, which weighed  $22\frac{1}{2}$  pounds, themselves weighed 8 pounds, and the number of eggs was about 3,300,000. The want of a natural opening for the escape of the eggs was evidently in this case the cause of death. In the fall of 1879 Dr. Hermes received a number of small sea eels taken in the vicinity of Havre. These eels ate greedily and grew rapidly. Only one was tardy in its development, so that it could easily be distinguished from the rest. This one died June 20, 1880, and was examined the same day. It proved to be a sexually mature male and served to clear up some very doubtful problems in the reproduction of the species, as well as its ally, the Common Eel.

38. Moon-eye (*Hiodon tergisus* LeSueur).

*Hiodon tergisus* DEKAY, N. Y. Fauna, Fishes, 265, pl. 41, fig. 130; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 260, 1883.

*Hiodon tergisus* BEAN, Fishes Penna., 57, pl. 25, fig. 44 (named *alosoides*), 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 413, 1896, pl. LXVIII, fig. 180, 1900.

This species is called Moon-eye, Toothed Herring, and Silver Bass. It is found in Canada, the Great Lakes region and the upper part of the Mississippi Valley, being very common in large streams and lakes. It abounds in Lake Erie and the Ohio and is seined in large numbers. DeKay observed the fish in the Alleghany River, N. Y. He recorded it also from Buffalo and Barcelona, on Lake Erie, at which places it is known as Moon-eye, Shiner and Lake Herring. He says it is very indifferent food.



MOON-EYE.

This species grows to a length of 1 foot and, like the other, though a beautiful fish and possessed of excellent game qualities, its flesh is full of small bones. It is a good fish for the aquarium; it will take a minnow or the artificial fly very readily, and the utmost skill is required in its capture. Its food consists of insects, small fishes and crustaceans.

Dr. Richardson describes this fish as a member of the minnow family, which, he says, is known to the Canadians under the name La Quesche. The fish is described as having the back brilliant green, sides and abdomen with a silvery luster. The specimens which were taken in the Richelieu, where it falls into the St. Lawrence, were about 9 or 10 inches long.

### 39. Northern Moon-eye (*Hiodon alosoides* Rafinesque).

*Hiodon alosoides* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 259, 1883.

*Hiodon alosoides* BEAN, Fishes Penna., 57, 1893 (not figure); JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 413, 1896.

*Hiodon clodalis* DEKAY, N. Y. Fauna, Fishes, pl. 51, fig. 164, not description, 1842.

The Northern Moon-eye is found from the Ohio River throughout the Great Lakes region to the Saskatchewan. It is very common in Manitoba and other parts of British America. In Pennsylvania it is limited to the western region.

DeKay must have had the Northern Moon-eye for study, though his description seems to apply to another species. The figure of his *Hiodon clodalis* represents a fish with a short dorsal fin, quite unlike his account in the text.

The Northern Moon-eye is very readily distinguished from the other species of the genus by its short dorsal fin, which contains only nine rays, and by its carinated belly. It grows to the length of 1 foot. The flesh is not greatly esteemed as a rule, but the fish is beautiful and has excellent game qualities.

Richardson says the fish inhabits lakes which communicate with the Saskatchewan, in the 53d and 54th parallels of latitude, but does not approach nearer to Hudson's Bay than Lake Winnipeg. This we know to be a mistake. He says further that it is taken during the summer months only, and in small numbers, in gill nets set for other fish. It bites eagerly at an artificial fly or worm. Its flesh is white, resembling that of the perch in flavor, and excelling it in richness.

### 40. Gizzard Shad (*Dorosoma cepedianum* LeSueur).

*Dorosoma cepedianum* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 271, 1883; GOODE,

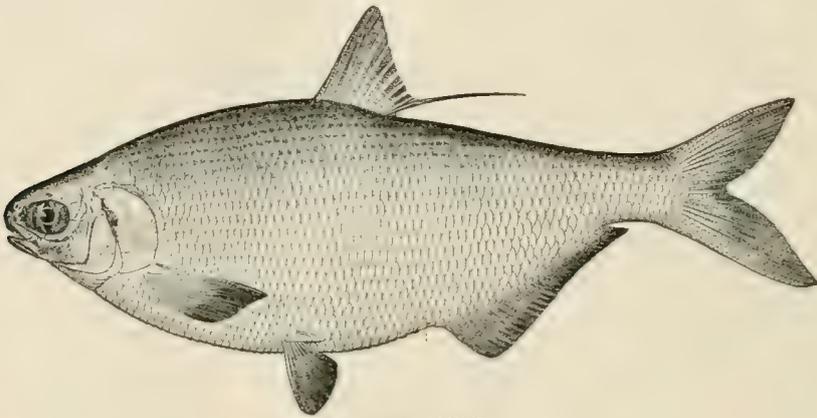
Fish & Fish. Ind. U. S., I, 610, pl. 217 A, 1884; BEAN, Fishes Penna., 63, 1893;

JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 416, 1896, pl. LXIX, fig. 183, 1900.

The Mud Shad, also known as Gizzard Shad, Winter Shad, Stink Shad, White-eyed Shad, Hickory Shad, Hairy Back and Thread Herring, is found in brackish waters along the coast from New York southward to Mexico, ascending streams and frequently becoming landlocked in ponds. A variety of this fish is also common in the Ohio and Mississippi valleys, whence it has spread through canals into Lakes Erie and Michigan.

Cuvier and Valenciennes had the species from New York, whence it was sent by Milbert. DeKay mentions it only as an extralimital fish, but in his time the fish fauna of Lake Erie was very little known.

This fish grows to a length of 15 inches and a weight of 2 pounds. It spawns in summer, and its food consists of algæ, confervæ, desmids and diatoms. With its food it takes large quantities of mud, from which it separates the organic substances after swallowing. This is a beautiful species, somewhat resembling the shad in general appearance, and has been very successfully kept in the aquarium where its bright colors and graceful movements make it attractive; but its flesh is soft, tasteless and seldom eaten when any better can be obtained. In most regions fishermen consider it a great nuisance and throw away their entire catch. Negroes eat the mud shad from tributaries of the Chesapeake, and in Florida the fish has been utilized to some extent in making guano. The name Gizzard Shad alludes to the form of the stomach, which is very much like that of a hen.



GIZZARD SHAD.

41. Sea Herring (*Clupea harengus* Linnæus).

*Clupea harengus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus. 265, 1883; BEAN, 19th Rept. N. Y. Comm. Fish., separate, 42, pl. XXIV, fig. 32, 1890.

*Clupea elongata* DEKAY, N. Y. Fauna, Fishes, 250, 1842.

The Sea Herring is the most important food fish of the world and it is undoubtedly the most abundant of all the fishes. Its food consists of small invertebrates, chiefly copepods and the larvæ of worms and mollusks. It forms the most important food of many of our valuable food fishes, including the cod, haddock, halibut, bluefish, and a great many others. Herring spawn at two seasons, spring and fall, the first spawning continuing from April to June and the second season between July and December. The eggs are adhesive and are deposited on the bottom, where they adhere to seaweeds and other objects of support. The egg is about  $\frac{1}{20}$  inch in diameter. The hatching period lasts from 12 to 40 days, according to the temperature of the water. Sea Herrings were artificially hatched as early

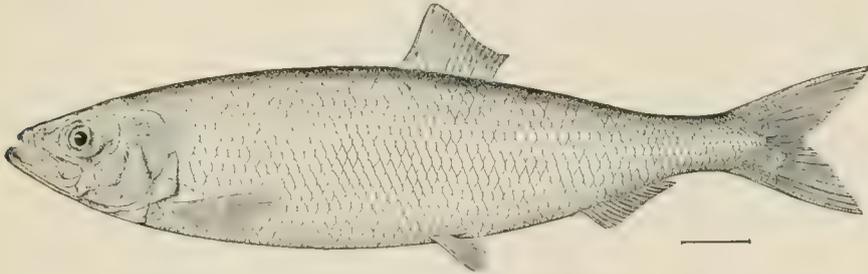
as 1878, both in Germany and the United States. It has been estimated that the annual yield of Sea Herring is 3,000,000,000 fish, principally taken in Norway.

The Herring occurs on our east coast from Labrador to New York. When found as far south as New York, it usually occurs in midwinter. Capt. Thurber obtained it in Great South Bay in the fall.

The young of the Sea Herring is well known as the whitebait of England and the United States, though in the latter country the young of other species are sometimes mingled with those of the Sea Herring.

Many young, translucent fish of the genus *Clupea*, a little under 2 inches long, are seen in spring in the shad fykes and pounds of Gravesend Bay. They are called "shad bait," because they are said to be taken frequently from shad stomachs.

Large Sea Herring, according to W. I. DeNyse, are rare in Gravesend Bay. Only about 100 or 200 are obtained there during fall and winter.



SEA HERRING.

Young examples, from  $4\frac{3}{4}$  to 6 inches long were obtained in the bay November 23, 1897.

In the vicinity of Woods Hole, Mass., according to Dr. Smith, "schools of large herring in spawning condition appear about October 15, and remain till very cold weather sets in, their departure corresponding with that of the cod. By January young herring  $\frac{1}{4}$  inch long are taken in surface tow nets; by May 1, they are 1 to  $1\frac{1}{4}$  inches long, and by August 1,  $2\frac{1}{2}$  to 3 inches. Fish 3 to 5 inches long, called "sperling" are found from September 1 to end of the season and are used for mackerel bait. About June 1, there is a large run of herring, smaller than those in the fall run. This lasts two weeks, during which time the traps are full of them. No use is made of the early run, but in fall they are caught in gill nets for food and bait."

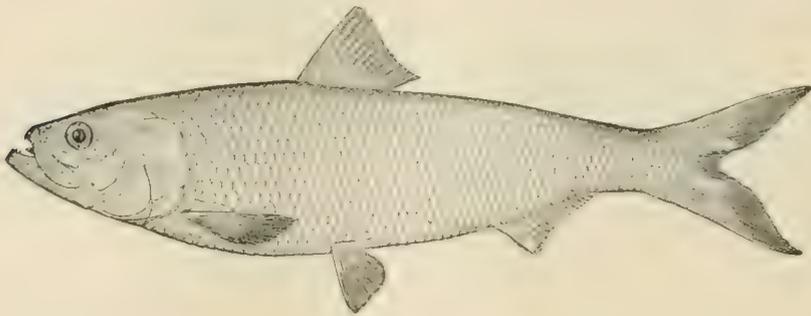
42. Skipjack (*Pomolobus chrysochloris* Rafinesque).

*Pomolobus chrysochloris* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 425, 1896, pl. LXX, fig. 187, 1900.

*Clupea chrysochloris* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus. 266, 1883; BEAN, Fishes Penna., 59, 1893.

The Golden Shad, or Skipjack, is a common inhabitant of the Ohio and Mississippi valleys and the Gulf of Mexico. In Pennsylvania this fish is confined to the Ohio and its tributaries. It prefers large streams. It has made its way into the Great Lakes through canals. The presence of the Golden Shad in the salt water of the Gulf of Mexico was discovered by Silas Stearns near Pensacola, Fla. This species grows to a length of 18 inches.

Unlike most other species of *Clupea*, this one, according to observations of Prof.

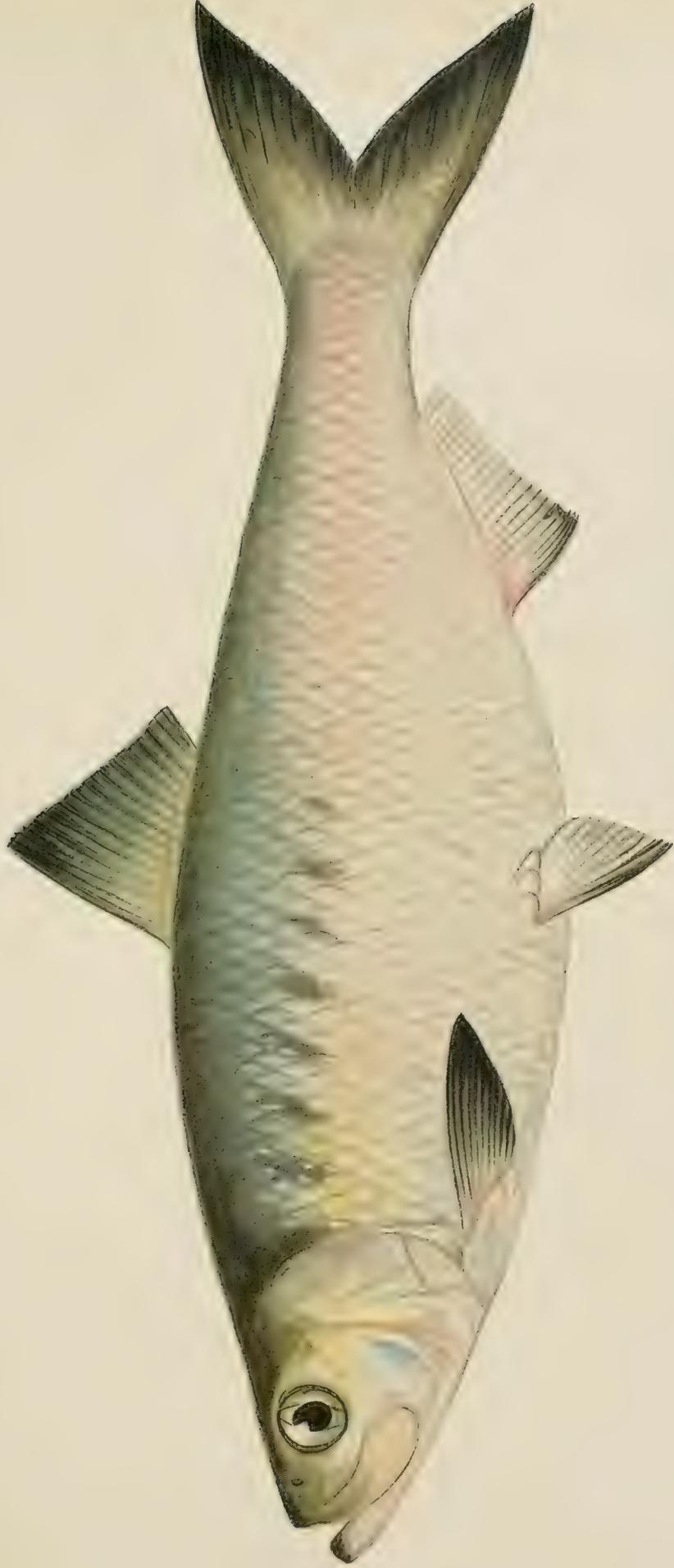


SKIPJACK.

S. A. Forbes of Illinois, is predaceous, feeding on other fishes. Two examples examined by him had eaten gizzard shad, *Dorosoma*, and another one individuals of some unidentified fish. The young of the Golden Shad,  $2\frac{1}{4}$  inches long, had consumed nothing but terrestrial insects, including flies, small spiders, etc.

Apparently it never ascends small streams. In the lower part of the Mississippi valley it migrates into salt water. In the upper part of this valley it is a permanent resident in fresh water. The name Skipjack is given in allusion to its habit of skipping along the surface of the water when in pursuit of its prey. In the water its movements are graceful and active.

The fish is full of small bones and its flesh is reputed to be tasteless and without value as food; but Kirtland says it is esteemed in Ohio as a good pan fish.



HICKORY SHAD | *POMOLOBUS MEDIOCRIS*

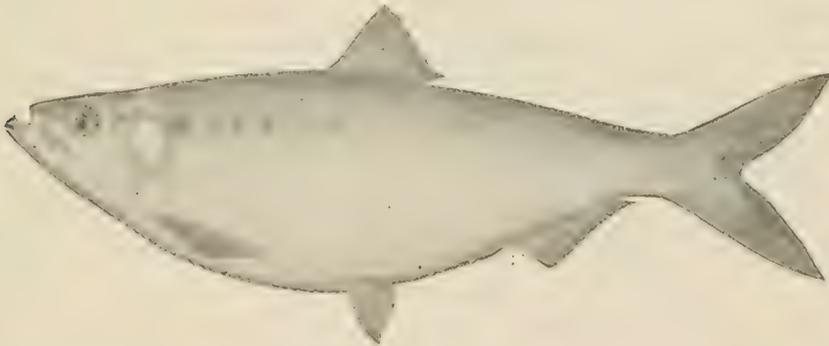


43. **Hickory Shad** (*Pomolobus mediocris* Mitchill).

*Clupea mediocris* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 266, 1883; BEAN, 19th Rept. N. Y. Comm. Fish., separate, 43, pl. XXV, fig. 34, 1890.

*Alosa mattowaca* DEKAY, N. Y. Fauna, Fishes, 260, pl. 40, fig. 127, 1842.

This species is referred to by Dr. Mitchill as the Staten Island Herring, *Clupea mediocris*, which, he says, grows very large for a herring, being frequently 18 inches long and almost as big as a small shad. It has "six or eight brown spots, longitudinally, below the lateral line," as reported by an inhabitant of that part of the bay of New York which borders on Staten Island. Mitchill also has the same species under the name of Long Island Herring, *Clupea mattowaca*. This, he says, is also called the Autumnal or Fall Herring, as well as Shad Herring and Fall Shad. Mitchill recognized it as probably the full grown fish of the *C. mediocris*. He was not able to distinguish it from that species. The length of the



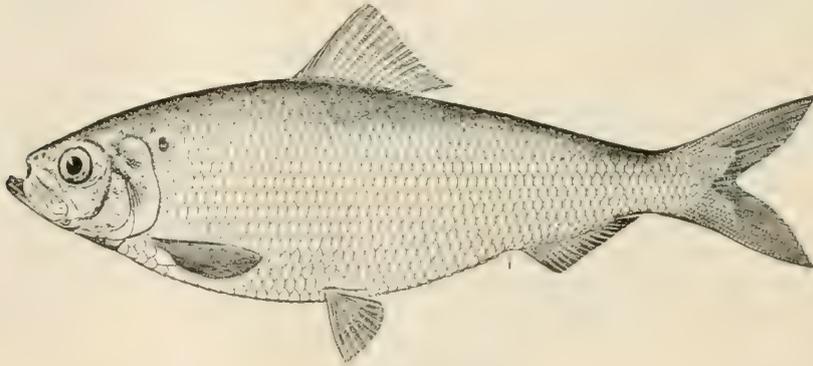
HICKORY SHAD.

Green Back, according to this writer, frequently reaches 2 feet, with a depth of from  $4\frac{1}{2}$  to 6 inches. At the time of this writing the fish was taken in October and November in seines on the surf side of the beaches fronting Long Island. Dr. DeKay mentions examples in the market early in July, which are brought from the Connecticut River, where they are called Weesick. He states that the specific name bestowed on it by Mitchill was derived from the aboriginal name of the island, Mattowaca or Mattowax. In Great South Bay the name Green Back is well established for the species. A single example was seined, September 29, at Fire Island. October 1, 1890, considerable numbers of large Green Backs were caught in a trap at Islip. The Hickory Shad is caught in Gravesend Bay during September, October and November, but is less plentiful than it was formerly. Large Hickory Shad weighing from  $\frac{1}{2}$  pound to  $2\frac{1}{2}$  pounds were shipped from waters near New York City to Fulton Market October 30, 1896. Each of them had in its stomach from

15 to 20 Sand Launce from  $3\frac{1}{2}$  to 5 inches long. A few specimens were seined at Blue Point Cove, Great South Bay, and at Howell's Point, in the same bay, August 31, 1898.

At Woods Hole, Mass., it comes in the spring, but is most numerous late in September and till trap fishing ends. In October, 1895, a trap near Tarpaulin Cove caught 3,500 at one lift. These brought 10 cents each in New York. In spring and summer the fish has no market value, but it sells in the fall.

The name Hickory Shad is applied to this species from the Chesapeake Bay region southward, and in some Georgia rivers this is abbreviated to Hicks. In the Potomac and some other rivers tributary to the Chesapeake, the name Tailor Shad is applied to this fish. The Hickory Shad occurs from Maine to Florida, entering rivers except in New England. The species is much less valuable than the shad, for which it is often sold by dealers. Nothing definite is known about its habits, but



BRANCH HERRING.

Marshall McDonald was of the opinion that it spawns in the rivers at a little earlier period than the shad, which it always precedes in the ascent of the streams in spring.

#### 44. Branch Herring (*Pomolobus pseudoharengus* Wilson).

*Clupea vernalis* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 267, 1883; BEAN, Fish & Fish. Ind. U. S., I, 588; Fishes Penna., 58, pl. 25, fig. 45, 1893.

*Alosa tyrannus* DEKAY, N. Y. Fauna, Fishes, 258, pl. 13, fig. 38, 1842.

The Branch Herring, River Herring, or Alewife has a variety of additional names. It is the Ellwife or Ellwhop of Connecticut River, the Spring Herring of New York, the Big-eyed and Wall-eyed Herring of Albemarle, the Sawbelly of Maine, the Gray-back of Massachusetts, the Gaspereau of Canada, Little Shad of certain localities, and the Cayuga Lake Shad of New York. The recorded range of the Branch Herring is from the Neuse River, N. C., to the Miramichi River, in New Brunswick, ascending

streams to their headwaters for the purpose of spawning. The fish is found abundant in Cayuga and Seneca Lakes, N. Y., where it has probably made its way naturally. In Lake Ontario, since the introduction there of the shad, the Alewife has become so plentiful as to cause great difficulty to fishermen, and its periodical mortality is a serious menace to the health of the people living in the vicinity. The belief is that the fish were unintentionally introduced with the shad. In Pennsylvania the Branch Alewife occurs in the Delaware and the Susquehanna in great numbers in early spring.

The U. S. Fish Commission, in 1894, obtained specimens at the following localities of the Lake Ontario region: Cape Vincent, June 21; Grenadier Island, June 27; mouth Salem River, Selkirk, July 25; Long Pond, Charlotte, N. Y., August 17; Lake Shore, mouth Long Pond, August 17; Sandy Creek, North Hamlin, August 20.

Not a native of Cayuga Lake, but often found there in large numbers. Known to the fishermen as Sawbelly. It is thought to have been introduced into the lakes of Central New York by the State Fish Commission. Large numbers are often found dead on the shores of Seneca and Cayuga Lakes. (After Meek.) DeKay says it appears in New York waters with the shad about the first of April, but never in sufficient numbers to form a separate fishery.

The Branch Herring, or Alewife, is the first of the alewives to appear in Gravesend Bay; it comes with the shad. It endures captivity well. November 30, 1897, individuals above 7 inches in length were caught in Gravesend Bay, which were probably the young of the year.

The Alewife seldom exceeds 1 foot in length, the average market examples being about 10 inches. The weight of the largest is about  $\frac{1}{2}$  pound, and the average weight is about 5 or 6 ounces.

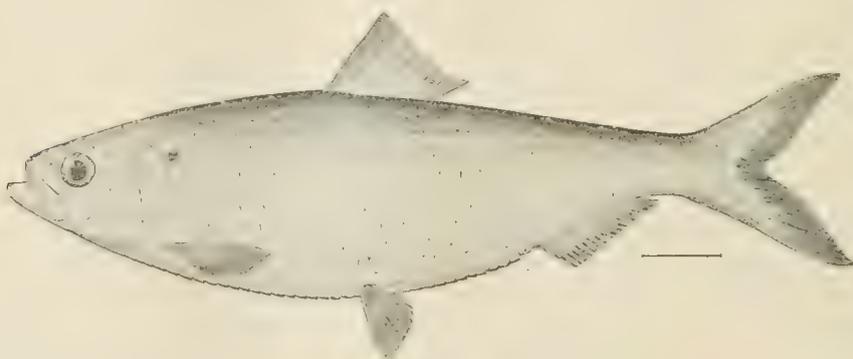
The fish enter the rivers earlier than the shad and return to the sea, or to estuaries adjacent to the river mouths at some undetermined date in the fall. During the summer months enormous schools of full-grown, but sexually immature alewives migrate along the coast, feeding on small crustaceans and themselves furnishing food for bluefish, sharks, porpoises and other predaceous animals; but none of them are known to enter fresh water. In the rivers the alewives appear to eat nothing, but they can be captured with small artificial flies of various colors. Their eggs are somewhat adhesive and number from 60,000 to 100,000 to the individual. They are deposited in shoal water; spawning begins when the river water is at 55° to 60° F. The period of hatching is not definitely known, but is believed to exceed four days.

During the spring and summer the young grow to a length of 2 and 3 inches;

after their departure from the streams nothing is known of their progress, but it is believed that they reach maturity in four years. We have no means of learning the age of the immature fish seen in great schools off shore, and thus far the rate of growth is unsettled.

The Branch Alewife, though full of small bones, is a very valuable food fish and is consumed in the fresh condition as well as dry salted, pickled and smoked. The fry can be reared in ponds by placing adults in the waters to be stocked a little before their spawning season; and they furnish excellent food for bass, rockfish, trout, salmon and other choice fishes. The proper utilization of the immense oversupply of these fish in Lake Ontario has become a serious economic problem.

Alewives are caught in seines, gillnets, traps and pounds, and they are often taken by anglers with artificial flies.



GLUT HERRING—MALE.

#### 45. Glut Herring (*Pomolobus cyanonoton* Storer).

*Pomolobus astivalis* GOODE & BEAN, Bull. Essex Inst., 24, 1879; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 246, 1896.

*Clupea astivalis* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 267, 1883.

Mitchill's name, *astivalis*, cannot be applied with any certainty to the "Glut Herring;" it appears to be a synonym of *mediocris* and *mattowaca* of the same author. Its relation to *mattowaca* was long since pointed out by Dr. Gill. The description herewith appended appears to make this conclusion inevitable. (Mitchill, Trans. Lit. & Phil. Soc. N. Y. p. 456, pl. 5, fig. 6, 1814.)

Summer Herring of New York. (*Clupea astivalis*.) Has a row of spots to the number of seven or eight, extending in the direction of the lateral line. Tail forked. Belly serrate; and, in most respects, resembling the *C. halac*, herein already described. Rays: Br. 6; P. 15; V. 9; D. 16; A. 19; C. 19.

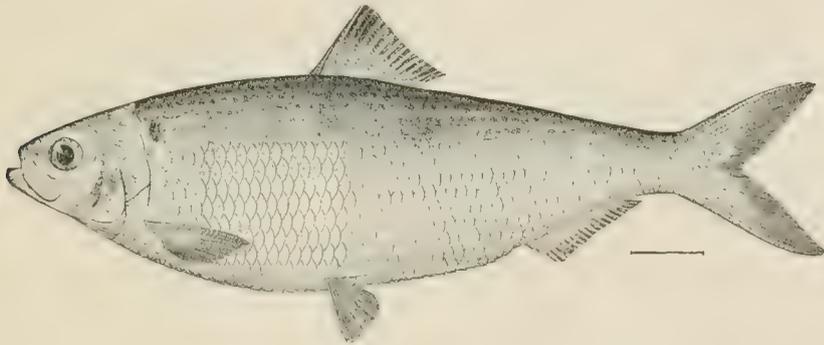
The figure shows a row of eight spots on the side extending as far back as the

end of the dorsal fin on the level of the eye. This resembles the hickory shad, *Pomolobus mediocris*, more than anything else, and it probably was that species.

The Glut Herring arrives later than the Branch Herring and does not ascend streams far above salt water. It appears to spawn only in the larger streams or their tidal tributaries and at a temperature of 70° to 75°; while the Branch Herring spawns in water as low as 55° to 60° and ascends far up the streams and their small fresh-water branches.

In Gravesend Bay the Glut Herring is called Shad Herring. November 30, 1897, two young fish of the year, measuring about 7 inches in length, were obtained from that bay. In Great South Bay the species is called Herring. A single example was secured there on September 29, 1890. In 1898 it was not collected either in Great South Bay or Mecox, in both of which the Branch Herring was abundant.

At Provincetown the species is known as the Blueback and Kiouk. According to



GLUT HERRING—FEMALE.

Storer, it appears there in small numbers in May, but is not abundant before June 10, and it remains on the coast for a short time only. The Alewife, or Branch Herring, arrives on the coast of Massachusetts about the end of March, and is taken till the middle or last of May.

#### 46. Shad (*Alosa sapidissima* Wilson).

*Clupea sapidissima* BEAN, Fishes Penna., 60, pl. 2, 1893; CHENEY, 4th Ann. Rep. N. Y.

Com. Fish, colored pl. facing p. 8, 1899.

*Alosa praestabilis* DEKAY, N. Y. Fauna, Fishes, 255, pl. 15, fig. 41, 1842.

*Alosa sapidissima* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 427, 1896, pl. LXXII, fig. 191, 1900.

The Shad is known also as the White Shad, and in the Colonial days it was known to the negroes on the lower Potomac River as Whitefish. It is found naturally along the Atlantic Coast of North America from the Gulf of St. Lawrence to

the Gulf of Mexico, ascending streams at various dates from January in its extreme southern limit to June in far northern waters. In the Delaware and Susquehanna it makes its appearance in April and departs after spawning; but remains, sometimes, as late as July 18, and many die.

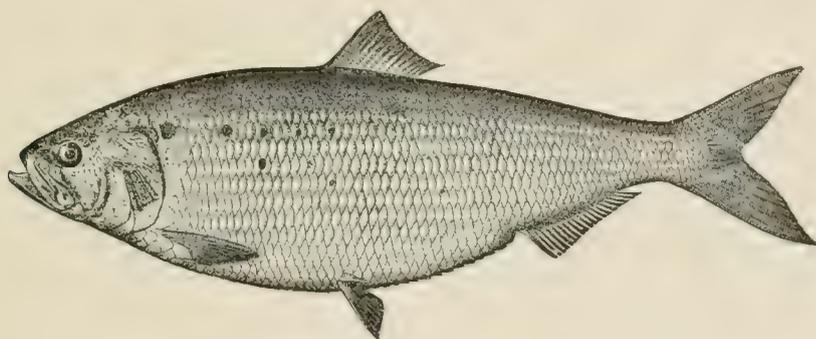
The original distribution of the shad has been widely extended by artificial introduction. In certain rivers flowing into the Gulf of Mexico the fish has been established by planting. In the Ohio River a fishery has been created by the same method; and in the Sacramento River, Cal., the shad was successfully introduced, and it has colonized not only this river but all suitable rivers from San Francisco to Southern Alaska. It is now one of the common market species in San Francisco and other west coast cities.

In the Susquehanna the shad was formerly one of the most important native food fishes, but its range is now very limited on account of obstruction by dams. Twenty years ago the Fish Commission reported that a few shad are taken yearly above the Clark's Ferry dam, none, or at least a few dozen, above the Shamokin dam, none above the Nanticoke dam and none above Williamsport. The largest run of shad that has been known to pass the Columbia dam was that of 1867. "In 1871 the finest Columbia shad were hawked in the market at Harrisburg, 30 miles from the fisheries, at considerable less than a dollar a pair. The catch at Columbia exceeded 100,000."

The obstructions in the Delaware have been almost entirely overcome. In 1891 shad were caught higher up the Delaware than for many years, and spawned in the upper reaches of the river beyond the New York State line. In 1891 the Delaware, for the first time since 1823, was restored to its normal condition by means of the fishway at Lackawaxen; and, according to Col. Gay, it is at present the best shad river in the country. The number of eggs obtained for artificial propagation in the lower river was unusually small, but the number naturally deposited in the upper waters was greater than for many years. Col. Gay observed a large number of big female shad at Gloucester City, but a great scarcity of males. This necessitated a long run up the river before spawning. The cause is believed to be the lower temperature of the water during May, the lack of rain cutting off the usual supply of warm surface water and the tributaries of the upper river bringing down nothing but cold spring water, keeping the temperature of the river below the normal for spawning purposes. Consequently the shad ascended more than 300 miles. Mr. Ford noticed that every pool in the upper river was full of shad, and he saw them playing in the water by hundreds. Mr. Van Gordon saw them above Port Jervis, and they were observed as far up as Deposit, N. Y.

The shad reaches a length of 2 feet. It is asserted that 50 years ago shad weighing from 8 to 13 pounds were not uncommon in the Susquehanna. It is said that even larger individuals were taken. In California the shad reaches a larger size than it does in the east, specimens weighing from 13 to 14 pounds being often seen in the markets. The average weight of the females is 4 or 5 pounds. The male is much smaller.

The young shad remain in the rivers till the approach of cold weather, when they descend to the sea, and they are usually seen no more till they return as mature fish ready for reproduction. They are known to feed on small flies, crustaceans and insect larvæ. They have been fed with fresh-water copepods and kept alive in this way till they obtained a length of more than 1 inch. In the Carp ponds at Washington, Dr. Hessel succeeded in rearing shad on the *Daphnia* and *Cyclops* to



SHAD.

a length of 3 or 4 inches, and one time, when they had access surreptitiously to an abundant supply of young carp, well-fed individuals reached a length of 6 inches by the first of November. Shad have been kept at the central station of the U. S. Fish Commission over the winter, but at the age of one year, doubtless for lack of sufficient food, the largest was less than 4 inches long. At this age they were seen to capture smaller shad of the season of 1891, which were an inch or more in length. The Commissioner of Fisheries detected young shad also in the act of eating young California salmon; and on one occasion found an undigested minnow, 2 or 3 inches long, in the stomach of a large shad, and they have been caught with minnows for bait. The principal growth of the shad takes place at sea, and when the species enters the fresh waters for the purpose of spawning it ceases to feed, but will sometimes take the artificial fly and live minnows. The migratory habit of the shad has already been referred to. The spawning habits have been thus described by Marshall McDonald:

The favorite spawning grounds are on sandy flats bordering streams and on sand

bars. The fish appear to associate in pairs, usually between sundown and 11 P. M. When in the act of spawning they swim close together near the surface, their dorsal fins projecting above the water and their movements producing a sound which the fishermen call "washing." The eggs are expressed by the female while in rapid motion; the male following close and ejecting his milt at the same time. Such of the eggs as come in contact with the milt are impregnated, but the greater portion of them are carried away by the current or destroyed by spawn-eating fishes. After impregnation the egg sinks to the bottom and under favorable conditions develops in from three to eight days. According to Seth Green, the embryo shad swim as soon as they break the shell and make their way to the middle of the stream where they are comparatively safe from predaceous fishes. A mature female shad of 4 or 5 pounds contains about 25,000 eggs on the average, but as many as 60,000 have been obtained from a 6-pound fish, and 100,000 were obtained from a single female in the Potomac. There is great mortality among the shad after spawning. Dead fish of both sexes are frequently seen floating in the water in the late months of summer.

Mitchill states that the shad visits New York annually about the end of March or beginning of April; that it ascends toward the sources of the Hudson; that it usually weighs 4 or 5 pounds, but sometimes as much as 12 pounds. DeKay says a large variety, supposed to be old fish, and weighing from 10 to 12 pounds, were frequently taken in the Hudson, under the name of Yellow Backs. The shad, in his time, ascended the river 150 miles to spawn, and descended in the latter part of May. The introduction of gill nets, he writes, has caused a scarcity of the fish and will drive them from the river before many years.

Nets set off shore in Gravesend Bay in the fall frequently enclose large quantities of young shad, sometimes a ton and a half at one time, during their migration seaward, but they are at once liberated. The fish are usually about 6 to 8 inches long. October 17, 1895, sixty or seventy were caught in John B. DeNyse's pound, among them a male 11 inches long and  $2\frac{3}{4}$  inches deep, and a female 12 inches long and 3 inches deep. October 31, 1895, a male  $13\frac{1}{2}$  inches long and  $2\frac{1}{2}$  inches deep, and a female  $13\frac{1}{2}$  inches long and  $3\frac{1}{2}$  inches deep were obtained in the same pound. Apparently the shad do not all remain at sea after their first migration till they are sexually mature. In the Potomac River young shad 8 to 9 inches long occasionally enter in the spring with the adults in large numbers. Mr. DeNyse informs me that in the first spring run of small shad in Gravesend Bay fully 90% are males.

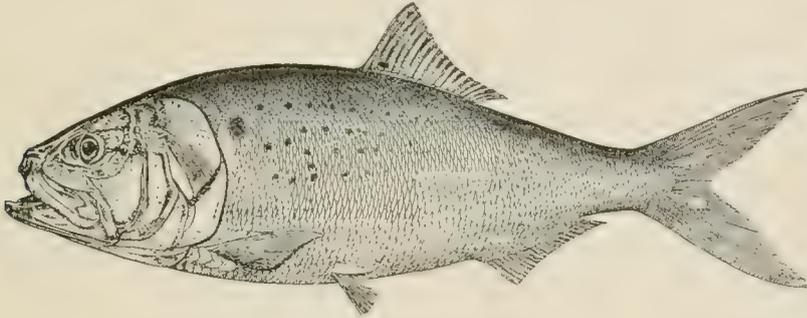
47. Menhaden (*Brevoortia tyrannus* Latrobe).

*Clupea menhaden* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 453, pl. V, fig. 7, 1815, New York.

*Alosa menhaden* DEKAY, N. Y. Fauna, Fishes, 259, pl. 21, fig. 60, 1842.

*Brevoortia tyrannus* BEAN, 19th Rept. N. Y. Comm. Fish, separate, 44, pl. XXV, fig. 35, 1890; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 433, 1896, pl. LXXIII, fig. 195, 1900.

The Menhaden has received more than 30 common names, among which the one here employed is the best known and most suitable. In New Jersey it is frequently called Bunker or Moss Bunker, and in some other localities it is the Bony Fish. It is also called Bugfish, because of a crustacean parasite which is found in the mouth.



MENHADEN.

The Menhaden reaches a length of 15 inches or more; its average size is about 1 foot. It is found along our east coast from Maine to Florida, swimming in immense schools and fluctuating greatly in abundance. In certain localities its movements are affected chiefly by temperature.

The use of the Menhaden as a source of oil and a material for fertilizers is so well known as scarcely to need mention here. As an edible fish it is not generally esteemed; in most localities it is seldom eaten, though in some places it is considered a good food fish. Since the mackerel is becoming scarce, Menhaden are often salted in barrels as a substitute for that fish.

The Menhaden appears in Dr. Mitchill's Fishes of New York as the Bony Fish, Hardhead or Marshbanker. The aboriginal name Menhaden, and the one most suitable for the species, is mentioned by this writer. Dr. DeKay, in his New York Fauna, introduced the name Mossbunker as well as the Indian names Panhagen and Menhaden. He notes also the names Skippang and Bunker as in use at the east end of the island. For a survey of the 30 or more additional appellations of this

well-known fish, the reader is referred to the complete history of the American Menhaden by Dr. G. Brown Goode.

The Menhaden comes into Gravesend Bay in May and through the summer. Occasional individuals are seen there in the fall as late as November. The fish can be kept alive in winter in captivity, provided the water temperature does not fall below 50° F. It makes its appearance on the shores of Long Island about the beginning of June, sometimes in May, and remains till the cold season sets in. A few specimens were taken September 22 in Blue Point Cove in 1884, and October 1, 1890, many thousands were caught in a trap at Islip; these were large and very fat fish. The use of the Menhaden as a bait fish is too well known to need special mention. In "chumming" for Bluefish near Fire Island Inlet this is the favorite bait. In 1898 the young were obtained at Duncan's Creek, Howell's Point and Nichols's Point August 29. Adults were sent from Islip by W. F. Clock August 18.

In the vicinity of Woods Hole, Mass., according to Dr. Smith, Menhaden arrive in schools about May 20, but scattered fish are taken in March with Alewives; they remain till December 1, sometimes till December 20, but are most abundant in June. When the schools first arrive, the reproductive organs of many of the fish are in an advanced stage of development, but after July 1, none with large ovaries are found. Late in fall the fish again have well-developed roes. The smaller fish are about an inch long; these are found in little schools about the shores and wharves as early as July 15. The young are abundant throughout summer and fall. The average length of adults is 13 or 14 inches; one fish 18 inches long was caught at Woods Hole in 1876.

#### 48. Striped Anchovy (*Stolephorus brownii* Gmelin).

*Clupea vittata* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 456, 1815; DEKAY N. Y. Fauna, Fishes, 254, 1842.

*Stolephorus brownii* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 273, 1883; BEAN, Bull. U. S. F. C., VII, 149, 1888; Rept. N. Y. Comm. Fish., 279, 1890.

The species occurs from Cape Cod southward to Brazil and the West Indies.

This is the Satin Striped Herring of Mitchill's Fishes of New York, p. 456. By some of the fishermen in Great South Bay it is supposed to be the Whitebait, and is so called. The Anchovy was extremely abundant in the bay in September, 1884. I found it at the mouth of Swan Creek, in Blue Point Cove, near the Life Saving Station, at Oak Island and at Fire Island. Specimens were seen as late as October 7.

This Anchovy forms a very important part of the food of the young weakfish and bluefish in Great South Bay. It is present in very large numbers and could be

utilized as a food species. The largest examples of this fish which we have seen were taken in Great Egg Harbor Bay in August; individuals measuring  $5\frac{1}{2}$  inches in length were taken in the surf by hundreds, and weakfish were feeding on them ravenously. In two hauls of a 20-fathom seine we took here 54 weakfish.

This species was not common in Great South Bay during the summer of 1898. It was found at Blue Point Cove August 18, and young were obtained at Nichols's Point September 1.

Dr. Smith records it as unusually abundant at Woods Hole, occasionally rather uncommon. Found from August to late in fall. More numerous than any other Anchovy.

#### 49. Anchovy (*Stolephorus mitchilli* Cuv. & Val.).

*Stolephorus mitchilli* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 248; BEAN, Bull. U. S. F. C., VII, 149, 1888; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 446, 1896.

Cape Cod to Texas on sandy shores; the most abundant of the New York species. It enters Gravesend Bay in May and remains till October. Locally known as Anchovy and Whitebait. An excellent food fish and very important as the food of larger fishes.

It is very generally distributed in bays along the south shore of Long Island, having been found abundant in Scallop Pond, Peconic Bay, in Mecox Bay, and almost everywhere in Great South Bay from July to September, 1898. A specimen taken at Fire Island has a lernæan parasite attached to it. At Woods Hole, Mass., Dr. Smith reports it abundant, associated with *S. brownii*.

#### 50. Round Whitefish (*Coregonus quadrilateralis* Richardson).

*Coregonus quadrilateralis* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 298, 1883; BEAN, Fishes Penna., 66, pl. 26, fig. 47, 1893.

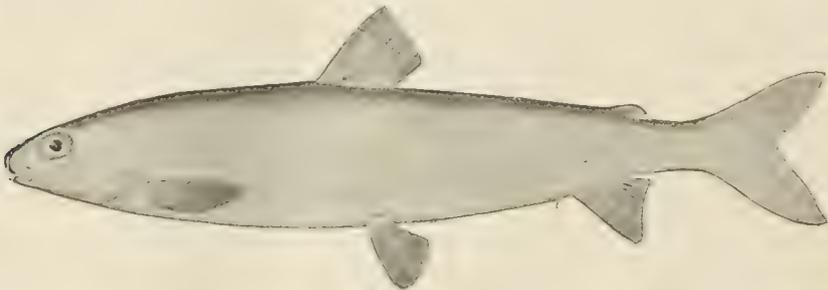
This species is called Frost Fish in the Adirondacks; other names are Menominee Whitefish, Roundfish, Shad-waiter, Pilot-fish and Chivey, the last term applied to the fish in Maine.

The Round Whitefish is found in lakes of New England, sometimes running into streams, the Adirondack region of New York, the Great Lakes and northward into British America and Alaska. Its distribution has been extended by transplanting on account of its great value as food for the Lake Trout and other large fish of the Salmon family. It seldom exceeds a length of 12 inches and a weight of 1 pound. Like some other species of Whitefish it spawns in shallow parts of lakes or ascends

their small tributaries for that purpose. The food consists of small shells and crustaceans. The species frequents deep waters, where it falls an easy prey to the voracious Lake Trout.

The Round Whitefish is excellent for the table. Its capture with hook and line is difficult because of its very small mouth and its habit of retiring into deep water. In the Great Lakes it does not constitute an important element of the fishery, but in northern regions it is one of the most useful and highly prized of the food fishes.

This small Whitefish is one of the characteristic species of the Adirondack Lakes. James Annin, Jr., sent specimens for identification from Hoel Pond and Big Clear Lake, in Franklin County, N. Y., and from the third lake of the Fulton



ROUND WHITEFISH.

Chain. He states that the fish spawns in the little inlets or on the sand beaches. It never appears until about the time the water begins to chill and freeze about the edges. On the Fulton Chain of lakes the spawning season of 1895 was practically closed about November 20. The Frostfish, according to Mr. Annin, is "a delicious morsel."

An example taken at Sanarac Lake, November 23, 1897, showed the following colors: Purplish gray; lower parts whitish; pectorals, ventrals and anal vermilion; eye pale golden; head especially behind the eyes with iridescent gold and purple tints; caudal, chiefly vermilion in life. The fish is a male with ripe milt. There are numerous small tubercles on the scales of the sides above and below the lateral line.

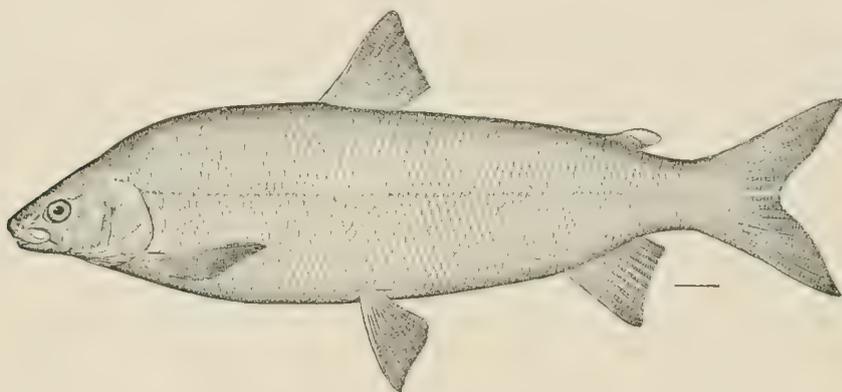
51. Common Whitefish (*Coregonus clupeiformis* Mitchill).

*Coregonus albus* KIRTLAND, Bost. Jour. Nat. Hist., III, 477, pl. XXVIII, fig. 3, 1841 ;  
DEKAY, N. Y. Fauna, Fishes, 247, pl. 76, fig. 240, 1842.

*Coregonus clupeiformis* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 299, 1883 ; BEAN,  
Fishes Penna., 67, color pl. 3, 1893 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat.  
Mus., I, 465, 1896, pl. LXXVI, fig. 202, 1900.

The name Whitefish is thoroughly identified with this species and is seldom varied except by means of the prefix "common" or "lake." A well-marked variety in Otsego Lake, N. Y., has long been known as the Otsego Bass.

The Common Whitefish occurs in the Great Lakes and northward into British America ; its northern limit is not definitely known. In Alaska, where the species was formerly supposed to exist it is replaced by a similar, but well-marked form,



COMMON WHITEFISH.

the *Coregonus richardsoni* of Günther. The variety known as Otsego Bass is found in Otsego Lake. If we may judge from the yield of the fisheries, Lake Michigan has more Whitefish than any of the other lakes ; Superior ranks second ; Erie third ; Huron fourth ; and Ontario is sadly in the rear.

The largest individual on record was taken at Whitefish Point, Lake Superior ; it weighed 23 pounds. A 17-pound specimen was caught at Vermilion, in Lake Erie, in 1876. The size varies greatly with locality, ranging in general all the way from  $1\frac{3}{4}$  pounds to 14 pounds. In Lake Erie, in 1885, the average weight was between 2 and 3 pounds. The length of adults will average 20 inches.

There is a movement of the Whitefish in many lakes from the deep water early in the summer into the shoal water near the shore. In the mid-summer, however, the usual retreat of this species is the deep and cold parts of the lakes which they inhabit. Again as the spawning season approaches, in October, the Whitefish come toward the shore to deposit their eggs. It is said that they do not spawn till the

water has reached a temperature of about 40°. After spawning they again retire to deep water where they remain during the winter. Mr. Milner observed that the shoreward migration varies with locality and is influenced also by depth of water and temperature. In Lake Erie, for example, which has a high summer temperature, there is no shoreward migration in summer. It is noted also that the Whitefish moves along the shore and in some cases it ascends rivers for the purpose of spawning. It is believed also that when the feeding grounds of the Whitefish are polluted by mud the fish temporarily seek other localities. There appears to be a spring and summer migration likewise from lake to lake. Spawning takes place during October, November and December on shoals or occasionally in rivers. The female is larger than the male. According to the observations of George Clarke, the two sexes in the act of spawning frequently throw themselves together above the surface, emitting the spawn or milt with the vents close together. Spawning operations are most active in the evening, are continued at night and the eggs are deposited in lots of several hundred at a time. The number of eggs in a fish of 7½ pounds was 66,606; the average number being nearly 10,000 for each pound of the female's weight. The period of incubation depends on the temperature. The usual time of distribution of the young is in March and April. The very young are described as swimming near the surface and not in schools. They are very active and soon seek deep water to escape from their enemies. Their food consists chiefly of small crustaceans. The adults subsist on the same food with the addition of small mollusks.

The only means of determining the rate of growth of the Whitefish is by artificial rearing. Samuel Wilmot had young fish which were 5 inches long at the age of four months. The growth under natural conditions must be even greater than this. Mr. Wilmot has seen Whitefish measuring 7 inches in December in his ponds.

The eggs of the Whitefish are destroyed in immense numbers by the Lake Herring, *Argyrosomus arctedi*. The water lizard, *Menobranhus*, also consumes vast numbers of the eggs. The young Whitefish are eaten extensively by the Pikeperch, Black Bass, Pike, Pickerel and fresh-water Ling. The Lake Trout also feed on the Whitefish. A leech parasitic of the Whitefish proves very troublesome to that species, and the scales are liable to a peculiar roughness which has been observed late in November or during the spawning season. There is also a lernean which fastens itself to the gills and other parts of the Whitefish.

The excellence of the flesh of the Whitefish is so well known as scarcely to require mention. Its commercial value is great. In Lake Erie in 1885, according to statistics collected by the U. S. Fish Commission, 3,500,000 pounds of Whitefish

were caught, more than 2,000,000 of this amount by fishermen from Erie alone. In that year Erie County had 310 persons employed in the fisheries. The capital invested in the business was nearly \$250,000. The wholesale value of the fish products was upward of \$400,000. The Whitefish was the third species in relative importance, Blue Pike ranking first, and the Lake Herring second. In Erie County Whitefish are caught chiefly in July, August and November, and the bulk of them are taken in gill nets. Pound nets are also employed in the capture of Whitefish.

Carl Miller of New York and Henry Brown of New Haven are credited with the first attempt to propagate the Whitefish artificially. Their experiments were made in Lake Saltonstall, near the city of New Haven. The result of the experiments, which were repeated in 1858, is not known. In 1868, Seth Green and Samuel Wilmot began a series of experiments in the same direction, and in 1869, N. W. Clark of Clarkson, Mich., took up the same work. In 1870 a half million eggs were placed in hatching boxes by Mr. Clark. In 1872, through the aid of the U. S. Fish Commission, Mr. Clark's hatching house was doubled in capacity, and a million eggs were taken from Lake Michigan. Since that time both the National and State Governments have made the Whitefish the object of their most extensive operations.

Dr. Meek saw no specimens of Whitefish from Cayuga Lake, but he thinks it is an inhabitant. The U. S. Fish Commission obtained a specimen at Cape Vincent, N. Y., November 17, 1891.

A young individual was received from Wilson, Niagara County, N. Y., caught in a gill net in Lake Ontario and sent by James Annin, Jr.

A male and female were received through James Annin, Jr., from Upper Saranac Lake, November 16, 1895. Both fish were nearly spent. A male from Chazy Lake arrived through the same source November 22, 1895. It was doubtfully called "Blackfin Whitefish." At that time the fish had left the spawning beds and were in deep water. June 17, 1896, a female  $19\frac{5}{8}$  inches long was shipped by Mr. Annin from Canandaigua Lake. Its stomach is pear-shaped with walls more than  $\frac{1}{4}$  inch thick; it contained numerous small shells of several genera, not yet identified.

The species is reported by fishermen to be very abundant in that lake, and to be destructive to eggs of other fish. They say it comes in great numbers into shallow water near the shore in early summer when the water is roily, and can be caught on set lines. Mr. Annin saw men baiting their set lines with small minnows on Canandaigua Lake, and, when the lines were taken up in the morning, the Whitefish was found on the hooks. It is said that one so taken weighed 6 pounds. Supt. O. H. Daniels, of the New Hampshire Fish Commission, forwarded a specimen from Lake Winnesquam, at Laconia,  $19\frac{7}{8}$  inches long, weighing 46 ounces, and he wrote that

individuals weighing  $7\frac{1}{2}$  pounds had recently been taken. The species was called "Bluefin" and Whitefish.

The fish-eating habit of the Whitefish was fully verified in the aquarium on examples obtained in Canandaigua Lake in November, 1896, by Mr. Annin. Knowing that the species usually subsists on small mollusks and crustaceans, efforts were made to provide the fish with *Physa* and *Gammarus*; but this became difficult in winter, and an experiment was made with small Killifish (*Fundulus heteroclitus* and *majalis*), which proved satisfactory during the cold months. In summer, however, it was found necessary to return to the use of *Gammarus*. The Whitefish at first took the Killifish without any eagerness, but they soon learned to chase their prey and take it much as trout do.



SMELT.

52. Smelt of New York Lakes (*Argyrosomus osmeriformis* H. M. Smith).

*Coregonus osmeriformis* SMITH, Bull. U. S. F. C., XIV, 2, pl. 1, fig. 2, 1895, Lakes Seneca and Skaneateles, New York.

*Coregonus hoyi* BEAN, Proc. U. S. Nat. Mus., V, 658, 1883; GOODE, Fish and Fish. Ind. U. S., I, pl. 197 B, 1884; not *Coregonus hoyi* Gill.

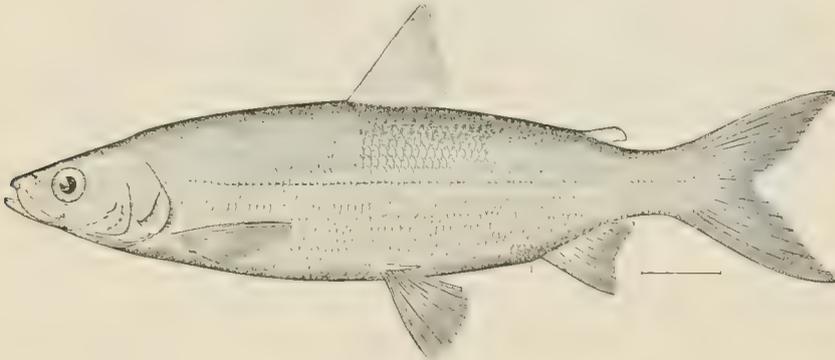
*Argyrosomus osmeriformis* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 468, 1896.

Body elongate, moderately compressed, slender; head less compressed than body, its greatest width equaling one-half of distance from tip of lower jaw to nape; the lower jaw projecting considerably even when the mouth is closed; mouth large, the maxillary reaching to the vertical through the anterior margin of the pupil; preorbital bone long and slender, more than one-third as long as the head; supra-orbital as long as the eye, four times as long as broad.

The greatest height of the body is considerably less than the length of head, and is contained five times in the total length without caudal. The greatest width of the body is less than one-half its greatest height. The least height of caudal peduncle equals the length of the orbit and about one-third of the greatest height of the body. Scales small, nine in an oblique series from the dorsal origin to the

lateral line, 82 tube-bearing scales and eight in an oblique series from the ventral origin to the lateral line.

The length of the head is one-fourth of the total length to the end of the lateral line. The distance of the nape from the tip of the snout is nearly one-third of the distance from the tip of the snout to the origin of the first dorsal. The length of the maxilla is one-third of the length of the head. The mandible is one-half as long as the head. Lingual teeth present. The eye is as long as the snout and one-fourth as long as the head. Gill-rakers long and slender, the longest five-sixths as long as the eye; there are 55 on the first arch, 35 of which are below the angle. The insertion of the dorsal is nearer the tip of the snout than the end of the middle caudal rays. The longest ray of the dorsal equals the length of the ventral and is contained seven times in the total length to the end of the middle caudal rays (six and two-thirds times in length to end of lateral line). The length of the pectoral is one-sixth of the standard body length.



LAKE HERRING.

The insertion of the ventral is midway between the tip of the snout and the end of the middle caudal rays. When the ventral is extended the distance of its tip to the vent is only one-fourth of the length of the fin. In this respect the species differs widely from *A. arctedi*.

The colors are, back grayish silvery; sides silvery; dorsal and caudal with darker tips.

### 53. Lake Herring (*Argyrosomus arctedi* LeSueur).

*Coregonus arctedi* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 301, 1883; BEAN, Fishes Penna., 69, pl. 26, fig. 48, 1893.

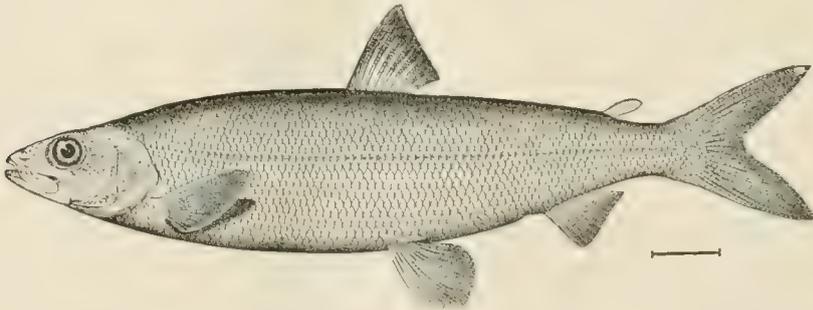
*Coregonus clupeiformis* DEKAY, N. Y. Fauna, Fishes, 248, pl. 60, fig. 198, 1842.

*Argyrosomus arctedi* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 468, 1896.

The Lake Herring frequents shoal waters and occurs in enormous schools, as one may judge from the quantity captured in Lake Erie. Its food consists of

insects and crustaceans. During the spawning season of the Whitefish, however, it feeds exclusively on the eggs of this species and proves very destructive. The Lake Herring will take the hook, and has been caught with live minnows. Spawning takes place about the end of November in shoal waters.

As a food fish this species is inferior to the Whitefish, but it is in great demand over an extensive area of the country, and is shipped in the fresh condition many hundred miles east and west. I have elsewhere referred to the enormous number taken in 1885 in Lake Erie. These are caught chiefly in pound and gill nets. The catch in 1885 amounted to more than one-third of the entire quantity of fishes taken in this lake. There is no apparent diminution in the number of these fishes, and their artificial propagation has only recently been commenced.



MOONEYE CISCO.

54. **Mooneye Cisco** (*Argyrosomus hoyi* Gill).

*Argyrosomus hoyi* GILL, Mss.; JORDAN, Amer. Naturalist, 135, March, 1875, Lake Michigan, near Racine, Wis.; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 342, 1897, Canandaigua Lake; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 464, 1896. *Coregonus hoyi* JORDAN, Man. Vert. ed. 2, 275, 1878; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 299, 1883; SMITH, Bull. U. S. F. C., XIV, 6, pl. 1, fig. 1, 1895.

Mr. Annin wrote me that the people at Canandaigua Lake told him that there were large quantities of small Lake Shiners, as they are called, in the lake. A fisherman said that they are seen in immense schools at the top of the water occasionally, and, by firing a gun loaded with shot into them, men can stun them so as to pick up quite a number. They are eagerly sought after for trolling bait for the Salmon Trout found in that lake.

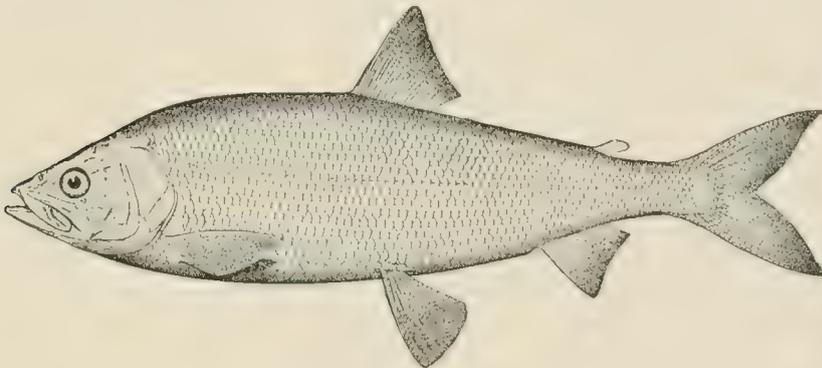
This species is recorded with certainty from Lake Michigan only. It is taken in gill nets in deep water and, notwithstanding its small size, has become commercially important. It was for the first time announced as a member of the New York fauna in 1897, and the description leaves no doubt of the correctness of the identi-

fication. The fish examined, a female with ripe eggs, was taken in Canandaigua Lake, December 19, 1896, by Mr. Annin's men. It was the only one caught, and was captured by becoming gilled in the funnel of the net. Mr. Annin is satisfied that this is the Lake Shiner of the fishermen, which they sometimes see in immense schools at the surface, and kill for trolling bait by shooting them.

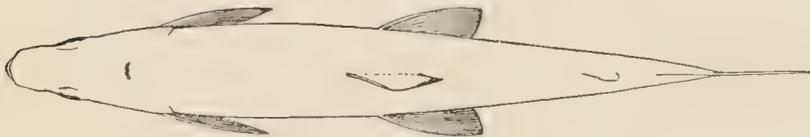
55. **Long Jaw ; Bloater** (*Argyrosomus prognathus* H. M. Smith).

*Coregonus prognathus* HUGH M. SMITH, Bull. U. S. F. C., XIV, 4, pl. 1, fig. 3, 1895, Lake Ontario, at Wilson, N. Y.

*Argyrosomus prognathus* EVERMANN & SMITH, Rept. U. S. F. C., XX, 314, pl. 26, 1896; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 471, 1896.



LONG JAW.



OUTLINE OF FISH, VIEWED FROM ABOVE.

Body oblong, much compressed, back elevated, tapering rather abruptly toward the narrow caudal peduncle, the adult fish having a slight nuchal hump as in *C. clupeiformis*; greatest depth three and one-half to four in body length; head rather short and deep, pointed, four to four and one-third in length; greatest width half the length, cranial ridges prominent; snout straight, its tip on level with lower edge of pupil; top of head two in distance from occiput to front of dorsal; mouth large and strong, maxillary reaching to opposite middle of pupil, two and one-half in head, length three times its width, mandible long, projecting beyond upper jaw when mouth is closed, reaching to or beyond posterior edge of eye, one and three-fourths to one and seven-eighths in head; eye small, five in head, one and

one-half in snout, one and one-third in interorbital space, one and one-half in suborbital space; gill rakers slender, about length of eye, 13 above and 25 below angle. Adipose fin the length of eye, its width half its length. Narrowest part of caudal peduncle contained nearly four times in greatest body depth. Dorsal rather high, with nine or ten developed rays, the longest one-half longer than base of fin and contained one and three-fourths times in greatest body depth, three and one-fourth times in distance between dorsal and snout, and one and one-half times in head; free margin slightly concave; origin midway between end of snout and base of caudal; dorsal base opposite nine scales. Anal with 10 to 12 developed rays, the longest ray equal to base of fin and two-thirds of height of dorsal. Ventrals as long as dorsal is high, their origin midway between anterior edge of orbit and base of caudal. Ventral appendage short, covering about three scales. Pectorals as long as ventrals. Scales rather large, about 75 in lateral line, seven or eight above the lateral line, seven or eight below the lateral line. Lateral line straight except at origin, where it presents a rather marked curve. Sides of body uniformly bright silvery, with pronounced bluish reflection in life; the back dusky, the under parts pure white without silvery color. Above lateral line, light longitudinal stripes involving central part of scales extend whole length of body. Fins flesh color or pinkish in life, the dorsal and caudal usually showing dusky edges; postorbital area with a bright golden reflection; iris golden, pupil black. Branchiostegals, eight. Average length, 15 inches.

*Habitat.* Lake Ontario, Lake Michigan, Lake Superior, and doubtless the entire Great Lake basin, in deep water. This fish is called Long Jaw in Lakes Michigan and Ontario. Specimens were obtained from John S. Wilson, of Wilson, N. Y., and from George M. Schwartz, of Rochester, N. Y. Dr. R. R. Gurley also secured examples at Nine Mile Point, N. Y., in June, 1893.

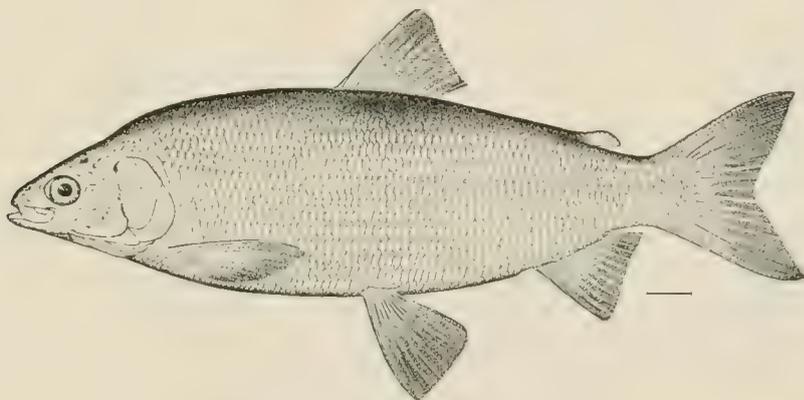
This species is quite different from any other Whitefish inhabiting the Great Lake basin. It may be at once distinguished from all the Whitefishes known to occur in the United States by the general form of body combined with the very long lower jaw, which is contained less than twice in the length of the head and extends backward to or beyond the posterior edge of orbit.

56. Tullibee; Mongrel Whitefish (*Argyrosomus tullibee* Richardson).

*Coregonus tullibee* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 301, 1883; BEAN, Fishes Penna., 70, pl. 27, fig. 49, 1893.

*Argyrosomus tullibee* JORDAN, Man. Vert. ed. 2, 361, 1878; EVERMANN & SMITH, Rept. U. S. F. C., XX, 320, pl. 28, 1896; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 473, 1896; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 343, 1897.

The body of the Tullibee is very short, deep and compressed; its greatest height about one-third of the length without caudal. The head is pointed, as in the blackfin, the mouth large, with the lower jaw scarcely longer than the upper. The maxilla extends to below the middle of the eye. The eye equals the snout in length and is two-ninths of length of the head. Scales much larger on front part of



TULLIBEE.

body than on the caudal peduncle. The gill rakers are long, slender and numerous, about 30 below the angle on the first arch. D. 11; A. 11. Scales in lateral line 74, eight rows above and seven below lateral line; pyloric cæca, 120. The upper parts are blueish; sides white and minutely dotted. The spermary, according to Richardson, is wood-brown.

This species is usually called the Tullibee, but in Lakes Erie and Michigan it is sometimes styled the Mongrel Whitefish on the supposition that it is a cross between the common Whitefish and the Lake Herring.

The Tullibee has been taken recently in Lake Michigan; and Dr. E. Sterling had a specimen from Lake Erie. It is found occasionally in others of the Great Lakes, and extends northward into British America, but is comparatively little known to the fishermen and is very rare in collections. This fish grows to a length of 18 inches.

The late F. C. Gilchrist was the first to describe the habits of the Tullibee, and this he did in *Forest and Stream* in the following language:

In September they will again be found gradually nearing the shoal water, feeding heavily, and plump with fat and the now swelling ovaries. Later on they appear to eat little or nothing and devote all their time to playing until about the 25th of October, when they have settled down to the business of propagation, which they have finished by November 10. They prefer shallow water close to shore with clean sand to spawn on, and during the day they may be seen in pairs and small schools, poking along the shores, but at night they come in thousands and keep up a constant loud splashing and fluttering, very strange and weird on a calm night. Two years ago I carefully counted the ova from a ripe fish, 2½ pounds in weight, and found there were 23,700, closely resembling whitefish eggs in appearance, but somewhat smaller. After spawning the fish are very thin, lank, dull in color, and quite unfit for human food.

James Annin, Jr., furnished me the following notes on the spawning of the Tullibee in Onondaga Lake, N. Y.

They generally commence running up onto the shoals about November 15, and the season extends into December. They come up to the banks or gravelly shoals and spawn in from 3 to 6 and 7 feet of water. They have never been caught with the hook in this lake; and an old fisherman told me that he had tried almost every kind of bait, and had used the very finest gut and the smallest hooks baited with *Gammarus* (fresh-water shrimp) and other kinds of natural food—that is, he supposed the food was natural to them. At the same time, he claims he could see them in large schools lying in the water 8 or 10 feet from the surface.

A female Tullibee was sent from Onondaga Lake by Mr. Annin November 18, 1895, and another of the same sex November 25, 1896.

The following notes relate to the female obtained November 18, 1895:

	INCHES.
Length to end of caudal, - - - - -	18½
Length of upper caudal lobe, - - - - -	2⅝
Length of middle caudal rays, - - - - -	1
Least depth of caudal peduncle, - - - - -	1⅜
Depth of body at dorsal origin, - - - - -	4⅝
Length of head, - - - - -	3¼
Length of maxilla, - - - - -	⅞
Diameter of eye, - - - - -	⅝
Length of longest gill raker, - - - - -	16

The mandible projects slightly. B. 8; D. 11; A. 11; V. 11. Scales 8-75-8; gill rakers, 17+27.

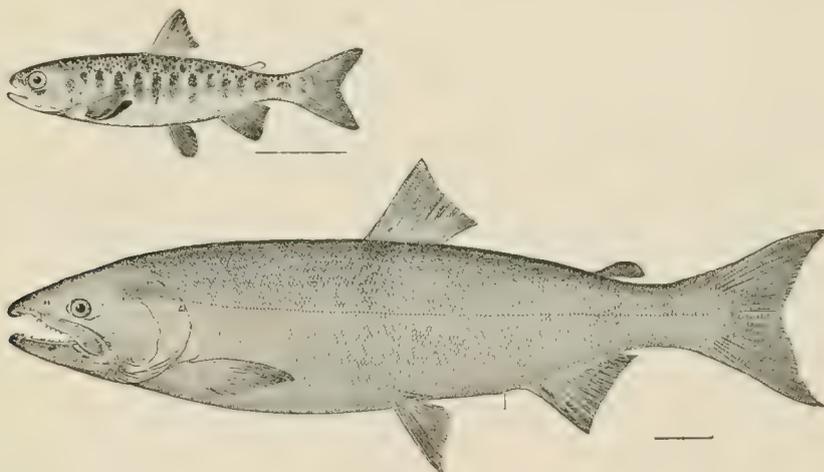
The female received November 25, 1896, is 15 inches long.

57. **King Salmon; Quinnat Salmon** (*Oncorhynchus tshawytscha* Walbaum).  
(Introduced.)

*Oncorhynchus chouicha* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 306, 1883; STONE in Fish & Fish. Ind. U. S., I, 479, pl. 186, lower fig., 1884; BEAN, Bull. U. S. F. C., IX, 190, pl. XLVI, fig. 1, 1891; Fishes Penna., 72, 1893.

*Oncorhynchus tshawytscha* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus. 479, 1896, pl. LXXVII, fig. 206, 1900.

The Quinnat Salmon is the largest and finest of the Pacific salmon. It ranges from Monterey, Cal., to Alaska and Eastern Asia, ascending rivers in some cases



KING SALMON.

The upper figure is drawn from a young example, four inches long, taken in Alturas Lake, Idaho, September 9, 1895.

1,500 miles or further from the sea. It has been introduced into lakes of New York, but there is no evidence that it has become established in any waters of the State. Possibly better results might be secured if larger fish were selected for the experimental stocking.

This is the largest fish of the Salmon family, individuals weighing 100 pounds and measuring upward of 5 feet in length being on record from the Yukon and other Alaskan rivers. The average weight of adults is above 20 pounds. The flesh of this Salmon is paler in color than that of the Red Salmon, but it is superior in flavor to all others.

The Quinnat is the first to arrive near the shores in the spring, and the time of

the run depends on the latitude, becoming later and later till, in Norton Sound, the present known northern limit of its migration, it appears early in June. Unless the spawning period be close at hand, it does not ascend rivers rapidly, but generally plays around for a few days, or even a couple of weeks, near the river limit of tide-water. It has been estimated that it proceeds up the Columbia River at the rate of 100 miles a month till the exigencies of reproduction compel a faster rate of travel.

In the sea this Salmon feeds on herring, capelin and crustaceans. A male of about 35 pounds, taken at Karluk August 4, had in its stomach 45 capelin. In fresh water the fish take no food.

Spawning takes place near the head waters of streams in clear shallow rapids. The fish excavate oblong cavities in the gravel beds where there is a current, and in these nests the eggs and milt are deposited. The eggs are protected from some of their enemies and fatalities by their environment, but are still a prey to freshets and to the pestiferous little fresh-water sculpins, or blobs, that abound in all trout and salmon waters, so far as observed. The young are hatched in from 60 to 100 days. They are destroyed in large numbers by aquatic birds, blobs and large fishes. The adults are killed by seals, sea lions and sharks. After spawning nearly all the parent fish die, especially those that ascend rivers a long distance.

The Quinuat is a very valuable fish for canning, salting and smoking. If it could be acclimated in the Great Lakes it would form the basis of new and important industries. The practicability of rearing this species in fresh waters without access to the sea has been satisfactorily demonstrated in France by Dr. Jousset de Bellesme, director of the aquarium of the Trocadéro, in Paris.

The results of the experiment of introducing this Salmon into New York waters are as yet unknown, but it is to be hoped that it will be successful. Since the change of method by which larger fish are employed for transplanting the outlook appears to be more favorable.

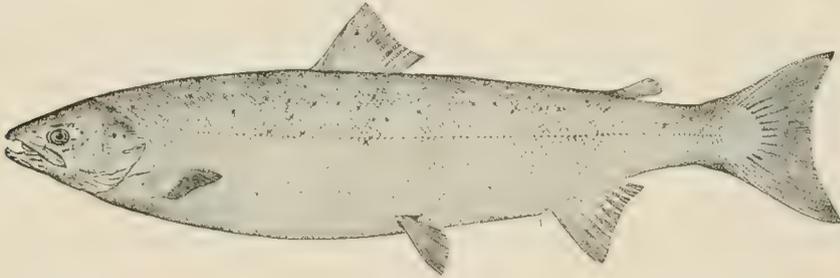
#### 58. Atlantic Salmon (*Salmo salar* Linnæus).

*Salmo salar* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 435, 1815; DEKAY, N. Y. Fauna, Fishes, 241, pl. 38, fig. 122, 1842; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 312, 1883; GOODE, Fish & Fish. Ind. U. S., I, 468, pl. 186, upper fig. 1884; BEAN, Fishes Penna., 74, color pl. 4, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 486, 1896; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 344, 1897.

The Salmon in America has but a single common name. When the young have reached a length of 2 inches and taken on the vermilion spots and dark cross bands they are called parr, and retain this name while they remain in fresh water. Before

descending to the sea in the second or third spring the parr assumes a bright silvery coat, and is then known as a smolt. After a sojourn in salt water lasting from four months to about two years it may return to its native river, either as a sexually immature Salmon or as a grilse, the female not yet ready for reproducing its species though the male is sexually mature. The landlocked variety of the Atlantic Salmon has been variously denominated Fresh-water Salmon, Schoodic Trout, Sebago Trout, Dwarf Salmon and Winninish, the last in use in the Saginaw region. In some Nova Scotian rivers a misnomer, Grayling, is applied to the Landlocked Salmon.

This species inhabits the North Atlantic, ascending rivers of Europe and America for the purpose of reproduction. In Europe it extends southward to France, and in the United States the most southern river in which specimens have been obtained is the Potomac. It occurs in small numbers in the Delaware and in large numbers in the Hudson, but in the last three river basins mentioned its presence is



ATLANTIC SALMON.

the result of artificial introduction. It is not found in abundance south of the Merrimack, and in rivers of New England and Canada in which it is native it is maintained almost exclusively by artificial culture. Its occurrence in Lake Champlain, the St. Lawrence River, and tributaries of Lake Ontario is due also to modern fish culture. The usual weight of the Atlantic Salmon ranges from 15 to 40 pounds, but individuals weighing 60 pounds have been recorded. The growth of the Salmon is accomplished chiefly in the ocean. As a rule the adults enter the rivers on a rising temperature when ready to deposit their eggs, the spawning occurring on the falling temperature in water not warmer than 50°. The time of entering the Delaware and Hudson is April, the Connecticut a little later, the Merrimack still later; to the Penobscot the Salmon come most abundantly in June and July, and to the Miramichi from the middle of June to October. The Salmon is not much affected by changes in temperature of the water, enduring a range of fully 45°. The eggs are deposited in shoal water on sandy or gravelly bottom, the parent fish making deep depressions by means of their noses or by flopping motions of

the tail. The period of egg-depositing lasts from 5 to 12 days. The spawning season begins about the middle of October and may run into December. In some European rivers the season continues till February. The eggs are about one-fourth of an inch in diameter, and the female is estimated to have about 1,000 for each pound of her weight. In the Penobscot, according to the observations of Mr. Atkins, an eight-pound female yields from 5,000 to 6,000 eggs; and a female of 40 pounds about 15,000 eggs. The hatching period ranges from 140 to 200 days or more, depending on the temperature. A newly hatched Salmon is about three-fourths of an inch long, and the yolk sac is absorbed in from a month to six weeks. It then begins to feed on small organisms in the water. At the age of two months it measures  $1\frac{1}{2}$  inches and begins to show crossbars and red spots, gradually coming into the parr stage. In the sea the Salmon feeds on herring, capelin, sand lance, smelt and other small fishes, besides crustaceans; but during its stay in fresh water it takes no food.

Among the worst enemies of salmon eggs are trout, eels, suckers and frogs. Numerous species of birds destroy the fry, among them sheldrakes, kingfishers, gulls and terns.

The value of the Salmon as a food and game fish is so well known as to require no description here. Those that find their way into market are usually caught in pound nets, gill nets or seines, and the bulk of them are taken at or near the mouths of the streams which they are about to enter for the purpose of spawning. Many are captured in the upper reaches of streams by the spear.

Mitchill, in the first volume of the Transactions of the Literary and Philosophical Society of New York, says that the Salmon "has been taken, since the discovery, a few times in the Hudson. But here he is a straggling fish, and not in his regular home. There is no steady migration of Salmon to this river. Though pains have been taken to cherish the breed, the Salmon has never frequented the Hudson in any other manner than as a stray."

In 1842 DeKay published the following note:

The Sea Salmon rarely now appears on our coast except as a straggling visitor. Such an occurrence took place in August, 1840, when a Salmon weighing eight pounds entered the Hudson River, and ascended it more than 150 miles, when it was taken near Troy. \* \* \* It now is only seen on our northern borders, ascending the St. Lawrence from the sea, and appearing in Lake Ontario in April, and leaving it again in October or November. They were formerly very abundant in the lakes in the interior of the State which communicated with Lake Ontario; but the artificial impediments thrown in their way have greatly decreased their

numbers, and in many cases caused their total destruction. I have seen some from Oneida Lake weighing 10 and 15 pounds. \* \* \* They are occasionally found in Lake Ontario during the whole year; but, as the same instinct which compels them to ascend rivers also leads them again to the sea, and as there is no barrier opposed to their return, we may presume that these are sickly or possibly barren individuals.

Experiments for restocking the Hudson are now in progress, and it is probable that the river may again become a Salmon stream.

**59. Landlocked Salmon** (*Salmo sebago* Girard). (Introduced.)

*Salmo sebago* GIRARD, Proc. Ac. Nat. Sci. Phila., 380, 1853, Sebago Lake, Maine.

*Salmo salar* var. *sebago* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 312, 1883.

*Salmo salar sebago* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 487, 1896; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 344, 1897.

There are at least two well marked races of Salar Salmon which do not enter the sea but live permanently in fresh water. Both of these differ from the migratory Salmon in several particulars: they are smaller, their eggs are larger, they retain the parr marks much longer, they are more subject to disease attending the egg-producing season, and the young grow more rapidly. The *Ouananiche* of the Saguenay River country is the farthest removed from the typical Sea Salmon by its very much smaller size, larger fins and different pattern of coloration.

The larger of the two Landlocked Salmon of the United States is found in the four river basins of the State of Maine, the Presumpscot, Sebec, Union and St. Croix. Here the weights vary considerably, spawning fish ranging all the way from 3 pounds to 10 or 12 pounds, while occasional individuals reach 25 pounds. The Sebago form is the one that has been introduced into the Adirondack lakes and other New York waters. Spawning begins late in October, but is at its height in November. Eggs are shipped in January, February and March, and the fry are ready for planting in June.

At Green Lake, Me., the Landlocked Salmon often endure a summer temperature above 80° F., but they refuse to take food when the water reaches 75°.

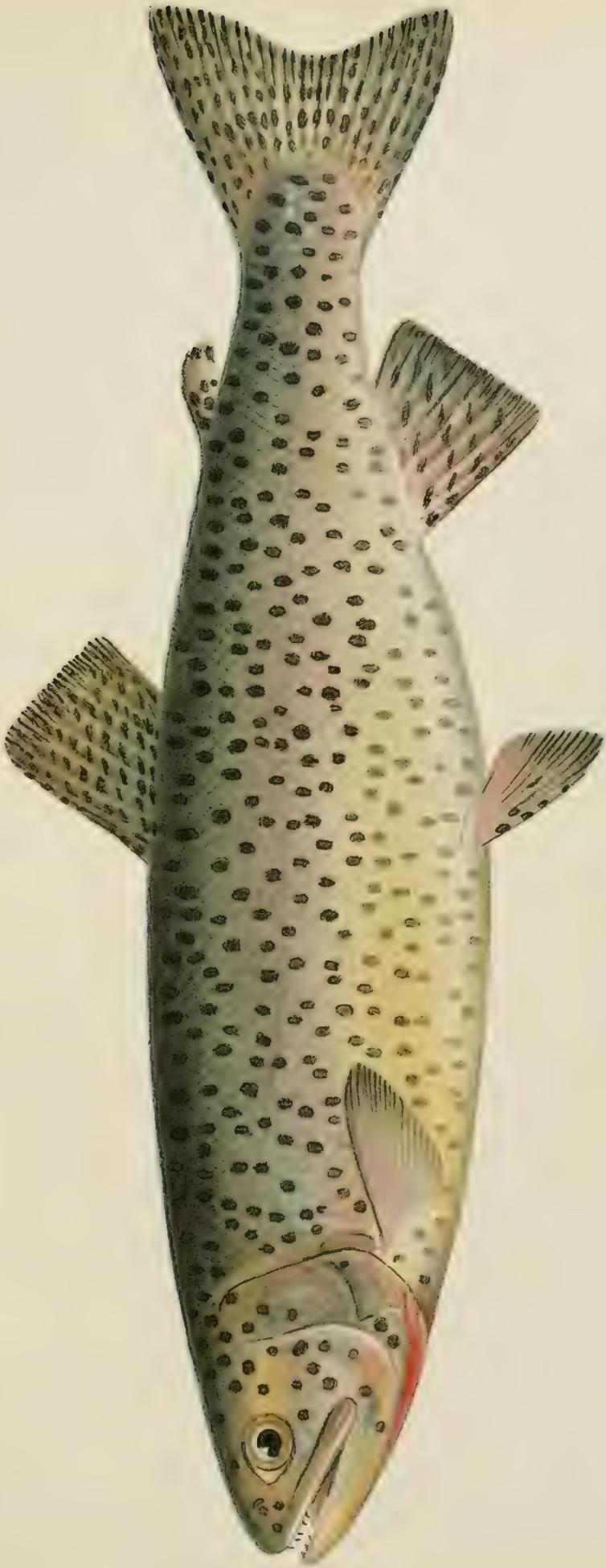
This Salmon has been introduced into New York waters from Maine, and appears to have become established in several localities. Caspian Lake is one of the lakes that have been stocked. A very fine example was obtained from the South Side Sportsmen's Club of Long Island, but it was injured in transportation and never recovered. In April, 1896, several individuals from Maine were presented by Eugene G. Blackford. One of these lived in a tank of salt water in the New

York aquarium for 19 months, and was then frightened by visitors when the water was drawn low for cleaning, and injured itself so badly that it died after a few hours of struggling. The following measurements were obtained from the fresh fish.

	INCHES.
Length, - - - - -	24
Middle caudal rays from end of scales, - - - - -	1 $\frac{5}{8}$
Depth, - - - - -	4
Least depth of caudal peduncle, - - - - -	1 $\frac{5}{8}$
Head, - - - - -	4 $\frac{3}{4}$
Snout, - - - - -	1 $\frac{1}{4}$
Eye, - - - - -	$\frac{11}{16}$
Orbit, - - - - -	$\frac{3}{4}$
Snout to dorsal, - - - - -	9 $\frac{1}{2}$
Dorsal base, - - - - -	2 $\frac{3}{4}$
Longest dorsal ray, - - - - -	2 $\frac{3}{8}$
Last dorsal ray, - - - - -	1 $\frac{1}{4}$
Snout to ventral, - - - - -	11 $\frac{1}{4}$
Length of ventral, - - - - -	2 $\frac{1}{4}$
Snout to anal, - - - - -	16 $\frac{3}{8}$
Anal base, - - - - -	1 $\frac{7}{8}$
Longest anal ray, - - - - -	1 $\frac{7}{8}$
Last anal ray, - - - - -	1 $\frac{1}{8}$
Snout to adipose dorsal, - - - - -	17 $\frac{5}{8}$
Width of adipose dorsal, - - - - -	$\frac{1}{2}$
Length of adipose dorsal, - - - - -	$\frac{3}{4}$
Length of pectoral, - - - - -	3 $\frac{1}{4}$
Upper jaw, - - - - -	2 $\frac{1}{4}$
Maxilla, - - - - -	2

The head has about 28 dark spots, the largest on the gill cover, oblong,  $\frac{5}{8}$  inch long. Body with many large and small black spots, a few with a pale ring around them, and some as large as the largest on the gill cover; one on the caudal peduncle of one side distinctly X-shaped. General color dark bluish gray; belly and lower parts iridescent silvery; fins all dusky; the dorsal with many black spots; eye pale lemon, the upper part dusky.

Gill rakers, 9 + 11, the longest  $\frac{5}{16}$  inch. B. 11; D. 10. Scales, 21-123-20.



TAHOE TROUT | SALMO HENSHAWI |



60. **Lake Tahoe Trout ; Red-throat Trout** (*Salmo henshawi* Gill & Jordan).  
(Introduced.)

*Salmo henshawi* GILL & JORDAN, Man. Vert. ed. 2, 358, 1878, Lake Tahoe ; Rept. Chief Eng., part 3, 1878, App. NN, 1619, pl. IV.

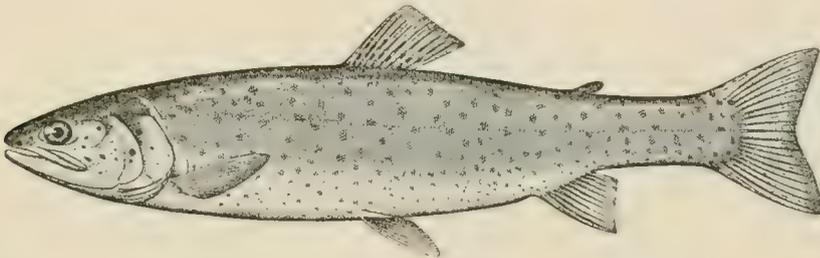
*Salmo purpuratus* var. *henshawi* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 316, 1883.

*Salmo mykiss* CHENEY, Third Ann. Rept. N. Y. Comm. Fish, 239, color pl. facing p. 238, 1898.

*Salmo mykiss henshawi* JORDAN, Bull. U. S. F. C., IX, 14, pl. II, fig. 5, 1891 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 493, 1896.

*Salmo clarkii henshawi* JORDAN & EVERMANN, op. cit. 2819, pl. LXXIX, fig. 208, 1900.

Body elongate, not much compressed, its greatest depth one-fourth of the total length without caudal ; caudal peduncle rather long, its least depth equaling two-fifths of the length of the head ; head long, conical, slender, its length contained about four times in the total to caudal base ; a slight keel on the top of the head ;



LAKE TAHOE TROUT.

snout obtusely pointed ; maxilla not extending far behind the eye, about equal to pectoral, which is three-fifths of length of head ; gill rakers short and stout, about 18 on the first arch, of which 13 are below the angle ; vomerine teeth in two long, alternating series ; hyoid teeth rather weak, in a small patch ; dorsal fin small, its last rays two-thirds as long as the highest ; anal fin rather high ; caudal short and distinctly forked. D. 9 to 11 ; A. 12 ; B. 10. Scales 27 to 37-160 to 200-27 to 40 ; pyloric cæca 50 to 60.

Color dark green in life, varying to pale green ; the sides silvery with a broad coppery shade which extends also on the cheeks and opercles ; a yellowish tinge on the sides of the lower jaw and red or orange dashes between its rami ; back everywhere covered with large, roundish black spots ; dorsal, adipose fin and caudal fin with similar spots, and a few on the anal ; belly with black spots.

The Tahoe Trout is a large species inhabiting Tahoe Lake, Pyramid Lake, Webber Lake, Donner Lake, Independence Lake, Truckee River, Humboldt River, Carson River, and most streams of the east slope of the Sierra Nevada ; it occurs

also in the head waters of Feather River, west of the Sierra Nevada, probably by introduction from Nevada.

The usual weight is 5 or 6 pounds, but individuals weighing 20 to 29 pounds are recorded.

Eggs of the Lake Tahoe, Cal., Trout were obtained by James Annin, Jr., at Caledonia, N. Y., and young fish reared at his establishment were sent to the aquarium in November, 1896. They thrived till the latter part of June, 1897, when they were overcome by the warm water. They could not endure a transfer to the cooler salt water, like most of the other fish of the Salmon family.

At Caledonia Station, according to Mr. Cheney, this fish begins to spawn before the middle of March, and continues for two months. The impregnation of eggs is from 90% to 95%, but just before the hatching period a large number of the eggs burst and the embryos are lost. There is loss too between the hatching and feeding times, and the fry do not feed as readily as the Brook Trout. Altogether, Mr. Annin, the superintendent of hatcheries, estimates the total loss between impregnation of the eggs and feeding of the fry as about 40%. After the fry begin to feed they are not more difficult to rear than Brook Trout.

**61. Steelhead; Gairdner's Trout; Salmon Trout** (*Salmo gairdneri* Richardson).  
(Introduced.)

*Salmo gairdneri* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 313, 1883; BEAN, Bull. U. S. F. C., IX, 198, pl. XLIX, fig. 9, 1891, not fig. 10, which is young *mykiss*; JORDAN & EVERMANN; Bull. 47, U. S. Nat. Mus., 498, 1896, pl. LXXXI, fig. 215, 1900; CHENEY, Third Ann. Rept. N. Y. Comm. Fish, 241, color pl., 1898.

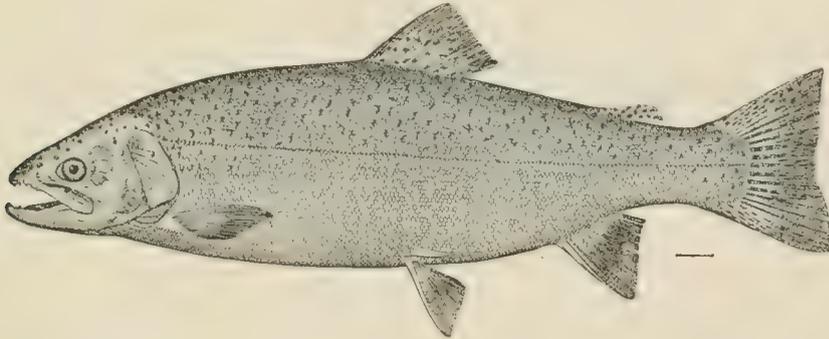
Form of *S. salar*. Body elongate, little compressed, its greatest depth two-ninths of the total length without caudal; caudal peduncle short, its least depth three-sevenths of length of head; head rather short, one-fifth of total length without caudal, maxilla reaching far behind the eye, its length one-half the length of head; eye small, two-thirds of length of snout, two-elevenths as long as the head; teeth rather small, vomerines in two long, alternating series about as long as the palatine series; gill rakers short and stout, about 20 on the first arch, of which 12 are below the angle; dorsal origin much nearer to tip of snout than to base of caudal, base of dorsal two-thirds of length of head, longest dorsal ray one-half the length of head and twice as long as last ray; adipose fin very small and narrow, over the beginning of the anal; caudal fin moderately forked in the young; ventral origin midway between tip of snout and base of caudal, ventral fin one-half the depth of body; anal base one-half as long as the head, longest anal ray equal to postorbital part of

head; pectoral fin one-eighth of total length without caudal. B. 11 or 12; D. 11, A. 12. Scales from 137 to 177, usually about 150-28; pyloric cæca 42; vertebrae 38+20=58. Color olive green above, sides silvery, head, back, dorsal and caudal fins profusely covered with small black spots, no red between the rami of the lower jaw.

The Steelhead Trout is found in coastwise streams from Southern California to Bristol Bay, Alaska. It spawns in the late winter and early spring; ripe eggs were obtained at Sitka, Alaska, June 10. Spent fish of this species are frequently taken with the spring run of the King Salmon.

The economic value of the Steelhead is very great; the fish reaches a weight of 30 pounds, though the average weight is under 20 pounds, and the non-anadromous forms seldom exceed 5 or 6 pounds.

From information furnished by Mr. Annin it appears evident that some of the eggs of Trout received at Caledonia, N. Y., many years ago from the McLeod River,



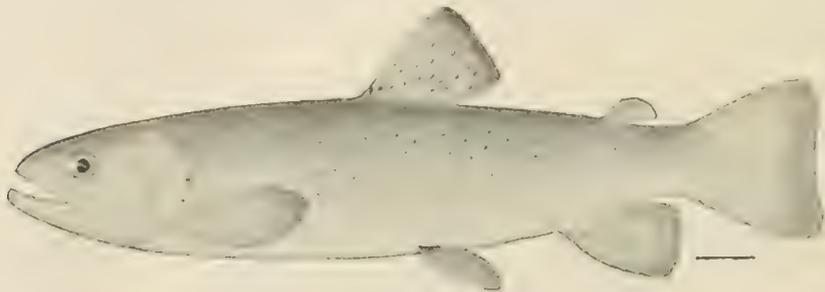
STEELHEAD.

Cal., as Rainbows, really included both Rainbows and Steelheads. He finds certain females producing deep salmon-colored eggs while in the same pond and receiving the same food as other females which furnish very light-colored, almost white, eggs. Some of the females also differ from others in going to the spawning beds nearly two months earlier. It is now known also that the McLeod contains a small-scaled form of the Rainbow, known to the Indians as the *no-shuc*, and this also may easily have been sent to the east under the name of Rainbow. Striking differences in the appearance and habits of so-called Rainbows introduced into the various States lend color to this supposition.

Steelheads were obtained for the New York aquarium in November, 1896, from the U. S. Fish Commission. They were hatched from eggs shipped from Fort Gaston, Cal., to the station at Craig Brook, Me. The length of the trout when received ranged from 4 to 4½ inches. After one year they were 10 inches long on

the average, and weighed many times as much as they did when received. None of them at any time showed a red lateral band such as is present in the Rainbow, and they are farther distinguished by the presence of white tips on the ventral and anal fins; the dorsal also has a small white tip. They have been kept almost from their arrival in salt water, and could not have been kept in the warm Croton water in June. The salt water never rose above  $71\frac{1}{2}^{\circ}$  F. and continued at this high temperature only 10 days.

The N. Y. Fisheries, Game and Forest Commission planted some of these trout in a Long Island stream and some in a lake in Northern New York. Those that were planted on Long Island, says Mr. Cheney, when rather more than a year old rose to the fly of the trout fisherman and made a most gallant fight, but it is too early to tell the outcome of the experiment. The eggs are one-fifth of an inch in diameter; they hatch in 42 to 50 days with water at  $50^{\circ}$ .



BROWN TROUT.

62. **Brown Trout** (*Salmo fario* Linnæus). (Introduced.)

*Salmo fario* BEAN, Fishes Penna., 78, color pl. 6, 1893; JORDAN & EVERMANN, Check-List Fish. N. A., 512, 1896.

*Salar ausonii* CUVIER & VALENCIENNES, Hist. Nat. Poiss., XXI, 319, pl. 618, 1848.

The Brown Trout of Europe was introduced into the United States from Germany in February, 1883, and in subsequent years; it has now become thoroughly acclimated in the fresh waters of many of the States.

The body of this trout is comparatively short and stout, its greatest depth being contained about four times in the length without the caudal. The caudal peduncle is short and deep, its depth equal to two-fifths of the length of the head. The length of the head in adults is one-fourth of the total length without caudal or slightly less. The diameter of the eye is about one-fifth of the length of the head, and less than length of snout. The dorsal fin is placed nearer to the tip of the snout than to the root of the tail; the longest ray of this fin equals the distance from the

eye to the end of the opercle. The ventral is under the posterior part of the dorsal; its length is about one-half that of the head. The adipose dorsal is placed over the end of the anal base; it is long and expanded at the end. The caudal is emarginate in young examples, but nearly truncate in specimens 10 inches long. The pectoral is nearly one-sixth of the length without the caudal. In the male the jaws are produced, and very old ones have a hook. The maxilla extends to the hind margin of the eye. The triangular head of the vomer has a transverse series of teeth, and the shaft of the bone bears two opposite or alternating series of strong persistent teeth. D. 13-14; A. 10-11; P. 13; V. 9. Scales 25-20-30; pyloric cæca 38-51; vertebrae 57-58.

On the head, body and dorsal fin usually numerous red and black spots, the latter circular or X-shaped and some of them with a pale border; yellowish margin usually present on the front of the dorsal and anal and the outer part of the ventral. The dark spots are few in number below the lateral line. The ground color of the body is brownish or brownish black, varying with food and locality.

*Names.* In European countries in which this species is native it bears the name of trout or brook trout or the equivalents of these terms. In Germany it is *bachforelle*; in Italy, *trota*; in France, *truite*. In the United States it is known as the Brown Trout and von Behr trout, the latter in honor of Herr von Behr, president of the Deutscher Fischerie Verein, who has been very active in the acclimation of the fish in America.

*Distribution.* The Brown Trout is widely distributed in Continental Europe and inhabits lakes as well as streams, especially in Norway and Sweden. Tributaries of the White Sea, the Baltic, the Black Sea and the Caspian contain this species. In Great Britain it lives in lakes and streams and has reached a high state of perfection; in Germany and Austria, however, the Trout is a characteristic fish, and our supply has been drawn principally from the former country. Moreau found it at an elevation of 7,000 feet in the Pyrenees, and a color variety is native to Northern Algeria in about 37° north latitude. In the United States the Brown Trout has been successfully reared in Colorado at an elevation of nearly 2 miles above sea level; it is now well established in New York, Pennsylvania, Maryland, Missouri, Michigan, Wisconsin, Nebraska, Colorado, and several other States. This Trout has proved to be well adapted to the region east of the Rocky Mountains, which has no native black spotted species, though the western streams and lakes contain many forms in a high state of development.

*Size.* Under favorable conditions the Brown Trout has been credited with a weight of 22 pounds and a length of 35 inches. In New Zealand rivers, where it

was introduced with unusual success, it now approximates equal size; but in most localities 10 pounds is about the limit of weight and 5 or 6 pounds is a good average, while in some regions the length seldom exceeds 1 foot, and the weight ranges from  $\frac{1}{2}$  pound to 1 pound. In the United States a wild specimen, seven years old, weighed about 11 pounds. In a well in Scotland an individual aged 15 years measured only about 1 foot in length. These illustrations will serve to show how much the growth of a Brown Trout is affected by its surroundings and food supply. The species has been known to become sexually mature when two years old and 8 inches long.

*Habits.* The Brown Trout thrives in clear, cold, rapid streams and at the mouths of streams tributary to lakes. In its movements it is swift, and it leaps over obstructions like the Salmon. It feeds usually in the morning and evening, is more active during evening and night, and often lies quietly in deep pools or in the shadow of overhanging bushes and trees for hours at a time. It feeds on insects and their larvæ, worms, mollusks and small fishes, and, like its relative, the Rainbow Trout, it is fond of the eggs of fishes. In Europe it is described as rising eagerly to the surface in pursuit of gnats, and is said to grow most rapidly when fed on insects.

*Reproduction.* Spawning begins in October and continues through December and sometimes into January. The eggs are from one-sixth to one-fifth of an inch in diameter and yellowish or reddish in color: they are deposited at intervals during a period of many days in crevices between stones, under projecting roots of trees, and sometimes in nests excavated by the spawning fishes. The parents cover the eggs to some extent with gravel. The hatching period varies according to temperature from 40 to 70 days. Females aged three years furnish on the average about 350 eggs each, but individuals of this age have yielded as many as 700, and even at the age of two years some females produce from 400 to 500. When they are four or five years old, the number of eggs has reached 1,500 to 2,000. The young thrive in water with a temperature of about 50° F. Sterility in the females is common, and breeding females have been observed to cease reproduction when eight years old.

*Qualities.* The Brown Trout is in its prime from May to the last of September. Its flesh is very digestible and nutritious, and deeper red than that of the Salmon when suitable food is furnished; the flavor and color, however, vary with food and locality. Insect food produces the most rapid growth and best condition. This species has been so long known as one of the noblest of the game fishes and its adaptability for capture with artificial flies because of its feeding habits is so well understood that I need not dwell on these familiar details.

63. Hybrid Trout (Brown and Brook).

A very beautiful and interesting hybrid is produced by crossing the Brown Trout and the Brook Trout. The following is a description of this hybrid :

**Salmo** (HYBRID=**fario**+**fontinalis**)

*Hybrid Trout.*

In a paper published some years ago the writer stated, as a result of his studies, that when a large-scaled trout is crossed with a small-scaled one, the hybrid will be large-scaled whichever way the cross be made. The hybrid between the Brown Trout and the Brook is a large-scaled form, and it is sterile as far as reported. The New York aquarium has had this hybrid from the South Side Sportsmen's Club and from the New York hatcheries at Coldspring Harbor, L. I., and Caledonia. It is always a strikingly handsome fish, and grows to a large size ; but it is far less hardy than either of its parents. The cross has always been artificially made, and never occurs naturally. Two specimens studied gave the following measurements in inches :

MEASUREMENTS.

	CALEDONIA, N. Y. JUNE 10, 1896. JAMES ANNIN, JR.	OAKDALE, N. Y. MARCH 23, 1897. G. P. SLADE.
Extreme length, - - - - -	9¼	14¼
Length of middle caudal rays from end of scales, .	¾	
Depth of body, - - - - -	1⅞	3⅞
Least depth of caudal peduncle, - - - - -	⅞	
Length of head, - - - - -	2	3¼
Length of snout, - - - - -	½	1⅞
Length of upper jaw, - - - - -	1¼	
Length of lower jaw, - - - - -	1⅜	
Diameter of eye, - - - - -	5/16	7/16
Distance from snout to dorsal origin, - - - - -	3¾	
Length of dorsal base, - - - - -	13/16	
Length of longest dorsal ray, - - - - -	15/16	
Length of last dorsal ray, - - - - -	¾	
Distance from snout to ventral origin, - - - - -	4½	
Length of ventral, - - - - -	1⅞	
Distance from snout to anal origin, - - - - -	6	
Length of anal base, - - - - -	⅞	
Length of longest anal ray, - - - - -	1¼	
Length of last anal ray, - - - - -	½	

The Caledonian specimen has no hyoid teeth; the vomerines are in a very small patch on the head of the bone only. The gill rakers are 4+10, the longest about one-half the diameter of the eye. It has about 124 tubes in the lateral line. Branchiostegals, 10. The following color notes were taken from the fresh fish: Dorsal fin with numerous dark blotches resembling those of young rainbow; adipose long and slender, amber color with two obscure dusky blotches, one of these very indistinct; lower half of sides pink; ventral, anal and caudal pink; ventral and anal with a milk white front margin, that in the anal limited behind by a dark line as in Brook Trout; sides reticulated with large meshes of lemon yellow interspersed with darker purplish or olive. Dorsal blotches are mingled with pale lemon. Pectoral pale vermilion. Eye silvery white with yellowish reflections.

The specimen from Oakdale, L. I., weighed 20 ounces. It has a triangular patch of vomerine teeth, as found in *fontinalis*, but continued behind by several teeth in a single row, the entire length of the vomerine series being seven-sixteenths of an inch.



LOCH LEVEN TROUT.

64. **Loch Leven Trout** (*Salmo trutta levenensis* Walker). (Introduced.)

*Salmo levenensis* WALKER, Wern. Mem., I, 541, 1811; YARRELL, Brit. Fish., ed. 2, II, 117, 1841; ed. 3, I, 257, fig. 1859; GUNTHER, Cat. Fish. Brit. Mus., VI, 101, 1866; DAY, Fish. Great Brit. & Ireland, II, 92, pl. CXVI, fig. 2 & 2a, 1884; BAIRD, Rept. U. S. F. C., XII, LVIII, 1886.

*Salmo trutta levenensis* JORDAN & EVERMANN, Check-List Fish. N. A., 512, 1896.

The Loch Leven Trout of Great Britain was introduced into the United States from Scotland in 1885 and subsequent years. It is somewhat closely related to the European Brown Trout, *Salmo fario*, and has been artificially crossed with that species in the United States, so that it is sometimes difficult to find the pure bred Loch Levens in fishcultural establishments at home.

The body of the Loch Leven is more slender and elongate than that of the Brown Trout, its greatest depth contained four and one-fourth to four and one-half times in the total length without caudal. Caudal peduncle slender, its least depth

three-eighths of the greatest depth of the body, and equal to length of snout and eye combined. The head is rather short and conical, its length two-ninths to one-fifth of the total length without caudal. The snout is one-fourth or slightly more than one-fourth as long as the head. The interorbital space is somewhat convex, its width equal to three-fifths of the length of postorbital part of head. The eye is of moderate size, its long diameter contained five and one-half to six times in the length of the head, and equaling about twice the greatest width of the maxilla. The maxilla reaches to or slightly beyond the hind margin of the eye. Teeth rather strong, those in the intermaxillary and mandible the largest, triangular head of vomer with two or three in a transverse series at its base, teeth on the shaft of the vomer usually in a single, partially zigzag, persistent series. Mandible without a hook and little produced even in breeding males. Dorsal origin distant from tip of snout about as far as end of dorsal base from base of caudal; the dorsal fin higher than long, its base one-eighth of total length without caudal, its longest ray equal to longest ray of anal fin. The anal fin is much higher than long, its distance from the base of the ventral equaling length of the head. The ventral origin is nearly under the middle of the dorsal, the fin being as long as the postorbital part of the head. Pectoral equals length of head without the snout. Adipose fin very small, its width one-half its length, which is about equal to eye. Caudal fin emarginate unless fully extended, when it becomes truncate, the outer rays about one-seventh of total length, including caudal. D. 13 (—iv, 9); A. 12 (=iii, 9); P. 14; V. 9. Scales 24 to 28—118 to 130—26 to 30; pyloric cæca 47 to 90; vertebrae 56 to 59.

Upper parts brownish or greenish olive, or sometimes with a reddish tinge, sides silvery with a varying number of x-shaped black spots, or sometimes rounded brown spots or rounded black spots which may be ocellated; occasionally red spots are seen on the sides, and the adipose fin may have several bright orange spots, or it may show a red edge and several dark spots; sides of the head with round black spots; dorsal and adipose fins usually with numerous small brown spots; tip of pectoral blackish; anal and caudal fins unspotted, but the caudal sometimes has an orange margin and the anal a white edge with black at its base; a similar edge may sometimes be observed on the ventral.

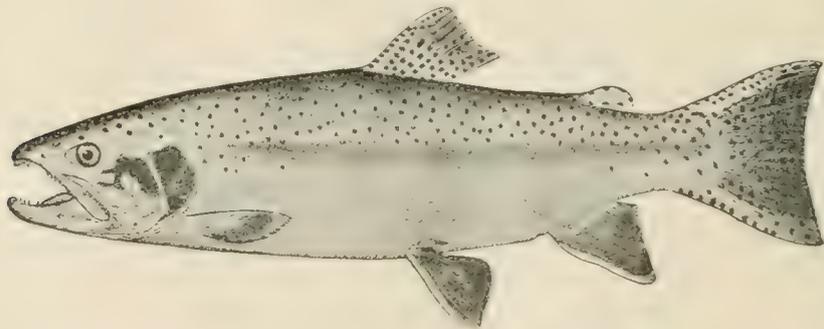
The Loch Leven Trout is a non-migratory species, inhabiting Loch Leven and other lakes of Southern Scotland and of the North of England. Its range in Great Britain and on the Continent of Europe has been greatly extended by fishcultural operations, and the fish is now fairly well known in the United States, though mixed to some extent with the Brown Trout, as remarked above.

The Loch Leven Trout has been recorded of the weight of 18 pounds, but the average weight at 6 years of age is about 7 pounds, though some individuals of that age may reach 10 pounds. The natural food of this species includes fresh-water mollusks (snails, *Buccinum*, etc.), crustaceans, worms and small fish. In captivity it is reared on liver, horse flesh, chopped clams and various other meats.

As a food fish the Loch Leven is highly esteemed on account of the red color and the delicate flavor of its flesh when obtained from suitable waters; in some localities the flesh often becomes white from lack of food or improper food.

The spawning season may begin late in September or early in October and continue till December. In Michigan it corresponds with that of the Brook Trout. The egg varies from about one-fifth to one-fourth of an inch in diameter. A Trout weighing 2 pounds contained 1,944 eggs, the weight of which was one-half pound.

The Loch Leven will take the artificial fly as readily as the Brown Trout and the Brook Trout. Its great size and strength add to its attractions for the angler.



RAINBOW TROUT—ADULT MALE.

**65. Rainbow Trout** (*Salmo irideus* Gibbons). (Introduced.)

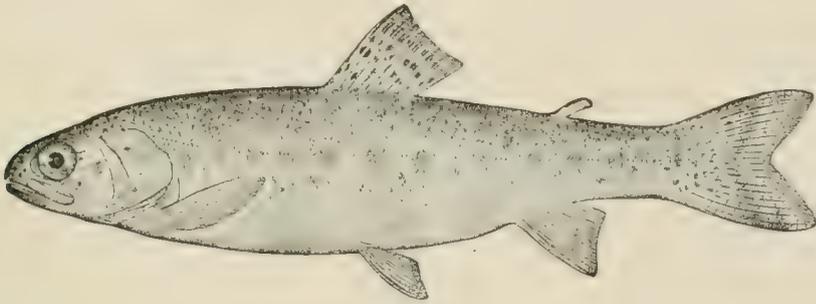
*Salmo irideus* GIBBONS, Proc. Cal. Ac. Nat. Sci., 36, 1855, San Leandro Creek, Alameda County, Cal.; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 312, in part, 1883; BEAN, Bull. U. S. F. C., XII, 36, pl. V, figs. 2 & 3, 1894; Fishes Penna., 77, color pl. V, 1893; Ann. Rept. N. Y. Comm. Fish, etc., I; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., pl. LXXXI, fig. 216, 1900.

*Salmo irideus shasta* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 502, 1896.

Body short and deep, its greatest depth equaling two-sevenths of the total length without caudal. The least depth of caudal peduncle equals one-half the length of head. The head is short and deep; its length is contained about four and two-thirds times in the total length without the caudal. The snout is short, not much longer than the eye, about one-fourth the length of head. Diameter of the eye contained four and two-thirds times in length of head; maxilla not quite reaching

to below hind margin of eye; vomerines in two irregular series; gill rakers about 20. Dorsal origin a little nearer tip of snout than to caudal base. The length of the dorsal base is contained seven and one-half times in total without caudal, and slightly exceeds longest dorsal ray; last dorsal ray one-half as long as the longest. Ventral origin is under middle of dorsal base; the fin is as long as the longest dorsal ray; the ventral appendage about as long as the eye; when the ventral is extended, the distance of its tip from the vent is one-third of length of head. The anal base is a little more than one-half as long as the head; the longest anal ray equals the longest dorsal ray; the last ray is not quite so long as the eye. Adipose fin short, its width nearly equal to its length and two-thirds of diameter of eye. B. 11; D. 11 divided rays and 4 rudiments; A. 10 divided rays and 3 rudiments. Scales 21—135 to 140—20.

The upper parts usually greenish blue, sometimes purplish; the sides more or less silvery and profusely spotted with small black spots, which are most numerous



RAINBOW TROUT—YOUNG.

above the lateral line; head, dorsal, adipose, and caudal fins also black spotted. Sea-run specimens are uniform silvery without black spots. In the breeding season the broad crimson lateral band becomes brighter, and the sides of both sexes are iridescent purplish. The jaws of the male in the breeding season are not much distorted, but they are very much larger than in the female.

The Rainbow Trout is a native of the mountain streams of the Pacific coast and ranges from California to Southern Alaska. A small example was taken at Sitka, in 1880, by Admiral L. A. Beardslee, U. S. N., and is now in the collection of the U. S. National Museum. This trout is found chiefly in mountain streams west of the Sierra Nevadas. It rarely descends into the lower stretches of the rivers, but occasionally does so and passes out to sea. The Rainbow has been extensively introduced into many Eastern States, but not with uniform success. In Wisconsin, Michigan, Missouri and North Carolina it has been well acclimatized, and it is also fairly established in New York.

The average individuals of this species are less than 1 foot in length, but specimens measuring more than 2 feet and weighing 13 pounds have been recorded. At Neosho, Mo., the young have been artificially grown to a length of nearly 1 foot in a year.

The Rainbow feeds on worms, insect larvæ and salmon eggs. In streams in which the California Salmon and Rainbow exist together, the Rainbow is more destructive to the salmon eggs than any other species. Spawning takes place in winter and early spring, varying with temperature and locality. The bulk of the eggs are usually taken in January, February and March, and the average yield from each female is about 900 eggs. A few of the females spawn when two years old, but about one-half of them begin at three years. The egg is from one-fifth to two-ninths of an inch in diameter; it has a rich cream color when first taken, changing to pink or flesh color before hatching.

The Rainbow will live in water of a much higher temperature than the Brook Trout will endure and it thrives in tidal streams and even in salt water. On Long Island, for example, the South Side Sportsmen's Club obtains a great deal of fine sport with this trout in the estuary of its trout brook. The flesh of the Rainbow is generally much esteemed, and in most localities the game qualities of the fish are scarcely inferior to those of the Brook Trout.

Large Rainbow Trout do not stand transportation well when ice is used to cool the water in which they are carried. They frequently injure their eyes, and become blind soon after the end of a journey. They are inveterate fighters, and the strongest invariably rules and harasses the rest. Contrary to what has been stated heretofore, they will not endure high temperatures as well as the Brook Trout, at least in the aquarium.

#### 66. Swiss Lake Trout (*Salmo lemanus* Cuvier). (Introduced.)

*Salmo lemanus* CUVIER, Régne Anim. *vide* Günther; GÜNTHER, Cat. Fish. Brit. Mus., VI, 81, 1866.

*Salmo trutta* JURINE, Mém. Soc. Phys. Genève, III, 1, 158, pl. 4, 1825.

*Fario lemanus* CUVIER & VALENCIENNES, Hist. Nat. Poiss., XXI, 300, pl. 617 (male), 1848.

Swiss Lake Trout ATKINS, Rept. U. S. F. C., XVII, XVIII, XIX, 1893 and 1894.

Head well proportioned in its shape, of moderate size, body rather stout; preoperculum with a distinct lower limb, operculum rather broad and high; snout of moderate length, rather produced in the male sex, in which a mandibular hook is developed in the spawning season; maxillary longer than the snout, and at least as

strong and broad as in *S. fario*; in specimens 12 inches long it extends somewhat behind the vertical from the hind margin of the orbit. Teeth moderately strong, those on the vomer in a single series, alternately bent toward the right and left, persistent throughout life. Pectoral fin rounded, its length being less, and in young individuals more than, one-half of its distance from the ventral. The caudal becomes truncate with age; in specimens of from 12 to 15 inches in length it is emarginate, the middle rays being half as long as the outer ones. The hind part of the body of moderate depth; there are 13 or 14 scales in a transverse series descending from behind the adipose fin forward to the lateral line.

Back greenish, sides and belly silvery, numerous very small X-shaped black spots on the sides; opercles and dorsal fin with numerous black dots; the other fins greenish. D. 13; A. 12; P. 14; V. 9. Scales 26 to 28—115 to 128—36; pyloric cæca 45—52; vertebrae 57 (once), 58—59. (After Günther.)

Attempts have been made from time to time to introduce into large, cold lakes of the United States the fine Lake Trout of Lake Geneva, Switzerland. Eggs have been furnished to the U. S. Fish Commission by the Swiss government, and these were hatched at the Craig Brook, Me., station, and from there the young were distributed to lakes believed to be suitable for the experiment. In New York, the Adirondack League Club obtained 1,000 of the young of this species in 1896 and deposited them in Green Lake, in Herkimer County. The specimen described below is probably one of the results of that experiment. Swiss Lake Trout were furnished also to the New York Fish Commission for planting in Lake George, and 100 yearlings were presented to the New York Aquarium.

A specimen taken in Green Lake, Adirondack League Club preserve, Herkimer County, July 29, 1899, was forwarded to the U. S. Fish Commission, Washington, D. C., and there described by Dr. W. C. Kendall, from whose notes the following account is drawn.

The total length of the specimen is  $11\frac{3}{8}$  inches. When first taken it was reported to measure  $11\frac{3}{4}$  inches. The body is moderately elongate, its greatest depth contained three and three-fifths times in the total length to base of caudal. Head large, slightly more than one-third of total length to base of caudal; eye rather large, about one-fifth of length of head; snout long, about three-tenths of length of head; teeth on jaws, palatines and tongue long, curved and sharp, those of the lower jaw longest, shaft of vomer long with a zigzag row of sharp teeth; gill rakers short, the longest one-third of diameter of iris, 4+11 on right side, 5+10 on left side. Height of longest dorsal ray two-thirds of length of head. Pectoral five-eighths as long as the head. B. 11-12; D. 9; A. 8. Scales in lateral line 115.

General appearance of *Salmo salar sebago*, from which it would probably not be distinguished by the casual observer if caught where the Landlocked Salmon occurs; but the *lemanus* is distinguishable by the heavier appearance forward of the dorsal fin.

Color in spirits, brownish on back, top of head and sides of head; sides and belly very silvery; large roundish black spots above lateral line forward and on cheeks and opercles; perpendicularly elongate spots forward below lateral line; black of all spots most intense on edges of scales; posteriorly the spots show only on the edges of the scales, being variously crescentic, double or triple crescentic, X or double X-shaped; fins pale with slightly dusky tinge; dorsal with 5 transverse rows of black spots.

Mr. De Witt, who sent the specimen, furnished the following notes on Green Lake, from whence it was forwarded: "Maximum depth 42 feet, with temperature at bottom at that depth, as far as I have been able to ascertain, about 40°. Has no outlet so far as we know. No Brown Trout have ever been put in it, and we take it for granted that the specimen I send is one of the Swiss Trout."



LAKE TROUT.

**67. Lake Trout; Salmon Trout (*Cristivomer namaycush* Walbaum).**

*Salmo amethystinus* MITCHILL, Jour. Ac. Nat. Sci. Phila., I, 410, 1818.

*Salmo confinis* DEKAY, N. Y. Fauna, Fishes, 238, pl. 38, fig. 123, 1842.

*Salmo amethystus* DEKAY, op. cit. 240, pl. 76, fig. 241.

*Salvelinus namaycush* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 317, 1883; GOODE, Fish. & Fish. Ind. U. S., I, 485, pl. 191B, 1884; BEAN, Fishes Penna., 82, color pl. 8, 1893.

*Cristivomer namaycush* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 504, 1896, pl. LXXXII, fig. 217, 1900; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 348, 1897.

The Lake Trout or Namaycush has a stout and moderately elongate body. The caudal peduncle is slender; its height little more than one-third of the greatest height of the fish. The eye is large, placed near the top of the head, two-thirds as

long as the snout, and contained four and a half to five and a half times in length of head. The maxilla reaches far behind the eye; its length nearly half that of head. The origin of the dorsal is midway between tip of snout and root of tail. The length of the base equals length of maxilla; its longest ray one-sixth of total without caudal. The ventral is under the hind part of dorsal; its length half the length of head. The appendage is very short, about half the length of eye. The fin, when extended, reaches nearly to the vent. The distance between ventral origin and anal origin is one-fifth of total length without caudal. The anal base is about one-third of length of head; the longest ray half of length of head; the last ray equal to eye. The pectoral is nearly two-thirds as long as the head. B. 11 to 12; D. 9 to 10, besides several rudiments; A. 9 and several rudiments; V. 9. Scales of lateral line about 200.

The coloration is extremely variable, generally grayish, in the variety known as the Tuladi, nearly black. Alaskan specimens are usually very dark; occasionally the upper parts are pale. The sides are profusely covered with roundish pale spots, sometimes with a reddish tinge. On the back and top of head there are fine vermiculations resembling those of the Brook Trout. The caudal, in addition to numerous pale spots, has many small dark blotches.

The Lake Trout has received many names, among which are the following: Mackinaw, Namaycush, Togue, Tuladi and Salmon Trout. Additional names of the species are Lunge, Red Trout, Gray Trout, and Black Salmon. Togue and Tuladi are names applied in Maine, New Brunswick and Canada, Mackinaw and Salmon Trout in the Great Lakes region, the latter used also in New York. Namaycush is of course an Indian name.

The Lake Trout is native in the Great Lakes region, lakes of New York and New England, Idaho and northward into Labrador, British America and Alaska. Extending over such a wide range of country, it varies greatly in size, form and color, which will in part account for the various names which it has received. It has been found above the Arctic Circle in Alaska.

This is one of the largest species of the Salmon family resident in fresh waters. It reaches a length of 3 feet, and specimens weighing 40 pounds are not uncommon. It is said that an example of 90 pounds and 6 feet in length has been taken. The species is found in its best condition in Lakes Huron, Michigan and Superior. In Alaska it grows to a large size, and is a very shapely and beautifully colored fish.

The Lake Trout is one of the most rapacious fishes of its family. In Lake Michigan it feeds largely on the Cisco and other small Whitefishes. At Two Rivers, Wis., a Lake Trout measuring 23 inches was found to contain a Burbot about 17

inches long. The gluttony of this species is proverbial. It will devour table refuse, and materials of this kind have frequently been taken from its stomach. Even twigs, leaves and pieces of wood have been taken by this Trout. The species is much more sluggish in its habits than the Brook Trout, and is taken on or near the bottom. The gill and pound nets in which this species is principally captured are set in deep water.

The spawning of the Lake Trout usually begins in October and continues into November. For this purpose they come up on rocky shoals and reefs in depths of from 70 to 90 feet, and spawn near the edges of rock caverns, into which the eggs settle. The young are hatched late in the winter or early in spring. In some localities the depth of the spawning areas ranges from 15 fathoms to only 7 feet. Mr. Milner found 14,943 eggs in a Lake Trout weighing 24 pounds. In the hatchery, with a water temperature of 47°, the young hatch about the last week of January, but their hatching may be retarded several weeks by lower temperatures.

The fishery for the Lake Trout is most active in September, October and November, and the fish are taken chiefly in pound and gill nets. In some regions many of them also are caught with hooks. In Lake Erie a few large trout of this species, weighing from 25 to 40 pounds, are taken off the city of Erie. In 1885, according to the statistics of the U. S. Fish Commission, 100,000 pounds of Lake Trout were taken in Erie County, Pa.

Hon. H. W. Sage is authority for the information that the Lake Trout was formerly common in the lake near Ithaca. About 1830 a large individual was found stranded in Cayuga Lake Inlet, about 1½ miles from the lake.

#### 68. Brook Trout (*Salvelinus fontinalis* Mitchill).

*Salmo fontinalis* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 435, 1815, near New York; RICHARDSON, Fauna Bor.-Amer., III, 176, pl. 83, fig. 1, 1836; DEKAY, N. Y. Fauna, Fishes, 235, pl. 38, fig. 120, 1842.

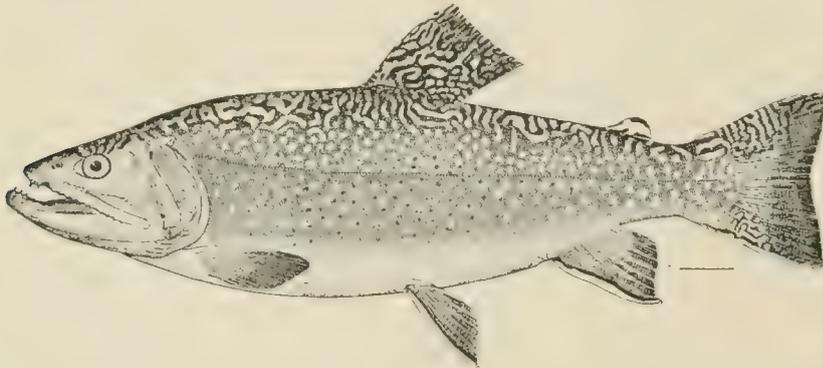
*Salmo erythrogaster* DEKAY, N. Y. Fauna, Fishes, 236, pl. 39, fig. 136, 1842.

*Baione fontinalis* DEKAY, op. cit. 244, pl. 20, fig. 58, 1842.

*Salvelinus fontinalis* GOODE, Fish. & Fish. Ind. U. S., I, 497, pl. 192, 1884; BEAN, Fishes Penna., 80, color pl. 7, 1893; Bull. Amer. Mus. Nat. Hist., IX, 350, 1897; BOWERS, Manual Fish Cult., ed. 2, color pl. frontispiece, 1900; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 506, pl. LXXXII, fig. 218, 1900.

The Brook Trout varies greatly in the shape of the body, which is sometimes short and deep and again elongate and moderately thin. The depth is usually about one-fourth or two-ninths of total length without caudal, and about equal to

length of head. The least depth of the caudal peduncle is a little more than one-third of its greatest depth. The head is large and the snout somewhat obtuse. The eye is in front of the middle of its length, a little more than one-half as long as the snout, and about one-sixth of length of head. The dorsal fin is about midway between tip of snout and root of tail. The length of its base equals about half its greatest depth of body. The longest ray equals length of ventral. The ventral origin is a little behind the middle of the dorsal. In the male, when laid backward, it reaches nearly to the vent. The length of the appendage equals that of the eye. The anal base is two-thirds as long as the ventral, its longest ray equal to ventral. The adipose fin is short and stout, its width two-thirds of its length and about two-thirds of length of eye. D. 10; A. 9. Scales in lateral line 225 to 235; six gill rakers above the angle of the first arch, 11 below.



BROOK TROUT.

The coloration is highly variable with age and locality. The upper parts are usually grayish, much mottled with dark olive or black. The dorsal fin and anterior part of caudal base and top of head are also mottled. The caudal has narrow dark bars. The lower fins dusky with a creamy white anterior edge bound behind by a narrow black streak. On the sides numerous pale brownish blotches encircle small vermilion spots.

The Brook or Speckled Trout of the east is indigenous to the region east of the Alleghany Mountains and the Great Lakes region, extending from North Carolina on the south to Labrador on the north. The distribution of this Trout has been wonderfully extended by artificial introduction, as it has always been a favorite with fish culturists. It is now to be found thriving in many of the Western States and Territories, and is particularly thrifty in Nebraska, Colorado, Nevada, and California. It has also been sent to Mexico and to European countries. The average Brook Trout seldom exceeds 7 or 8 inches in length, and smaller individuals are much

more abundant and require legal protection. In the northeastern part of its habitat the Brook Trout grows much larger, specimens weighing from 3 to 6 pounds being not uncommon; and in one of the Rangeley lakes an individual weighing 11 pounds is recorded, while Seth Green took a 12-pound specimen in the Sault St. Mary, and Hallock mentions one which was said to weigh 17 pounds.

The Brook Trout does not flourish in water warmer than 68° and prefers a temperature of about 50°. It is an inhabitant of the cold, clear mountain streams, and will leave a region which becomes polluted by mill refuse and other hurtful substances. In the Long Island region and around Cape Cod, where the Brook Trout has free access to salt water, it has the habit of going to sea in the fall and remaining during the winter. It then grows rapidly and becomes a much more beautiful fish than many which live exclusively in fresh water. In hot weather, when the temperature of the streams becomes too high and lakes are accessible, trout seek the deep parts of the lakes and the vicinity of cold springs. In streams they are to be found in deep pools or in channels. They feed in spring and early summer among the rapids on insects and small crustaceans.

The Brook Trout is a nest-builder. Cavities are made in the gravel, and the nest is shaped with the tail, and the larger stones are carried in the mouths of the parents. After the eggs are deposited they are covered with gravel. The eggs are not all deposited at one time. Spawning usually begins in October, but Brook Trout are spawning at some locality in almost every month of the year except mid-summer. The egg is about one-fifth of an inch in diameter, and varies in color from pale lemon to orange red. The average yield of the female is from 400 to 600. Livingston Stone has taken 1,800 from a fish weighing 1 pound.

The period of hatching will depend on the temperature, ranging from 165 days in water of 37° to 32 days in water of 54°. The yolk sack is absorbed in from 30 to 80 days, and after its absorption the young fish begin to feed. The rate of growth will of course depend on the amount of food consumed. In artificial culture yearlings, according to Mr. Ainsworth's estimate, will average 2 ounces; fishes of two years 4 ounces; of three years, 8 ounces, and of 4 years, 1 pound.

The value of the Brook Trout as a food fish and its game qualities are so well known that I need hardly refer to them here.

The Brook Trout is well adapted to domestication in aquarium tanks; it soon overcomes its fear of moving objects, takes its food regularly, and is always attractive because of its beauty and graceful movements. It will live in fresh and salt water. When it is attacked by fungus in fresh water, the parasite is easily killed by introducing salt water, gradually increasing in salinity, and the trout is not at all

injured or inconvenienced by the treatment. In captivity the food consists almost entirely of chopped hard clams and liver for the young, while hard clams, live killifish and occasional earthworms are given to the large fish. The increase in size with such feeding is remarkable. A Brook Trout from Caledonia, N. Y., not more than  $3\frac{1}{2}$  inches long in November, 1896, measured  $12\frac{1}{4}$  inches in length and  $3\frac{1}{2}$  inches in depth December 10, 1897.

A single young Brook Trout from Caledonia survived in water of  $76^{\circ}$  F., but that temperature was generally fatal to the species.

Dr. Meek has found the trout in small streams on the uplands throughout the Cayuga Lake basin.

Mitchill knew this fish chiefly as an inhabitant of Long Island waters, and has given an interesting account of the fishing at Nichols', Patchogue and Fireplace, where a Mr. Robbins in 12 days in the summer of 1814 caught 190 trout weighing 139 pounds 11 ounces. The largest at Patchogue weighed  $2\frac{1}{2}$  pounds, the largest at Fireplace, 3 pounds. A Mr. Purvis of New York caught a trout measuring 24 inches and weighing  $4\frac{1}{2}$  pounds at Fireplace.

At that time, according to Mitchill, the trout was "bought at the extravagant price of a quarter of a dollar for a single fish not more than 10 or 12 inches long," and New York anglers traveled "away to Hempstead and Islip for the pleasure of catching and eating him."

#### 69. Saibling (*Salvelinus alpinus* Linnæus). (Introduced.)

*Salmo alpinus* LINNÆUS, Syst. Nat., ed. X, I, 309, 1758, Lapland, West Gothland.

*Salvelinus alpinus* BEAN, Proc. U. S. Nat. Mus., Sterling Lake, New York and New Jersey; JORDAN & EVERMANN, Check-List Fish. N. A., 293, 1896; and Bull. 47, U. S. Nat. Mus., I, 508, 1896.

Body moderately elongate, compressed, its greatest depth two-ninths of total length to caudal base; the caudal peduncle short and stout, its least depth two-fifths of length of head; head rather short, its length contained from four and one-third to four and one-half times in total length to base of caudal (middle caudal rays). The body is somewhat elevated at the nape and for a short distance behind it. Mouth large, the maxilla reaching somewhat behind eye, its greatest width less than one-fourth of its length, the upper jaw one-half as long as the head; eye rather large, nearly equal to snout, one-fifth of length of head; interorbital space convex, one and one-half times diameter of eye; lower jaw very slightly projecting; vomerine teeth in a very small patch on the head of the bone, lingual teeth strong, teeth on both jaws well developed, those of the mandible strongest; gill rakers short,

straight, very slender, the longest one half as long as the eye, 11 above and 14 below the angle of the first arch. The dorsal origin is nearer to tip of snout than to base of caudal, its distance from the snout equaling twice the length of head; the dorsal base is as long as the postorbital part of head; the longest dorsal ray is two-thirds as long as the head, and nearly twice as long as the last ray. Adipose fin twice as long as wide, as long as the iris, its origin distant from base of middle caudal rays a space equal to length of head without the snout; the fin is over the end of anal base. Ventral midway between tip of snout and base of middle caudal rays, its length two-thirds of length of head; its appendage as long as the eye. Anal fin distant from ventral origin a space equal to length of head; anal base as long as snout and eye combined; longest anal ray equal to ventral and nearly two and one-half times last anal ray. Pectoral as long as the head without the snout. Caudal well forked, its outer rays about as long as the pectoral fin.

Color of the upper parts dark gray or greenish, the sides with a silvery shade passing into a deep red or orange on the lower half and, especially, the belly; red spots on the sides; lower fins margined with white and a blackish shade within the margin; sides of the head silvery; dorsal and caudal fins uniform dusky, unspotted.

The Saibling has been introduced into the United States, and a specimen was obtained from Sterling Lake, N. J., December 29, 1888. This was presented by A. S. Hewitt, Jr., to Eugene G. Blackford of New York City, and by him forwarded to the U. S. National Museum for identification and preservation. The specimen is  $9\frac{3}{5}$  inches long. It does not differ in any way from European specimens with which it has been compared, as may be seen from the following description:

The greatest height of the body equals two-ninths of the total length without caudal; the least height of the caudal peduncle is two-fifths of greatest depth of body and one-third of length of head. Head large, one-fourth of total length without caudal; snout equal to eye, four in head; maxilla extending to slightly behind orbit, its width nearly one-fourth of its length; mandible slightly projecting. Dorsal origin nearer to tip of snout than to base of caudal; base of dorsal one-half as long as the head; longest dorsal ray equal to pectoral and nearly two-thirds of length of head; last dorsal ray one-third of length of head. Adipose fin over the last two or three anal rays, its length about equal to diameter of iris. The ventral origin is under the fifth or sixth divided ray of the dorsal; the fin is as long as the postorbital part of the head; its appendage is not quite one-third as long as the fin, and equals the diameter of the iris. The anal base is four-ninths as long as the head; the last ray of the fin is one-half as long as the longest, which is one-half as long as the head. The pectoral reaches almost to below the origin of

the dorsal, its length two-thirds of length of head. Caudal deeply forked, its middle rays less than one-half as long as the outer, which are equal to length of head without the snout.

The fish is an immature male with about 10 oblong parr marks on the sides and with a few narrow dark blotches simulating half bands on the back from near the nape to a point behind the dorsal fin; numerous pale spots along the middle of the sides, each of which no doubt had a vermilion spot in the center in life.

Sterling Lake is in New York and New Jersey; and it was stated that the trout are found in streams emptying into the lake. This is noteworthy as being the only instance, as far as known, of successful introduction of the Saibling into our waters.

**70. Sunapee Trout; Golden Trout; Silver Trout** (*Salvelinus aurcolus* Bean).  
(Introduced.)

*Salvelinus aurcolus* BEAN, Proc. U. S. Nat. Mus., 628, 1887; Sunapee Lake, New Hampshire.

*Salvelinus alpinus aurcolus* JORDAN, Forest and Stream, Jan. 22, 1891; QUACKENBOS, Trans. N. Y. Ac. Sci., XII, 139, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 511, 1896, pl. LXXXIII, fig. 220, 1900.



SUNAPEE TROUT.

The type of the description, No. 39,334, was obtained in Sunapee Lake, N. H., in the fall of 1887 by Dr. John D. Quackenbos.

The length of the specimen to the caudal base is  $6\frac{2}{5}$  inches; the greatest height of the body equals the length of the head, and is contained about four times in the total without caudal; the least height of the tail equals one-third the length of the head. The maxilla reaches past the middle, but not to the end of the eye; its length is contained about two and two-thirds times in length of head. The length of the upper jaw is contained about two and one-third times in the length of the head, and is equal to the longest anal ray; the eye is a little longer than the snout, and is contained four and two-sevenths times in the length of the head; hyoid teeth well developed; the first dorsal is a little nearer the tip of snout

than to the base of caudal, and the length of its base is one-half the length of the head; the adipose dorsal is distant from end of first dorsal a space equal to twice the length of the ventral; the anal is at a distance from the snout equal to about three times the length of the head; the longest anal ray is equal to the length of the upper jaw; the length of the middle caudal rays is equal to twice the diameter of the eye. The ventral is situated midway between the tip of the snout and caudal base; its length equals one-half the length of the head. The length of the pectoral is about twice the width of the interorbital area. B. 10; D. iv, 9; A. iii, 8; P. 13; V. 9. Scales, 35-210-40; gill rakers, 6+10-12. The peculiarity of the gill rakers of this trout is that they are always curled up at the ends and not straight, as in the *oguassa* from Maine.

*Colors.* Sides silvery white. Back with about six well-defined band-like markings, besides some irregular dark blotches. There are about 10 parr marks on the sides and numerous small, roundish, white spots. In colors this char is different from the *oguassa* from Maine, but, if fresh specimens of the Maine trout were compared with this young fish, the difference in color might not be so great.

The specimen described is a young male with the spermaries showing as a mere slight ribbon. Its stomach contained an earthworm and the wing cases of a squash beetle. The other two specimens (somewhat smaller) are females far from maturity.

In a female, 11 inches in total length, both parr marks and bands across the back show very plainly. This female has a few free eggs in the abdominal cavity and seems to be nearly spent. In examples of this size the tail is deeply forked, the middle rays being less than one-half as long as the external rays.

In males the pectoral is always longer than in females of equal size.

The following color notes were taken from Nos. 38,321 to 38,328, collected by Col. Hodge in Sunapee Lake, December 10, 1886. Head and upper parts brownish gray, caudal the same, with the exception of a narrow white margin on the lower lobe; under surface of head, in most examples, brownish gray, in others whitish; belly orange, this color extending up on the sides but not to the middle line of the body; anal orange, with white margin in front; ventrals orange, with broad white margin on the outer rays; pectorals, gray upper half and orange lower half; dorsal gray, lighter along the base; sides, both above and below lateral line, with numerous orange spots, fading out to whitish. The largest of these spots are little more than one-third as long as the iris. No mottlings anywhere.

The Golden Trout is a native of Sunapee Lake and Dan Hole Pond, in New Hampshire, and of Flood's Pond, in Maine. Doubtless it exists in other lakes of New England and British North America.

It is a large species, reaching a length of 20 inches and the weight of 6 or 8 pounds; even larger individuals have been reported. Spawning takes place in Sunapee Lake on reefs in shallow water, and not in the streams tributary to the lake; the season is about the same as for the Brook Trout. The colors of the male in the breeding season are gorgeous, and the sight of a host of spawning fish in the water is one to be remembered.

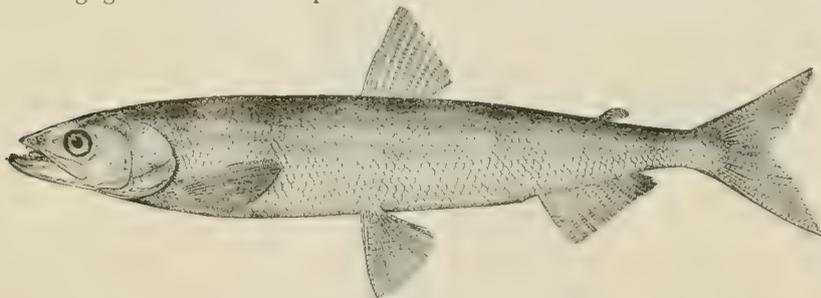
Many large and small trout of this kind have been deposited in Lake George and other suitable waters of the State.

#### 71. Smelt; Ice Fish (*Osmerus mordax* Mitchill).

*Atherina mordax* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 446, 1815, New York.

*Osmerus viridescens* DEKAY, N. Y. Fauna, Fishes, 243, pl. 39, fig. 124, streams flowing into Long Island Sound, Hackensack and Passaic Rivers.

*Osmerus mordax* BEAN, Fishes Penna., 64, pl. 26, fig. 46, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 523, 1896, pl. LXXXVI, fig. 228, 1900; EVERMANN & KENDALL, Rept. U. S. Commr. Fish & Fisheries for 1894, 593, 1896, Lake Memphremagog and Lake Champlain.



SMELT.

The Smelt is known along our east coast from Labrador to Virginia. It probably extends still farther north, but the record of W. A. Stearns, published in the Proceedings of the National Museum for 1883, p. 124, fixes the most northern locality known at present. He found the Smelt common in August in shoal water off the wharves of Cape Breton. In Pennsylvania the fish is common in the spring in the Delaware and Schuylkill Rivers. In numerous lakes of Maine, New Hampshire, and other New England States, the Smelt is common landlocked, and thrives as well as in the salt water.

DeKay knew the Smelt as a marine species ascending the Hackensack and Passaic Rivers. The species occurs also in Lakes Champlain and Memphremagog. In the former lake it reaches a large size. At Port Henry, N. Y., the fish is called Ice Fish.

The upper parts are greenish; a broad silvery band along the sides; body and fins with numerous minute dusky points.

The Smelt grows to a length of 1 foot; the average size as found in the markets is about 7 inches. It enters the rivers for the purpose of spawning and is most abundant in the winter and early spring months. Spawning takes place in the Raritan River, N. J., in March. The eggs of the Smelt have been artificially hatched by Mr. Ricardo, Fred Mather and other fish culturists.

The Smelt begins to run into Gravesend Bay in December and remains during cold weather. In the spring it ascends rivers to spawn. The eggs are small ( $\frac{1}{32}$  inch in diameter) and number 496,000 to the fluid quart; they adhere to stones, twigs, etc., on the bottom. Some females begin to spawn when only 3 or 4 inches long.

Its range has been widely extended by artificial introduction, which is very easily effected by transporting the fertilized eggs from the small brooks in which the species spawns.

In fish cultural operations, "the spawning fish, of both sexes, are placed in troughs, which are covered to exclude light, which is very injurious to the eggs. The eggs are naturally laid and fertilized, and become attached to each other and to the troughs. They are scooped up with a flat shovel, placed on wire trays in water, and are forced through the meshes of the trays to separate them. They are hatched in automatic shad jars, blanketed to exclude light. If during hatching the eggs bunch, they are removed from the jars and again passed through the meshes of the wire trays."

The Smelt is an excellent food fish and is also used for bait, and still more extensively as food for Landlocked Salmon, Lake and Brook Trout and other important salmonoids, which are artificially reared in lakes. It has proved to be one of the best fishes for this purpose. Immense quantities of Smelts are caught during the winter months in nets, seines and by hook and line. They are usually shipped to market in the frozen condition, packed in snow or crushed ice. The fish which have not been frozen, however, are prized more highly than any others.

The fry are hardy in transportation.

In captivity the adults live till about the end of June, when the water becomes too warm and they die. Their food consists mainly of shrimps and other small crustaceans.



BANDED PICKEREL | LUCIUS AMERICANUS



**72. Banded Pickerel (*Lucius americanus* Gmelin).**

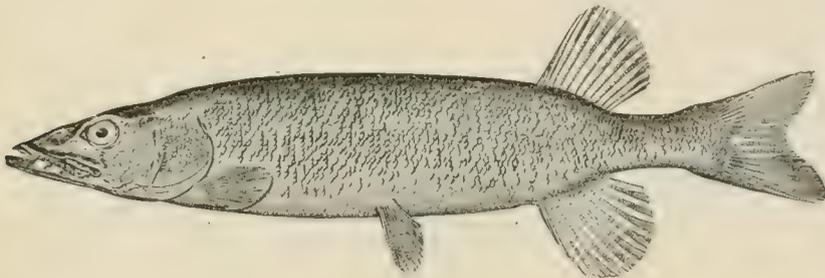
*Esox scomberius* MITCHILL, Amer. Month. Mag., II, 322, March, 1818, Murderer's Creek, New York.

*Esox fasciatus* DEKAY, N. Y. Fauna, Fishes, 224, pl. 34, fig. 110, 1842, streams and ponds of Long Island.

*Esox americanus* BEAN, Fishes Penna., 89, pl. 28, fig. 53, 1893.

The Banded Pickerel is probably identical with the "Mackerel Pike" of Mitchill. It is a small fish, seldom exceeding 12 inches in length, and will not average more than 1/2 pound in weight. It occurs only east of the Alleghanies, from Massachusetts to Florida in coastwise streams. In Pennsylvania it is limited to waters in the eastern part of the State, and the same is true in New York.

This Pickerel is too small to have much importance as a food fish. It resembles in general appearance and habits the Little Pickerel of the west. It frequents clear,



BANDED PICKEREL.

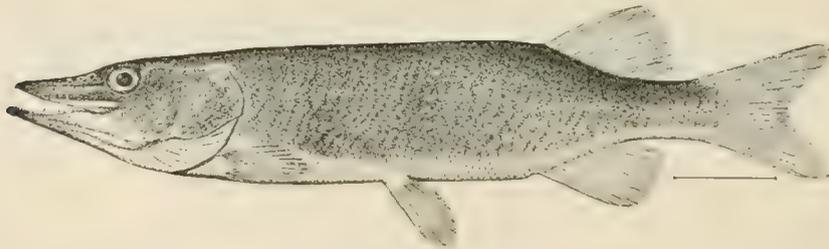
cold and rapid brooks and is said to associate with the Brook Trout without injury to the latter.

December 30, 1895, James Annin, Jr., sent from Rockland, N. Y., a small Pickerel which had attracted his attention on account of its colors and markings. It was taken in a small spring brook, tributary to the Beaverkill, which, about 10 or 15 miles below, unites with the Delaware. Subsequently two examples were forwarded alive from the same place. The following notes and measurements, in inches, relate to the first individual of undetermined sex, the organs being undeveloped.

MEASUREMENTS.

	INCHES.
Length, including caudal fin, - - - - -	7 3/4
External caudal lobe (horizontally), - - - - -	1 1/8
Middle caudal rays (from end of scales), - - - - -	1/2
Length of head, - - - - -	1 3/4
Greatest depth of body, - - - - -	1 1/8

	INCHES.
Least depth of caudal peduncle, - - - - -	$\frac{1}{2}$
Length of snout, - - - - -	$\frac{5}{8}$
Length of maxilla, - - - - -	$1\frac{1}{16}$
Length of mandible, - - - - -	$1\frac{3}{16}$
Diameter of eye, - - - - -	$\frac{5}{16}$
Distance from snout to dorsal, - - - - -	$5\frac{3}{16}$
Length of dorsal base, - - - - -	$\frac{7}{8}$
Length of longest dorsal ray, - - - - -	$\frac{3}{4}$
From end of dorsal to caudal origin, - - - - -	$\frac{7}{8}$
Distance from snout to pectoral, - - - - -	$1\frac{5}{8}$
Length of pectoral, - - - - -	$\frac{3}{16}$
Distance from snout to ventral, - - - - -	$3\frac{5}{8}$
Length of ventral, - - - - -	$\frac{3}{4}$
Distance from snout to anal, - - - - -	$5\frac{1}{4}$
Length of anal base, - - - - -	$\frac{3}{4}$
Length of longest anal ray, - - - - -	$1\frac{1}{16}$
From end of anal base to origin of lower caudal lobe, - - - - -	$\frac{3}{4}$



LITTLE PICKEREL.

B. 12; D. 12; A. 11; V. 9. Scales, 24-110. The maxilla reaches to below the middle of the pupil. The mandible projects  $\frac{1}{16}$  of an inch when the mouth is closed. The diameter of the eye is contained five and two-thirds times in length of head. The stomach was empty, but insect remains were voided from the vent.

### 73. Little Pickerel (*Lucius vermiculatus* LeSueur).

*Esox vermiculatus* BEAN, Fishes Penna., 90, pl. 28, fig. 54, 1893.

*Lucius vermiculatus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 627, 1896.

This Pickerel inhabits the valleys of the Ohio and Mississippi Rivers and streams flowing into the Great Lakes from the southward. In ponds formed in the spring by the overflow of river banks it is one of the characteristic fishes and is often destroyed in great numbers by the drying up of such bodies of water. In Pennsyl-

vania the Little Pickerel, or Trout Pickerel, is common in the Ohio and its tributaries. Prof. Cope mentions it also as an inhabitant of the Susquehanna River, in which it is probably not a native.

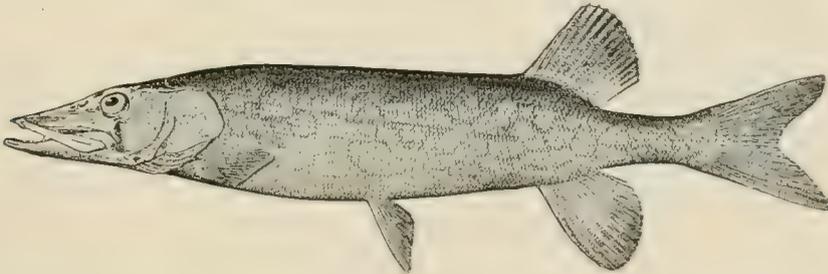
The U. S. Fish Commission obtained a moderate number of specimens in the Lake Ontario region at the following New York localities: Black Creek, tributary of Oswego River, Scriba Corner, July 15; Lakeview Hotel, 7 miles west of Oswego, July 17; Wart Creek, July 24; Great Sodus Bay, August 16; Outlet Long Pond, 4 miles west of Charlotte, August 7; Marsh Creek, near Point Breeze, August 21. This fish grows to the length of 1 foot and is, therefore, too small to have much importance for food.

**74. Chain Pickerel; Green Pike** (*Lucius reticulatus* LeSueur).

*Esox reticulatus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 353, 1883.

*Esox reticulatus* BEAN, Fishes Penna., 90, pl. 29, fig. 55, 1893.

*Esox tridecemlineatus* MITCHILL, MIRROR, 361, 1825, Oneida, N. Y.



CHAIN PICKEREL.

The Chain Pickerel is known under other names; it is the Jack of the south, the Federation Pike of Oneida Lake, N. Y., the Green Pike of the Great Lakes and the Eastern Pickerel of many writers. It does not occur west of the Alleghanies, but is found from Maine to Florida and Alabama east of this range of mountains. It lives in ponds, lakes and streams and occurs within the same territory as *L. americanus*, but farther away from the coast. (After Eugene Smith, Proc. Linn. Soc. N. Y., No. 9, p. 29, 1897.)

At Water Mill this Pickerel occurs in or near brackish water at the east end of Mecox Bay, and it is in very plump condition on account of the abundance of small fishes on which it feeds, for example, the Silversides, young Sunfish, and small Killifishes of several kinds.

Dr. Meek notes that the species seems to be subject to individual variation. In many respects the specimens from Cayuga Lake appear to be intermediate between *reticulatus* and *vermiculatus*. It is not very common.

The Pickerel is common in ponds and streams of the Hudson Highlands, accord-

ing to Dr. Mearns, and is taken in winter as well as summer. A specimen weighing  $3\frac{1}{2}$  pounds was caught in Poplopen's Pond in 1882. It is abundant also in Kaaterskill Lake, of the Catskill Mountains. The U. S. Fish Commission obtained it in Black River, Huntingtonville, N. Y., July 5. Examples were sent from Canandaigua Lake, and young were obtained in Bronx River.

The Pickerel is the largest of its group, reaching a length of 2 feet and a weight, occasionally, of 8 pounds, though this is much above the average.

Like the Pike, this is one of the tyrants among fishes, a fierce and hungry marauder; and yet it has been introduced by fishermen into many waters in which it is not native and has greatly multiplied. In the Potomac, the Connecticut, the Delaware and other large rivers the Pickerel abounds; it is to be found in large numbers lying in wait among the river grasses or in ponds under the shelter of leafy water plants for the minnows which it consumes in enormous numbers, or some unlucky insect, frog or snake which attracts its voracious appetite.

Spawning takes place in the winter and early in the spring, and the young soon become solitary and wolfish like their elders.

The fish obtained from Canandaigua Lake spawned in their tank in June, 1897, and the young were naturally hatched, but they died when about three-fourths of an inch long for want of acceptable food.

As a food fish not much can be said in praise of the Chain Pickerel, though it is eaten and doubtless liked by a good many people. The flesh is often coarse and watery and it is always full of small bones. This fish, however, furnishes considerable sport to the angler, since it is a very free biter and fights with great boldness and stubbornness when hooked. It is caught by trolling with a spoon or still fishing with live shiners, pickerel frogs and many other baits. A minnow gang is often very effective in Pickerel fishing. The hooks must be tied on gimp as a protection for the line from the sharp teeth of the fish.

This species is always hard to keep in good condition in captivity, because of its liability to fungus attacks. The salt water treatment, however, keeps the fungus in check.

#### 75. Common Pike (*Lucius lucius* Linnæus).

*Esox lucius* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 353, 1883.

*Esox lucius* BEAN, Fishes Penna., 91, pl. 29, fig. 56, 1893.

*Esox estor* DEKAY, N. Y. Fauna, Fishes, 222, 1842.

The ground color of the body is grayish varying to bluish or greenish gray. The sides are thickly covered with pale blotches, none of them as large as the eye,

arranged nearly in rows. The dorsal, anal and caudal fins have many rounded, dark spots. Adults without dark bar below eye. Naked part of opercle bounded by a whitish streak. In the young the sides are covered with oblique yellowish bars, which afterward break up into the pale spots of the adult.

Pike is the best known name for this species, though the misnomer "Pickerel" is rather extensively used. The origin of Pike is involved in uncertainty; some trace it to the resemblance in shape of the snout to the pike or spear, while others believe it to refer to the darting motion of the fish when speeding through the water. The name Pickerel is used in Vermont and around Lake George, N. Y. "Frank Forrester" (Herbert) styles it the Great Northern Pickerel. The name Jack is applied in Great Britain to young Pike. *Brochet* is the French name, *Hecht* the German and *Luccio* the Italian designation of the species. In Prof. Cope's paper in earlier reports of the Pennsylvania Fish Commission the names Lake Pike and Grass Pike are used for the fish.



COMMON PIKE.

*Distribution.* In the north temperate and arctic regions of North America, Europe and Asia the Pike is equally common. In North America it extends from Pennsylvania to high northern latitudes. In Alaska Townsend and others found it in abundance in the Yukon. From Greenland and the islands of the Arctic Ocean the Pike appears to be absent. The identity of our American Pike with the common one of Europe was recognized by Cuvier and Richardson more than half a century ago; the former compared specimens from Lake Huron with European examples, and Richardson with the English Pike, and both were unable to find specific differences between the two.

The Pike is said to be common in Lake Champlain and in all its larger tributaries. In the Lake Ontario region the U. S. Fish Commission collectors secured it at the following places: Mud Creek, Cape Vincent, N. Y., June 25, 1894, Chaumont River, July 10, outlet Long Pond, 4 miles west of Charlotte, N. Y., August 17.

Dr. Meek found the species in Cayuga Lake, where, he says, he was unable to find any other fish of the genus except the Pickerel. James Annin, Jr., obtained

the Pike in Silver Lake, Wyoming County, N. Y., July 1, 1896. He reports that it does not occur in Canandaigua Lake.

On the continent of Europe the largest recorded specimen was taken at Bregenty in 1862; this was said to weigh 145 pounds. In Scotland a Pike measuring more than 7 feet and weighing 72 pounds has been reported. We do not find monsters like these in America. "Frank Forrester" mentions individuals of 16 to 17 pounds. Lake George, N. Y., is famous for its large Pike. Dr. Frank Presbrey of Washington, D. C., caught one there in 1889 weighing a little more than 16 pounds, and more than 30 examples averaging in excess of 10 pounds each were taken that season by another Washington party in the same waters. Some of the largest Pike were upward of 4 feet long. The average length of adults is about 2 feet.

The fishing season generally begins June 1 and ends December 1, but many of the States have no close season. In Pennsylvania the close time lasts from December 1 to June 1.

The Pike is a voracious fish and destroys everything within its reach in the form of animal life; other fish, water birds and mammals are consumed in enormous numbers. From its concealment, like a beast of prey, it darts out suddenly on its victims and seldom misses its mark. The Pike is even more destructive than the Pickerel, and two of the latter, measuring 5 inches in length, have been reported to eat more than 100 minnows in a day. Spawning takes place in winter and early spring on shallows and frequently on overflowed meadows. The eggs are about one-eighth inch in diameter, and a female weighing 32 pounds was estimated by Buckland to contain 595,000. The young Pike has a very large yolk sac. The period of hatching varies, with the temperature of the water, from 14 to 30 days. The female is said to be larger than the male; the fish breeds at the age of three years. At the age of one year the fish may reach a length of 12 inches, and if well supplied with food it will increase in weight from 2 to 3 pounds yearly.

The Pike is a fairly good food fish and forms an important element of the Lake Erie fisheries. As a game fish the species is widely known; it can be readily caught by trolling or spinning or on lines set under the ice. Live minnows and frogs are favorite baits; and Dr. Henshall says it will rise to a large, gaudy fly. In Lake George the White Chub is one of the best known baits.



MASCALONGE *Esox maschali* (Cuv.)



**76. Mascalonge; Spotted Mascalonge** (*Lucius masquinongy* Mitchill).

*Esox masquinongy* MITCHILL, Mirror, 297, 1824, Lake Erie.

*Esox nobilior* BEAN, Fishes Penna., 93, pl. 29, fig. 57, 1893.

*Lucius masquinongy* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 629, 1896, pl. C., fig. 270, 1900.

The color is usually dark gray, sometimes immaculate as in the color variety *immaculatus*, but generally with numerous distinct, roundish, black spots about as large as buckshot. The dark spots are present only on the basal parts of the dorsal, anal and caudal fins. The lower parts are pale, the belly white.

The name of this giant Pike is apparently derived from the language of the Ojibwa or the Cree Indians; it is variously spelled and its meaning is uncertain, though the roots, according to H. W. Henshaw, are probably *mask* (ugly) and *kinongē* (fish). In the books it appears as Muscalonge, Muskellunge, Muskallunge



MASCALONGE.

Mascalonge and Maskinonge, all variations of the same term. Some writers style it the Great Pike, and by others it is confused with the common Pike, *E. lucius*. Prof. Cope mentions also the name Blue Pike.

The Mascalonge is recorded by Prof. Cope from Conneaut Lake, Crawford County, Pa., the specimen measuring 17 inches in circumference behind the eyes. It is found occasionally in the Ohio Valley. The species, however, is most abundant in the Great Lakes region. In Lake Erie favorite localities are Dunkirk and Barcelona, N. Y., Erie, Pa., and Mills' Grove, O. The northern limit of the fish is not definitely fixed.

It is asserted by some persons that the fish inhabits Cayuga Lake, but others deny this. Dr. Meek was unable to find it there after diligent search. It was known in Lake Champlain more than half a century ago and was described by Rev. Zadock Thompson. Mitchill and Kirtland had it from Lake Erie. DeKay confounded the Mascalonge with the Pike, and apparently had no example of the former. In the St. Lawrence River the species is well known.

It is recorded that in 1865 Mr. Schultz caught a Mascalonge at Milwaukee weighing 100 pounds. In 1864 Fred. Alvord declared that he had an 85-pound specimen in Maumee Bay. The average length of the species is about 3 feet, and there is reason to believe that a length of 8 feet is sometimes reached. Individuals weighing 50 pounds are moderately common. With the exception of the Lake Trout and some of the Salmon, this is undoubtedly the largest game fish in the United States.

The fish seem not to be gregarious, but occur usually in pairs. Their food consists mainly of smaller fishes, and their voracity is notorious. In the spawning season, in small rivers falling into Lake Simcoe, Richardson states that they feed on small fishes and on gelatinous green balls which grow on the sides of banks under the water.

This is an excellent food fish, but not common enough to have much commercial importance. As a game fish it has few superiors. The spoon bait is very effective in the capture of Mascalonge, and live fishes are extensively used. A correspondent of *Land and Water* describes a singular and successful lure made from a young brown calf's tail, through the center of which the shank of the hook was passed and fastened to a swivel.

#### 77. Northern Mascalonge (*Lucius immaculatus* Garrard).

Body unspotted, or with vague, dark, cross shades; tail a little more slender and fins a little higher than in the Spotted or Lake Mascalonge.

Lakes and rivers of Wisconsin and Minnesota, locally abundant. This is probably not distinct from the Mascalonge of Chautauqua Lake.

#### 78. Unspotted Mascalonge; Barred Mascalonge (*Lucius ohioensis* Kirtland).

*Lucius lucius immaculatus* BEAN, by error, Bull. Am. Mus. Nat. Hist., IX, 353, 1897.

Examples of Unspotted Mascalonge were received at the New York aquarium from Chautauqua Lake, N. Y., which belongs to the Ohio River drainage system. It appears that the typical spotted form also inhabits the Ohio basin, but occurs rarely. Mr. Annin sent one individual December 4, 1895, and two on May 4, 1896.

In all the specimens the maxilla extends to below the front edge of the pupil. The gill rakers are mere clumps of spiny tubercles. In the two males the diameter of the eye is contained from four and one-third to five times in the length of the snout, and from 10 to 11 times in the length of the head.

In the individual of December 4, 1895, the lateral line tubes are distributed over various parts of the sides without much regularity except in the median line. There are no black spots. About 20 entire, blotch-like, irregular cross bands and several parts of bands and blotches intervening. The lower third of the pectoral is pink. The dorsal, caudal and anal with dark blotches making pseudo bands. Iris lemon yellow overlying silvery white. The general color is olive green with golden tints.

The two males of May 4, 1896, furnished the following notes:

Olive green tinged with golden bronze; sides with about twenty irregular dusky blotches resembling interrupted bands; dorsal, caudal and anal with numerous large dusky blotches, those on dorsal and anal almost forming bands; iris lemon yellow and silvery in the larger, almost vermilion and orange in the smaller; a dark blotch at upper edge of opercle.

The Chautauqua Lake Mascalonge, according to James Annin, Jr., who sent the specimens, is a very fine food and game fish, and attains to the weight of 50 pounds. In the spring of 1895 it was not unusual to capture individuals weighing from 40 to 50 pounds, and 20 to 30 pounds was a very common weight. In winter the fish frequent nearly the same localities as in summer, being found in the vicinity of water plants. When the lake becomes very clear in February they go into deep water, but they live in deep water more or less all the year.

For the fish culture operations the nets are set as soon after the first of April as the ice leaves the lake. The fish begin to spawn a few days after and continue till the latter part of April. They go into shallower water for spawning; most of them spawn in from 10 to 15 feet of water. They do not resort to the gravel like many other fish, but to mud, generally going into bays. The eggs are placed in boxes, all of which are provided with screens at top and bottom. The bottom has an extra screen to prevent minnows from injuring the eggs. The boxes are sunk from 1 foot to 2 feet under the surface of the water. Every day or two they are drawn up, the covers removed, and all bad eggs and sediment cleaned out.

During the first experiments in Chautauqua Lake, N. Y., Monroe Green and Jonathan Mason obtained the eggs in April and May, 1890, and these were artificially hatched. A large female yielded 60,000 eggs. With the water at the temperature of 40° to 46° very few of the eggs were developed, but when it neared 60°, in May, better results were secured. On May 27 75,000 young fish were planted in the lake. The eggs were hatched in a box suspended about 4 feet from the bottom in 18 feet of water.

79. Silversides; Friar; Whitebait (*Menidia notata* Mitchill).

*Atherina notata* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 446, 1815; DEKAY, N. Y. Fauna, Fishes, 141, pl. 28, fig. 88, 1842, New York.

*Atherina viridescens* MITCHILL, op. cit., 447, 1815, N. Y.

*Chirostoma notatum* GOODE & BEAN, Bull. Essex Inst., XI, 21, 1879.

*Atherina menidia* DEKAY, op. cit., 142, pl. 74, fig. 236, 1842, N. Y., not of LINNÆUS.

*Menidia notata* BEAN, Bull. U. S. F. C., VII, 146, 1888; 19th Rept. Comms. Fish. N. Y., 271, 1890.

Translucent green; lateral band silvery, mostly on the level of the eye, its width less than one-half the diameter of eye. Scales of upper parts with dark dots along their edges; chin speckled.

The Common Silversides grows to a length of 6 inches.

The Silversides was first made known by Dr. Mitchill under the name of Small Silverside, *Atherina notata*, and he described the young of the same species as the



SILVERSIDES.

Green-Sided Silverside, *Atherina viridescens*. Dr. DeKay states that the Silversides was known in the harbor of New York as the Anchovy and the Sand Smelt. Friar is a New England name for the species; Capelin is in use about Boston, and Merit fish in the vicinity of Watch Hill. Sperling is a name recently applied to this species by some fishermen, and we have known persons to offer the Silversides as Whitebait. In Great South Bay it is known as Shiner.

The Silversides is known to occur on the coast from Maine to Virginia. It is one of the most abundant of the small fishes in our waters, swimming in immense schools made up of fish of different sizes, and it forms a considerable part of the food of more valuable species, such as the Mackerel, Bluefish, Weakfish and Flounders, and is very much in demand as a bait for hook and line fishing. We seined the Silversides in all parts of Great South Bay, and found it to be one of the most abundant and characteristic species.

The Common Silversides, or Sparring, lives in Gravesend Bay almost all the year, hibernating in spring holes in winter. It is well suited for a captive life and can endure a temperature of  $71\frac{1}{2}^{\circ}$  in the salt water.

In 1898 the species was found for the State Museum at all Long Island localities visited, Peconic Bay, Mecox Bay, the ocean at Southampton, and throughout Great South Bay. Small individuals are sold in the markets as Whitebait. In the time of DeKay the fish was called Anchovy and Sand Smelt and was esteemed a savory food. Twenty years before he wrote of the fishes of New York, it was caught from the wharves and sold for bait.

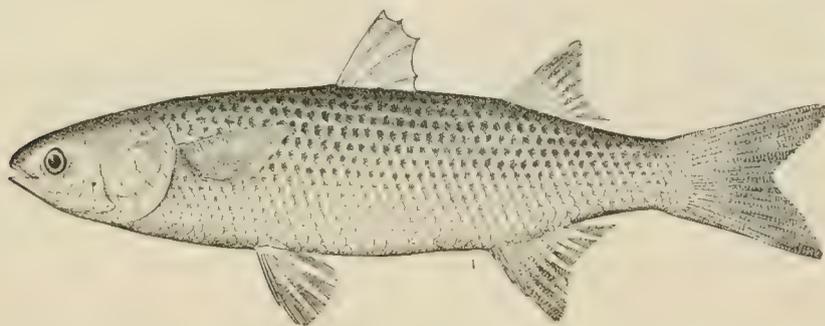
### 80. Striped Mullet (*Mugil cephalus* Linnæus).

*Mugil cephalus* BEAN, 52d Ann. Rept. N. Y. State Mus., 103, 1900.

*Mugil albula* BEAN, 19th Rept. Commrs. Fish. N. Y., 272, pl. XXI, fig. 26, 1890.

*Mugil lineatus* DEKAY, N. Y. Fauna, Fishes, 144, pl. 15, fig. 42, 1842, New York.

Color, darkish blue above; the sides silvery; exposed part of scales, especially of eight or ten upper series, darker than body color, causing a striped appearance



STRIPED MULLET.

belly and lower part of sides yellowish; ventral fins yellowish; soft dorsal, anal and ventrals dusky; tip and base of pectoral dusky.

The Striped Mullet grows to the length of 2 feet, but the average size in New York waters is much less.

The fish is known in Great South Bay as Mullet and Jumping Mullet; the name Mullet is applied to it also in the Gulf of Mexico, and is in general use along the east coast; it is known in the Chesapeake as Mullet or Fatback. The latter name is probably applied to more than one species.

The Striped Mullet is known on our coast from Cape Cod to the Gulf of Mexico. The young are much more abundant than the adults. In Great South Bay we found the species not uncommon; two examples were taken at the mouth of Swan Creek, September 12. Several schools were present. We were informed that they appear occasionally, and one gentleman of Patchogue was very successful in taking this and its allied species with hook and line. DeKay states that the Striped Mullet

was first observed in New York waters by Dr. Mitchill. He found them in the market in the beginning of September. This species is one of our choice food fishes. It is not uncommon in September in Great Egg Harbor Bay, N. J., but we are informed that large specimens are never taken in that body of water.

In 1898 the Striped Mullet was not abundant in the waters seined till fall; the great schools were absent till October. Several individuals were obtained in Mecox Bay, August 2, and a larger number in Clam Pond Cove, Great South Bay, August 22.

The young of this species are abundant in Gravesend Bay in midsummer; larger ones appear in September and October. One winter, some years ago, Mullet hibernated in the mud in Sheepshead Bay and were taken with eel spears. The Mulletts feed and thrive most of the year in captivity, but will not survive the intense heat of summer. In the aquarium their food includes hard clam and shrimp.

In 1883 Jordan & Gilbert established a genus *Querimana* for "little mullets with but two spines in the anal fin and with the teeth in the jaws less ciliiform than in *Mugil*; adipose eyelid wanting; preorbital serrate." The genus was based on *Myxus harengus* of Günther. *Querimana* is nothing more than the young of *Mugil*. The only good character by which it was distinguished is the presence of two anal spines instead of three; in all other respects *Querimana* and *Mugil* agree perfectly. As a matter of fact, all young *Mugils* pass through a *Querimana* stage in which only two of the three anal spines are developed, the adipose eyelid is rudimentary, and the teeth are comparatively stouter than in the adult. The third anal spine of *Mugil* is really a simple articulated ray till the fish reaches a length varying from about 40 mm. to 50 mm. The first simple ray of the anal becomes a spine by the breaking off at an articulation, the subsequent sharpening of the point, and the deposit of hard material in the articulations, thus forming a somewhat slender, but perfect spine.

This fact of development was carefully studied in large series of specimens in the U. S. National Museum, and it is both interesting and important from the fish cultural as well as the systematic standpoint. In *Mugil cephalus* one example, 41 mm. long, shows the third anal spine very plainly; it is well developed and has a sharp point, but several articulations still remain. Other examples of equal length have the first simple anal ray scarcely developed into a spine, and in still others this ray does not take on the character of a spine at all. *Querimana harengus*, the type of the genus, is the young of *Mugil curema*, and *Q. gyrans* is the immature *Mugil trichodon*. A re-examination of the types of *Querimana gyrans* shows the presence of 33 rows of scales in some examples instead of 29.

**81. White Mullet** (*Mugil curema* Cuv. & Val.).

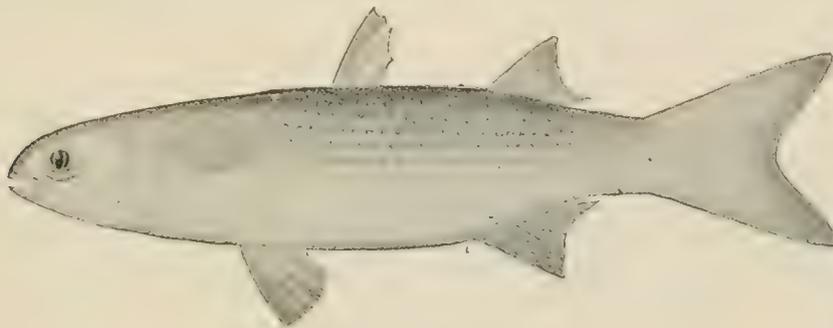
*Mugil curema* BEAN, Bull. U. S. F. C., VII, 145, 1888; 19th Rept. Commrs. Fish. N. Y., 272, pl. XXI, fig. 26, 1890.

*Mugil curema* BEAN, 52d Ann. Rept. N. Y. State Mus., 103, 1900.

*Mugil petrosus* DEKAY, N. Y. Fauna, Fishes, 147, 1842.

Color silvery, bluish above; no dusky streaks along the sides in life, but faint streaks are evident after preservation in spirits; a small dark blotch at base of pectoral; caudal pale, yellowish at base, dusky at tip; anal and ventrals yellowish; two yellow blotches on side of head.

The White Mullet reaches the length of 1 foot. On the Atlantic coast it ranges from Cape Cod to Brazil; in the Pacific it is recorded from California to Chili. It is a very important food fish.



WHITE MULLET.

The White Mullet appears with the striped species, but is less abundant in Gravesend Bay and is smaller in size. The young were taken in Great South Bay in August, 1898, and half-grown individuals were abundant in September and October. Adults were scarce.

Dr. Mitchill calls this the Summer Mullet. He records a specimen that weighed 2½ pounds, the heaviest coming under his observation. DeKay found the species in New York markets in July and August.

**82. Common Mackerel** (*Scomber scombrus* Linnæus).

*Scomber scombrus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 424, 1883.

*Scomber scombrus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 865, 1896, pl. CXXXIII, fig. 363, 1900.

Color dark blue, or greenish blue above, the upper parts with 30 or more wavy transverse bands of a darker hue, these extending below the lateral line and nearly to the median line of the body; beneath the ends of these lines and slightly sepa-

rated from them is a narrow, longitudinal, dark streak running almost the entire distance from the pectoral to the caudal; top of the head very dark; a dark blotch in the axil of the pectoral; gill covers and jaws silvery; sides white with cupreous reflections; belly white.

The Mackerel is one of the best known food fishes of the North Atlantic, ranging from Norway to Spain in Europe and from Labrador to Cape Hatteras in North America. It reaches the length of 18 inches. The fish is migratory and frequently disappears for a short or long period of time from its accustomed localities. On the New York coast the Mackerel appears in May and June in great schools, but the number varies greatly in different years.

Two young,  $3\frac{1}{4}$  to  $5\frac{1}{2}$  inches long, were taken in Gravesend Bay, L. I., May 23, 1896, in John B. DeNyse's shad fyke. No more were seen, and these were the first of the year. They come about the time of the appearance of Anchovy and Weak-



COMMON MACKEREL.

fish. They are often seen swimming at the surface of the bay in small bunches of 18 or 20, occasionally 100, in the latter part of May or early in June. They are always split up into small bunches, probably by the attacks of Weakfish and other predaceous species which are present at the time. Flukes attack them also in shallow water.

**83. Chub Mackerel; Thimble-Eye Mackerel (*Scomber colias* Gmelin).**

*Scomber colias* DEKAY, N. Y. Fauna, Fishes, 104, pl. 11, fig. 33, 1842.

*Scomber colias* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 866, 1896, pl. CXXXIII, fig. 364, 1900.

*Scomber colias* BEAN, Bull. Am. Mus. Nat. Hist., IX, 360, 1897.

Colors essentially the same as in *Scomber scombrus*, the wavy transverse bands about 30 in number; sides mottled with small dusky blotches below the median line; about 20 black specks on base of preopercle, usually arranged in more than one series; belly and sides silvery; a black blotch in axil of pectoral.

The Chub Mackerel is found in the Atlantic and Pacific Oceans, north to England and Maine and to San Francisco; very common in the Mediterranean and in Southern California; sometimes abundant on our eastern coast and frequently absent for long periods. It reaches the length of 14 inches, and is an important food fish.

July 25, 1887, the schooner Peter Cooper caught 6,000 Thimble-eye Mackerel off Manasquan, N. J. About 50,000 Mackerel were taken by the Menhaden steamer A. Morris near Ocean City, July 19, 1887. Some of these were preserved in brine by W. B. Steelman, and I found them to be *S. colias*.

The Thimble-eyes usually arrive in August. In 1886 they were often caught. This species was not found in large numbers in Gravesend Bay in 1897, but in 1896 it abounded in all the little creeks; and in some instances the fish could be dipped up by boat loads with scoop nets. The fish reached 10 inches in length before the end of the summer.



CHUB MACKEREL.

#### 84. Tunny; Horse Mackerel (*Thunnus thynnus* Linnæus).

*Thynnus vulgaris* DEKAY, N. Y. Fauna, Fishes, 105, pl. 10, fig. 28, 1842, after STORER.

*Orcynus thynnus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 429, 1883.

*Thunnus thynnus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 870, 1896.

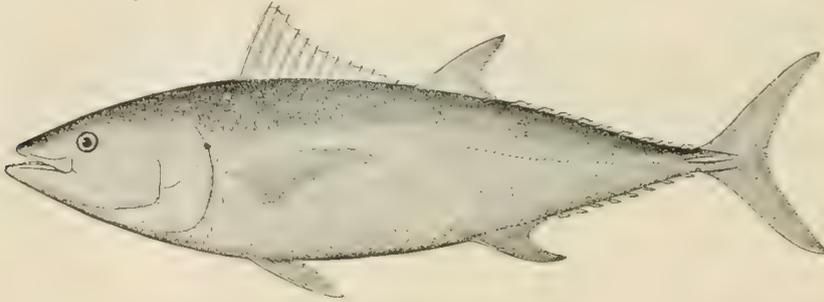
Color dark blue above; grayish below with silvery spots; pupil black, iris golden with greenish reflections; rays of spinous dorsal dusky, the connecting membrane nearly black, second dorsal reddish brown; pectorals silver gray; ventrals black above, white beneath; dorsal and anal finlets bright yellow, dark at base and on anterior edge; gill covers silvery gray.

The Tunny is the largest fish of the Mackerel family, reaching a length of 10 feet or more. It is pelagic, but comes to all warm coasts, northward to England, Newfoundland, San Francisco, and Japan. In our waters it appears usually in summer and is often taken in rather large numbers off Block Island, and on Cape

Cod and Cape Ann. On account of its enormous size and great strength, it is often destructive to the fishermen's nets.

Dr. Storer says it comes into Massachusetts Bay about the middle of June and remains till early in October. It was not uncommon to observe 50 or more in a day at Provincetown. It feeds on Menhaden, Mackerel, Whiting, Dogfish and other small fishes. The usual implement of capture at first was the harpoon, but, now that its flesh has become valuable for canning and when marketed fresh, it is taken in pound nets and by line fishing. The fish arrives on the coast in poor condition and without value, but becomes very fat during the summer months, and is then utilized for the oil, which is obtained from the head and belly by boiling, and for its flesh, which is favorably regarded, either fresh, salted or preserved in cans.

The Tunny is said to spawn in June, and the recently hatched young, according to Yarrell, weigh  $1\frac{1}{2}$  ounces, growing to 4 ounces by August and 30 ounces in October. Adults often weigh 1,000 pounds. The Killer Whale is the most dreaded enemy of the Tunny.



TUNNY.

In Southern California this fish is highly prized by anglers who are fond of big game and hard play. In the Bay of Chaleur and off Caraquette, in the Gulf of St. Lawrence region, 100 Tunny were captured by means of baited lines, and the fishing was considered exciting because the fish pulled with such violence as to endanger the lives of the fishermen by dragging them overboard. This kind of exercise might be had near Rockport, Mass., or off the New Jersey coast annually in summer.

#### 85. Bonito (*Sarda sarda* Bloch).

*Pelamys sarda* DEKAY, N. Y. Fauna, Fishes, 106, pl. 9, fig. 27, 1842.

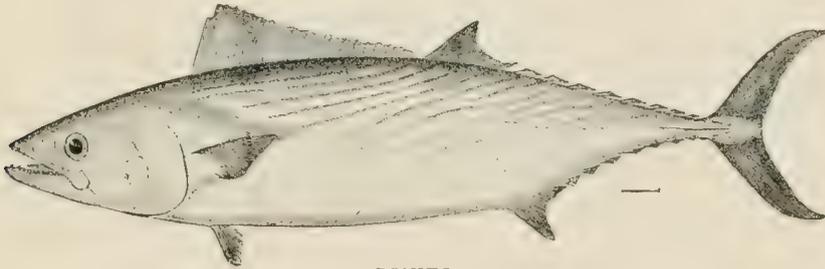
*Sarda sarda* BEAN, Bull. U. S. F. C., VII, 138, 1888; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 872, 1896; BEAN, Bull. Am. Mus. Nat. Hist., IX, 360, 1897, Gravesend Bay.

Color steel blue above, the sides silvery, the abdomen and under surface of head silvery white; from 10 to 20 dark bluish, narrow bands obliquely downward and for-

ward from the back, some of them almost reaching the belly; iris yellowish; first dorsal fin sometimes pale, sometimes nearly black; pectoral dark above, light beneath.

The Bonito inhabits the Atlantic Ocean on both coasts and is common in the Mediterranean. On our coast it ranges habitually north to Cape Ann. It reaches the length of 30 inches and the weight of 10 or 12 pounds. Though not generally esteemed as a food fish, it meets with a steady sale either fresh or salted like the Mackerel. The fish is believed to live in the open sea, coming to the shores only to feed or to deposit its eggs. It is predaceous and active, feeding insatiably on Mackerel and Menhaden; it takes trolling bait as freely as the Bluefish, to which it is not inferior in quality of flesh.

The fish is generally scarce in Gravesend Bay. Five were taken in one day in a pound net in October, 1897, an unusual number for that species. The Bonito will not live in captivity.



BONITO.

86. Spanish Mackerel (*Scomberomorus maculatus* Mitchill).

*Cybium maculatum* DEKAY, N. Y. Fauna, Fishes, 108, pl. 73, fig. 232, 1842, N. Y.

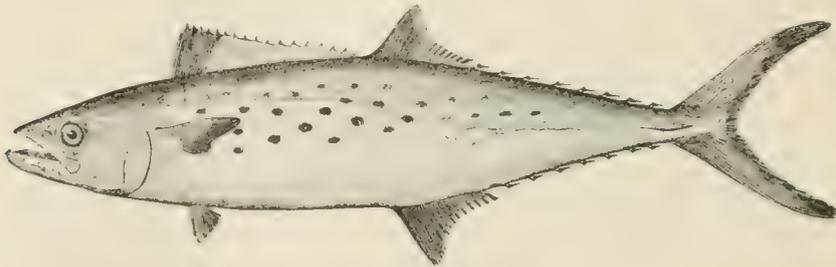
*Scomberomorus maculatus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 426, 1883, BEAN, Bull. U. S. F. C., VII, 138; 19th Rept. N. Y. Comm. Fish., 254, pl. VII, fig. 9, 1890; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 874, 1896, pl. CXXXIV, fig. 368, 1900.

Color silvery; upper parts bluish; sides with numerous oblong spots of a dull orange, none of them more than one-third as long as the snout, these spots fully as numerous above the lateral line as below it; the membrane connecting the first eight spines of the dorsal black, the rest of the fin white; soft dorsal with a yellowish tinge, its margin dark; anal and ventral white; pectoral black inside, yellowish with dark borders outside and covered with dusky points; caudal dusky except at base.

The Spanish Mackerel inhabits the Atlantic and Pacific coasts of North America,

on our coast ranging north to Maine and south to Brazil. It is one of the choicest of our food fishes and grows to the length of 3 feet and the weight of 10 pounds. The species spawns on the Long Island coast in August or earlier. The eggs are very small, about one twenty-fifth of an inch in diameter, and they float in salt water. The rate of growth is unknown, as the young are seldom or never seen by persons who know the fish. The Spanish Mackerel is caught chiefly in pound nets.

It is recorded that the species has been obtained off the coast of Maine by Capt. Atwood. Mitchill describes the species without making any remark on its abundance or scarcity, and states that it comes in July. In 1854 the species had very little importance in the New York market, but at the present time it is one of the most highly prized fishes and is obtained in large numbers. Spanish Mackerel have been sparingly caught by trolling off Fire Island Inlet. We did not obtain the species in



SPANISH MACKEREL.

Great South Bay, but Erastus Gordon, of Patchogue, informed us that it is obtained in moderate numbers. In 1884 the fish was not plentiful and the average price was about \$1 each. They appear in New York waters in July and usually leave in September. The spawning season at Long Island begins late in August and continues about a month. The Spanish Mackerel congregate in enormous schools. Mr. Earll records the appearance of a school off Long Island which was estimated to contain several million individuals. The fish are taken principally in traps; a few are caught by trolling, but this is an unsatisfactory method of capture.

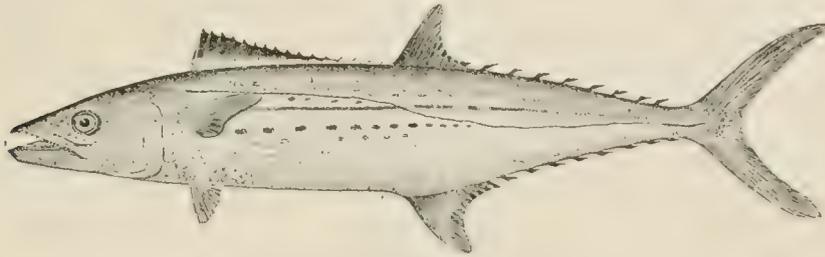
#### 87. Cero (*Scomberomorus regalis* Bloch).

*Scomberomorus regalis* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 426, 1883; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 875, 1896, pl. CXXXV, fig. 369, 1900.

Color silvery; a narrow longitudinal stripe of brownish or bronze beginning behind the pectoral and running to base of caudal; numerous oblong brownish

spots mostly below this stripe, none of them more than one-half the diameter of eye; upper anterior part of spinous dorsal black, the rest of the fin white.

The Spotted Cero is found from Cape Cod to Brazil, but is not common northward; it is abundant in the West Indies. The species grows to the length of 5 feet and the weight of 20 pounds; it is a fish of the same good qualities as the Spanish Mackerel and is readily caught by trolling.

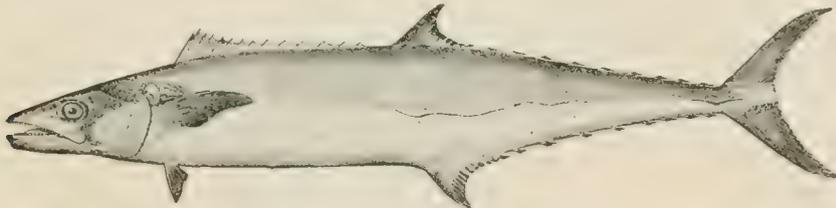


CERO.

88. **Kingfish; Sierra** (*Scomberomorus cavalla* Cuvier).

*Scomberomorus cavalla* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 427, 1883;  
JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 875, 1896.

Color grayish silvery, the sides sometimes with dark spots, or yellowish in the young; spinous dorsal blackish above, or without dark blotch.



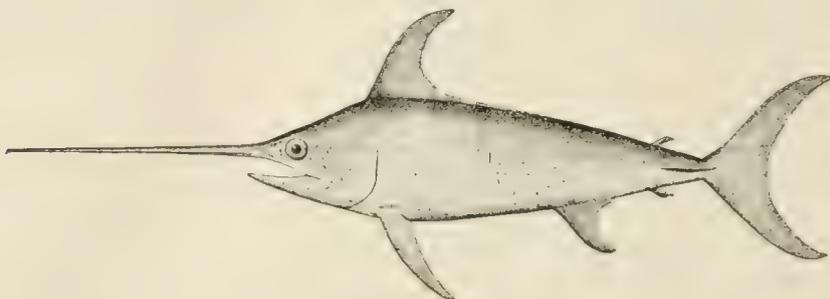
KINGFISH.

The Kingfish, or Cavalla, is a very important and valuable food fish of the tropical Atlantic, coming in immense numbers to the Florida Keys, the West Indies, and north to Charleston, occasionally, in summer, to Cape Cod. Southward it extends to Africa and Brazil, frequenting the open seas. In habits it resembles the Spanish Mackerel; it is caught by trolling, and at Key West it is so abundant that two men in a small sailboat sometimes catch more than 100 in a day. The flesh is excellent, either fresh or smoked.

89. Swordfish (*Xiphias gladius* Linnæus).

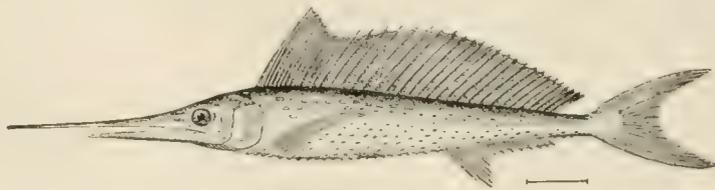
*Xiphias gladius* DEKAY, N. Y. Fauna, Fishes, III, pl. 26, fig. 79, 1842; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 420, 1883; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 894, 1896.

Color above rich purplish blue, shading into whitish beneath, the sides and belly with a silvery lustre. Fins, dark bluish with silvery sheen, except dorsal. Top of head rich purplish blue, the color extending upon the rostrum. Lower side of rostrum rich brownish purple. Eye deep blue.



SWORDFISH—ADULT.

The Swordfish inhabits the Atlantic and comes near both coasts; it is most abundant between Cuba and Cape Breton, rather common in the Mediterranean, and is occasionally taken off Southern California. The fish appear in the vicinity of Sandy Hook about June first, and the fishing season continues as far east as Martha's Vineyard and Nantucket Shoals till about the middle of September.



SWORDFISH—YOUNG.

They disappear to the southward as soon as the cold winds begin to blow. They feed on Mackerel, Menhaden and Squid. They are often caught on trawl lines, but the chief means of capture is the harpoon.

The average length of Swordfish is 10 feet, but individuals measuring 16 feet are on record. An individual weighing 750 pounds was killed in 1874 off Portland.

The flesh of this fish is very palatable, and the fishery is an important one as well as an exciting occupation.

Young Swordfish have the skin covered with small, rough excrescences, the jaws much more nearly equal, and the dorsal and anal fins not divided into two separate parts.

90. **Yellow Mackerel** (*Caranx hippos* Linnæus).

*Scomber hippos* LINNÆUS, Syst. Nat. ed., XII, I, 494, 1766, Charleston, South Carolina.

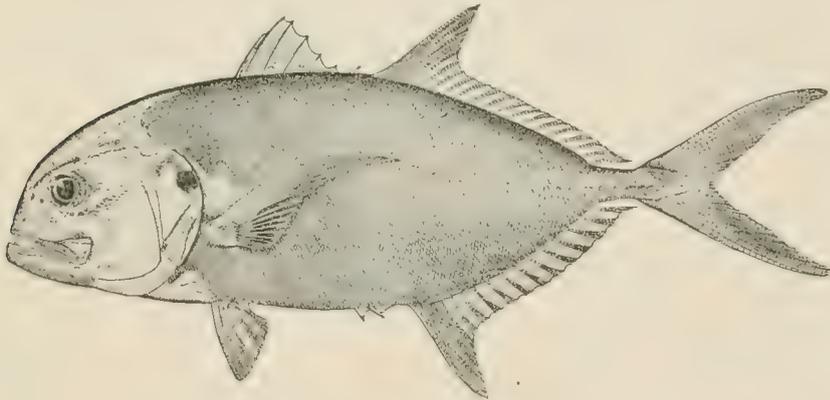
*Caranx carangus* CUVIER & VALENCIENNES, Hist. Nat. Poiss., IX, 91, 1833; GÜNTHER, Cat. Fish. Brit. Mus., II, 448, 1860.

*Caranx defensor* DEKAY, N. Y. Fauna, Fishes, 120, pl. 24, fig. 72, 1842; HOLBROOK, Ichth. S. C., 87, pl. 12, fig. 1, 1860.

*Carangus hippos* GILL, Proc. Ac. Nat. Sci. Phila., 433, 1862; GOODE & BEAN, Bull. Essex Inst., XI, 16, 1879.

*Caranx hippos* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 437, 1883; Proc. U. S. Nat. Mus., 200, 1883.

*Caranx hippos* BEAN, Bull. U. S. F. C., VII, 139, 1888; Bull. Am. Mus. Nat. Hist., IX, 362, 1897; 52d Ann. Rept. N. Y. State Mus., 103, 1900; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 920, 1896, pl. CXLI, fig. 387, 1900; MEARNs, Bull. Am. Mus. Nat. Hist., X, 318, 1898; SMITH, Bull. U. S. F. C., XVII, 98, 1898.



YELLOW MACKEREL.

Body oblong, the anterior profile very strongly arched. The depth is contained two and one-half times in the length. Head large and deep, its length being contained three and one-half times in that of the body; mouth large, low; lower jaw prominent, maxillary extending to nearly opposite posterior border of eye, two and one-third in head; teeth in upper jaw in a broad villiform band, an outer series of large, wide-set, conical teeth, teeth of lower jaw in one row, a distinct canine on each side of symphysis; villiform teeth on vomer, palatines, pterygoids, and tongue; lateral line with a wide arch, its length one and one-third in straight part, the angle under fifth dorsal ray, plates not covering all of the straight part,

lateral line (scutes) about 30; dorsal spines short, rather stout; gill rakers stout, rather long, 15 below angle; occipital keel sharp; eye not very large; pectoral falcate, one-fifth longer than head; breast naked or with only a small triangular patch of scales in front of ventrals; caudal lobes equal, nearly as long as head. D. VIII-I, 20; A. II-I, 17.

Olivaceous above, sides and below golden; a large, distinct black blotch on opercle, bordered behind with pale; a large faint black spot on lower rays of pectorals, the latter sometimes wanting in young; axil of pectoral with a black blotch; edge of soft dorsal black; upper edge of caudal peduncle dusky.

The Yellow Mackerel is a widely distributed fish in warm seas; it is recorded from the East Indies, both coasts of tropical America, and northward to Cape Ann and the Gulf of California. The young are common at Woods Hole, Mass., where they appear in July and become most abundant in October. Individuals 1 inch long have been obtained there about July 1; larger fish occur in the fall. In August, 1898, only a few young ones were secured in Great South Bay and at Southampton, L. I.

The fish probably spawns in West Florida in May in the salt water bayous, as the young fish are seen coming out of such places in schools in the fall on their way to the sea. Fish weighing about a pound or two are considered equal to Pompano for the table, but large fish are not esteemed, the flesh being dark and almost tasteless. The species reaches the weight of 20 pounds.

The Yellow Mackerel resembles the Big-eyed Scad in its endurance of captivity and its feeding habits. At the end of November it has been known to thrive in a pool containing about 50,000 gallons of water in company with the Crévallé, the Big-eyed Scad and other species.

#### 91. Crévallé (*Caranx crysos* Mitchill).

*Scomber crysos* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 424, 1815, New York.

*Caranx chrysus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 970, 1883; BEAN, 19th Rept. N. Y. Com. Fish., 256, pl. VII, fig. 10, 1890.

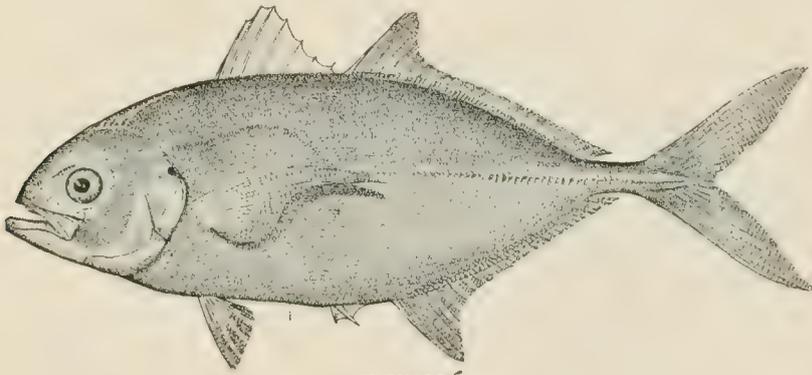
*Caranx crysos* DEKAY, N. Y. Fauna, Fishes, 121, pl. 27, fig. 85, 1842; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 921, 1896, pl. CXLII, fig. 388, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 362, 1897; SMITH, Bull. U. S. F. C., XVII, 98, 1898.

Greenish olive, golden yellow or silvery below; a black blotch on opercle; fins all pale. An individual  $3\frac{1}{2}$  inches long, taken at Beesley's Point, N. J., August 11, 1887, showed the following colors: Caudal yellow; basal half of elevated part of

anal yellow ; cheeks and lower half of sides also yellow ; a black opercular spot, but none on pectoral ; several narrow pale bars on sides ; tip of elevated part of soft dorsal dusky ; membrane between dorsal spines dusky ; iris copper color.

The Crevallé is found on the east coast from Nova Scotia southward, ranging to the West Indies and Brazil. The young are very common along the coast of Southern New England in summer. DeKay calls it the Yellow Caranx, and Mitchill mentions it as the Yellow Mackerel. The specimens seen by both these authors came from the Bay of New York.

At Woods Hole, Mass., the young arrive in July and leave in October. In Great Egg Harbor Bay, N. J., young individuals were taken sparingly in August. DeKay records the species as abundant in New York Bay in September and October. The writer saw several examples from a fish trap at Islip, L. I., October 1, 1890.



CREVALLÉ.

Young Crevallé make a croaking sound when captured in a net or held in the hand.

On the Gulf coast of Florida, Alabama and Mississippi the fish is migratory, just as it is here ; it makes its appearance in April, spawns in July or August, and then disappears and is replaced by the young. It feeds on small fish, which it pursues eagerly, and is preyed on by sharks and porpoises.

It grows to the length of 15 inches and is highly prized for food.

The Crevallé can be successfully kept in captivity in large pools with a temperature above 50° in winter. The fish occasionally school together under a large shark and follow it about.

92. Common Pompano (*Trachinotus carolinus* Linnæus).

*Lichia carolina* DEKAY, N. Y. Fauna, Fishes, 114, pl. 10, fig. 30, 1842, off Sandy Hook.

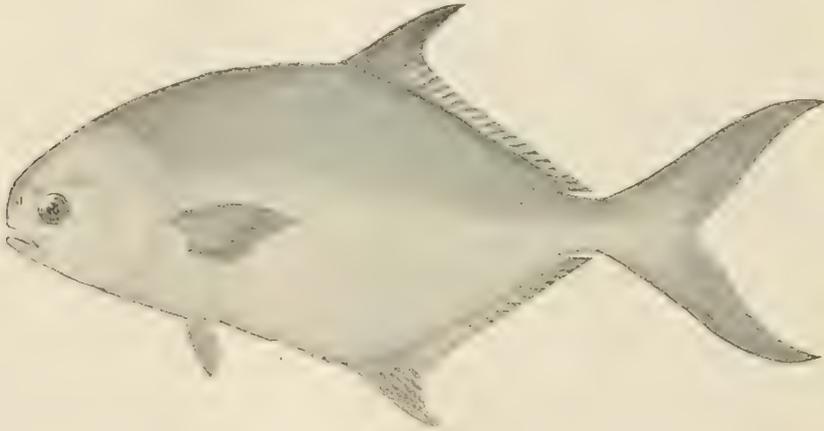
*Trachynotus carolinus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 442, 1883.

*Trachynotus carolinus* BEAN, Bull. U. S. F. C., VII, 140, 1888; 19th Rept. N. Y. Comm. Fish., 254, pl. VIII, fig. 11, 1890.

*Trachinotus carolinus* BEAN, Bull. Am. Mus. Nat. Hist., IX, 363, 1897, 52d Ann. Rept. N. Y. State Mus., 104, 1900.

Uniform bluish above, sides silvery, golden in the adult, without bands, fins plain silvery or dusky.

This fish has no other name on our east coast except the southern variation of Pompeynose. In Great South Bay the name Butter fish is applied to it because it is confounded with the *Poronotus triacanthus*, to which the name properly



COMMON POMPANO.

belongs. Mitchill described it under the name Thornbacked Grunt, a name not now in use.

The Pompano ranges on our coast from Cape Cod to Florida, the adults rarely or never coming into northern waters, but the young are taken in variable numbers every year. At Woods Hole they sometimes occur in considerable numbers, and they have been taken in great abundance in Great Egg Harbor Bay, but not recently. In Great South Bay, in 1890, only a single young individual was secured at Oak Island Beach on the last day of September. It occurs occasionally also on the Pacific coast. Dr. DeKay, in 1842, mentioned it as an exceedingly rare species on the New York coast. His description was based on a specimen taken off Sandy Hook more than 20 years before. In 1898 young specimens were found in moderate numbers at Oak Island Beach, Great South Bay, September 14, and on the east side

of Fire Island Beach September 16. The young are summer and fall visitors in Gravesend Bay. Twenty-two individuals were placed in a tank in August, 1897, and grew rapidly till the temperature of the water fell below 60° F. in November. During this month all of them died.

The species reaches the length of 20 inches. It is one of the finest of our food fishes.

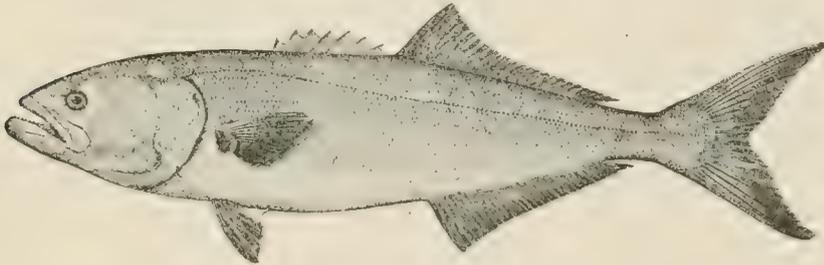
**93. Bluefish ; Snap Mackerel ; Snapper** (*Pomatomus saltatrix* Linnæus).

*Scomber plumbeus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 424, pl. IV, fig. 1, 1815.

*Temnodon saltator* DEKAY, N. Y. Fauna, Fishes, 130, pl. 26, fig. 81, 1842.

*Pomatomus saltatrix* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 914, 1883.

*Pomatomus saltatrix* BEAN, Bull. U. S. F. C., VII, 1888 ; 19th Rept. N. Y. Comm. Fish., 269, pl. XX, fig. 24, 1890 ; Bull. Am. Mus. Nat. Hist., IX, 363, 1897 ; 52d Ann. Rept. N. Y. State Mus., 104, 1900.



BLUEFISH.

Bluish or greenish, silvery below, a black blotch at the base of the pectoral.

Some of the many names applied to this widely distributed fish are the following: Mackerel (New Jersey), Horse Mackerel (New York and Rhode Island), Snapping Mackerel (New England and New Jersey), Skip Mackerel (New York), Snapper and Blue Snapper (New England), Green Fish (Maryland, Virginia and North Carolina), Salt-water Jack (Southern States), Tailor (Chesapeake Bay), Whitefish (Hudson River). Bluefish is the name most extensively used on the coast and in the Gulf of Mexico.

The Bluefish ranges on our coast from Maine to the Gulf of Mexico, and is believed to frequent warm seas of both continents. It ranged farther to the northward in 1887 than for many years before. We heard of its capture in the vicinity of Mount Desert, Me. On our coast and elsewhere its movements are erratic, and its abundance fluctuates greatly within certain periods; it disappears sometimes altogether for a term of years. The young, under about 1 inch in length, seem to be unknown. The spawning habits and localities have not been recorded. The

smallest known examples were obtained at the surface off shore by the U. S. Fish Commission. The writer has seined individuals a little more than an inch long at Ocean City, N. J., the last of August. The young ascend rivers into fresh water.

This is one of the most destructive of all fishes. It feeds ravenously, and, when gorged with food, continues to destroy its victims for the sake of gratifying its killing propensity. It follows the great schools of Alewives, Weakfish, Mulletts and other valuable food fishes along our coast in summer, and the young may be discovered in shallow bays and sounds, pursuing the Silversides, young Herring, Anchovies and other fishes smaller than themselves. According to DeKay Bluefish were unknown on the New York coast till about 1810, when a few appeared. In 1815 Dr. Mitchill wrote: "Young ones are taken plentifully with the hook at our wharves by the boys in August." The largest mentioned by Mitchill was 13 inches long, 3 inches deep and weighed about 14 ounces. The name Bluefish was in use at the time of Mitchill's report.

DeKay noticed the gradual disappearance of the Weakfish with the increasing abundance of Bluefish.

The best known methods of taking Bluefish are by trolling at the surface with a squid of metal or bone and by heaving and hauling in the surf near the mouths of streams into which Alewives are running. Artificial minnows are also used with a light rod, when young Bluefish are seen feeding near the surface. The most recent method in use by anglers is that of chumming in the manner usually employed in Striped Bass fishing. This method, which involves the use of rod and reel, was in use near the inlet at Fire Island early in October, 1890. During the summer, in this bay, it was not an uncommon thing for anglers to catch 150 or 200 small Bluefish with hook and line in a single day. The species is to be found in all parts of the bay visited by us. It was taken at the following localities: Blue Point Cove, Oak Island and Fire Island. Large numbers of Bluefish were caught late in September by means of gill nets set in the ocean near Blue Point life-saving station. A fisherman caught 450 at one time and 250 at another, the dates being September 23 and 24, 1890. In August of that year Bluefish drove immense schools of Round Herring (*Etruncus teres*) on the ocean beach, near the Life-saving station. September 24, while walking along the beach of East Island, not far from the Blue Point station, in a distance of half a mile, I saw 51 Round Herring lying on the beach, having been chased in a short time previously by Bluefish. When the fishermen find the Round Herring on the shore, they know that Bluefish are present. Small Bluefish were caught in a trap at Islip, October 1, 1890. In the summer of 1898

young Bluefish were abundant in all the waters visited in Peconic Bay and Great South Bay and were taken as late as October 16.

During the warm season they often run up the rivers, the young, called Snappers, frequently into nearly fresh waters. (After Eugene Smith.)

The Bluefish is so active in its movements that it is difficult to keep it in captivity. As with the species of *Caranx* and *Seriola*, however, its longevity depends on range and temperature; in a large body of water, not colder than 60° in winter, it can be maintained easily.

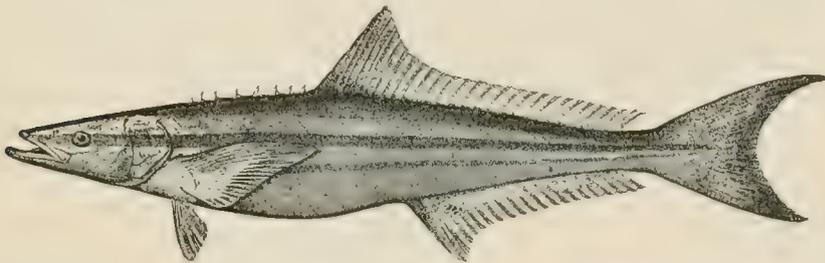
94. **Crab-eater; Cobia** (*Rachycentron canadus* Linnæus).

*Centronotus spinosus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 490, pl. III, fig. 9, 1815, New York.

*Elacate atlantica* CUVIER & VALENCIENNES, Hist. Nat. Poiss., VIII, 334, pl. 233, 1831, Brazil; DEKAY, N. Y. Fauna, Fishes, 113, pl. 25, fig. 77, 1842.

*Elacate canada* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 418, 1883; BEAN, Bull. U. S. F. C., VII, 144, pl. II, fig. 13, 1888; 19th Rept. N. Y. Comm. Fish., 270, pl. XX, fig. 25, 1890, young, Great Egg Harbor Bay.

*Rachycentron canadus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 948, 1896, pl. CXLVIII, fig. 401, 1900; SMITH, Bull. U. S. F. C., XVII, 98, 1898.



CRAB-EATER.

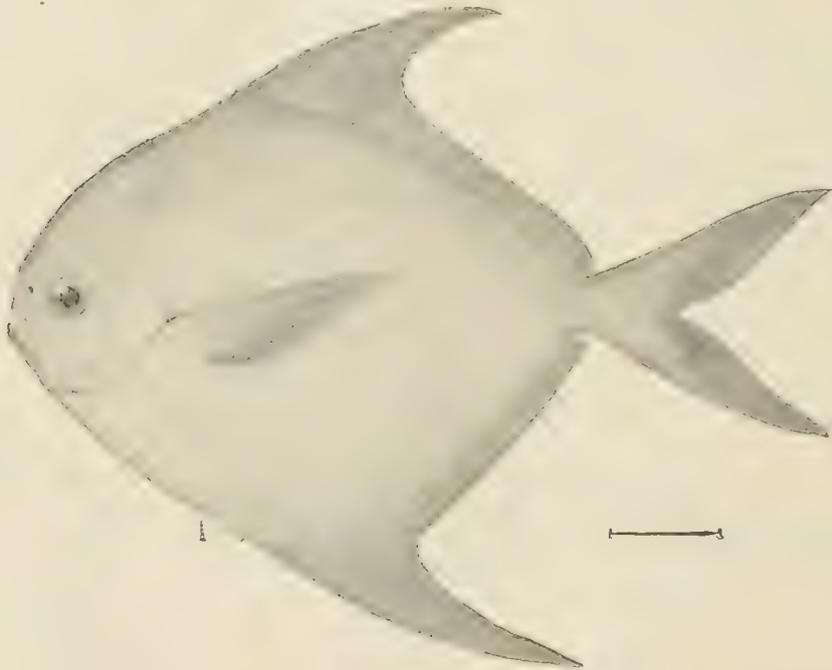
Color olive brown; sides with a distinct broad dark band and a less distinct band above and below it; lower parts silvery.

The Crab-eater inhabits all warm seas, occasionally appearing on our northern coast in summer and ranging northward to Massachusetts Bay. Individuals are occasionally taken at Woods Hole, Mass.

Dr. Mitchill had a specimen of the Crab-eater which was caught in New York Bay June 11, 1815. He found in its stomach 20 spotted Sand Crabs and several young Flounders. The fish was eaten at his table, and pronounced one of the best he had ever tasted. This example was 31 inches long. Dr. DeKay styles it the Northern Crab-eater. The specimen described by him was captured in Boston Harbor, and placed in a live car with other fish, chiefly Porgies (*Stenotomus chrysops*),

and it destroyed and ate every fish in the car. Dr. A. K. Fisher of Washington has found the young of the Crab-eater in the Hudson near Sing Sing. Though we have no specimens of the Crab-eater from Great South Bay, there is scarcely a doubt of its occurrence in that body of water.

A young example,  $3\frac{7}{8}$  inches long, was caught at Somers Point, N. J., near the club house, August 2, 1887, by Capt. Richard Chamberlain. Ground color nearly black; a white stripe, about as wide as pupil, from upper angle of gill opening to caudal; another one, but narrower, begins at lower extremity of pectoral base, curves very slightly upward, fading out near the tail; upper caudal lobe with a narrow



HARVEST FISH.

whitish margin along its upper surface, relieved by a trace of orange red at its base; lower caudal lobe with a narrow orange red margin; pectorals, ventrals and caudal black; back fades to a dark green; belly grayish white; iris golden bronze. This species has not previously been recorded from Great Egg Harbor Bay, and the young seems not to have been described.

Another example, 4 inches long, was seined in one of the thoroughfares in the bay August 23. This has the same markings as the first. The caudal when fully expanded, is rounded, the end truncate; there is no emargination as in the adult. A figure of the young is published in Bulletin of the U. S. Fish Commission, pl. 2, fig. 13, 1888.

**95. Harvest Fish ; Pappy Fish** (*Rhombus paru* Linnæus).

*Stromateus longipinnis* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 366, 1815, New York Bay.

*Rhombus longipinnis* DEKAY, N. Y. Fauna, Fishes, 136, pl. 75, 239, 1842.

*Rhombus paru* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 965, 1896, pl. CL, fig. 404, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 364, 1897.

Color greenish above, golden yellow below. Mitchill gives the following description: "Silvery, with tints of blue, green and iridescent; dusky on the head and with inky patches on the belly towards the tail, which in certain lights appear beautifully red and purple; back bluish, with occasional clouds."

The Harvest Fish inhabits the West Indies and is found on our Atlantic coast from Cape Cod southward, ranging to Brazil. The young are frequently seen swimming beneath the Portuguese Man-of-War.

DeKay had several specimens of the species, but found it less common than the Short-finned Harvest fish, *R. triacanthus*. At Charleston the fish is called Rudder fish.

The species reaches a length of 8 inches. It is a valuable food fish. It is a summer visitor in Gravesend Bay and is sometimes rare, but was formerly abundant there. It is not adapted to a captive life. At Woods Hole, Mass., Dr. Smith reports it as usually rare, but occasionally common. As a rule only 3 or 4 are taken in a season, but one year 300 or 400 were obtained. It occurs mostly in June and July, associated with the Butter fish, *R. triacanthus*.

**96. Butter fish ; Harvest fish** (*Rhombus triacanthus* Peck).

*Stromateus cryptosus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 365, pl. I, fig. 3, 1815, New York Bay.

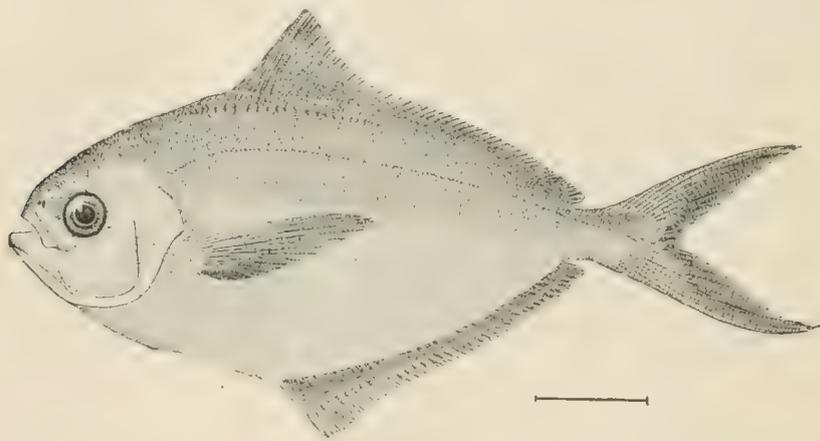
*Rhombus triacanthus* DEKAY, N. Y. Fauna, Fishes, 137, pl. 26, fig. 80, 1842; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 967, 1896, pl. CL, fig. 405, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 363, 1897; BEAN, 52d Ann. Rept. N. Y. State Mus., 104, 1900.

*Poronotus triacanthus* BEAN, 19th Rept. N. Y. Com. Fish., 257, pl. XI, fig. 14, 1890.

This is known as the Dollar fish, Harvest fish and Lafayette. Mitchill called it the Cryptous Broad Shiner, and DeKay described it under the name Short-finned Harvest fish. About Cape Cod it is the Sheepshead and Skipjack. In Connecticut it is called Pumpkin Seed and at Norfolk, Starfish.

The Butter fish ranges from Maine to South Carolina, and is gradually replaced southward by the Long-finned Harvest fish, *Rhombus paru*. It is a summer visitor, associated with the Mackerel. DeKay records it in New York Bay July 1, and obtained it from fyke nets in New York Harbor as late as October 12. We seined young examples at Blue Point Life-saving station October 7, and others were secured September 30 at Oak Island Beach. It is taken chiefly in pound nets, and has recently become a highly prized market fish. A few years ago it was little esteemed. The young are to be found in the summer months swimming at the surface in sheltered bays and frequently under the shelter of the streamers of Jelly fishes, where they are sometimes destroyed by the lasso cells of their host.

The Harvest fish is present in Gravesend Bay from April to November. Adults were taken at Southampton Beach August 1 and August 3, 1898. The fish was not found in Great South Bay during the summer and fall of 1898.



BUTTER FISH.

### 97. Crappie (*Pomoxis annularis* Rafinesque).

*Pomoxis annularis* BEAN, Fishes Penna., 103, pl. 30, fig. 59, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 987, 1896, pl. CLIV, fig. 415, 1900.

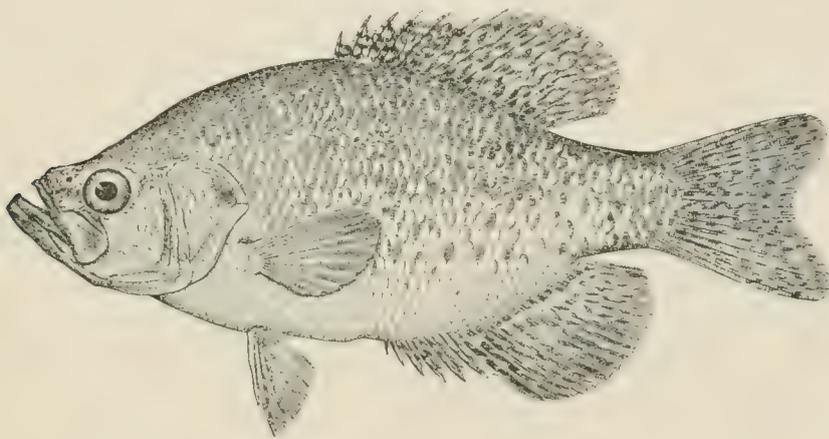
Color clear silvery olive, the sides mottled with dark greenish blotches. On the upper part of the body are traces of narrow vertical bars. The dorsal and caudal are mottled, but the anal is usually uniform pale.

Among the many names which have been applied to the Crappie are: Bachelor, Newlight, Campbellite, *Sac-a-lait*, Bridge Perch, Strawberry Perch, Chinquapin Perch, Speckled Perch, Tin Perch, Goggle-eye, John Demon, Shad, White Croppie and Timber Croppie.

In the lower Mississippi Valley the Crappie is one of the most common fishes. It is abundant also in the Ohio Valley and occurs rarely in Lake Eric. The Ohio, Illinois and Mississippi Rivers are particularly noted for an abundance of Crappies, and the fish is very plentiful in Lake Pontchartrain, La., where it is one of the most highly prized of the smaller game fishes.

Dr. Meek did not obtain the Crappie in the Cayuga Lake basin, but says it may be found in the canal near Montezuma, where the Calico Bass is said to be frequently taken.

The Crappie is a very general favorite for pond culture, can be readily transported and under favorable conditions multiplies prodigiously. Its range has been very much extended by artificial means. The best distinguishing marks between



CRAPPIE.

the Crappie and the Calico Bass are the more elongated form of the Crappie, the presence of six spines in the dorsal and the nearly uniform whitish color of the anal. In the Crappie the greatest depth of the body is usually contained two and one-half times in the total length without the tail, while in the Calico Bass the depth equals one-half the length. These two species are so similar in size and habits that they are rarely distinguished except by ichthyologists.

The Crappie grows to a length of about 1 foot and usually weighs 1 pound or less, but in a lake near St. Louis an individual weighing 3 pounds has been recorded.

Crappie fishing usually begins in June and lasts till the coming of cold weather. Large numbers of these fish are collected near Quincy, Ill., for distribution to other waters. At Peoria, Ill., Prof. Forbes has taken them in March and April; he has found them also in Pistakee Lake and at Ottawa. Cedar Lake, Ind., and King's Lake, Mo., are celebrated Crappie waters. Near Covington, Ky., in private ponds

belonging to Joseph Schlosser, there are myriads of Crappies as well as other game fishes.

Prof. S. A. Forbes has studied the feeding habits of the Crappie, and finds that the young live chiefly on entomostraca and small insect larvæ. The adults subsist on the same food when obtainable, but in times of scarcity they feed to some extent on other fishes. Small Minnows and Darters have been found in their stomachs. In the autumn Prof. Forbes has found a larger percentage of small fishes, sometimes constituting nearly two-fifths of their food. The Hellgramite is eaten by the Crappie. In cold weather it does not consume one-fourth the amount of food which it takes in the early spring. The Crappie prefers still waters, thriving even in warm and muddy water, and has been taken in large numbers in midsummer at depths of only a few feet; in cold weather it retires to deeper water, becomes rather sluggish and takes little food. Dr. Henshall states that the Crappie is found about dams and in deep, still parts of streams and ponds, especially about logs, brush and drift.

The Crappie is a very free biter and can be caught readily with Minnows or worms. Spoon bait has been successfully used in trolling for this species. It is recorded that two men have taken a thousand Crappies in three days' fishing with hook and line. As the fish is gregarious, congregating in large schools, and fearless, it can be taken in the immense numbers given. The best bait for Crappie is a small Shiner. It rises well also to the artificial fly. As a food fish this is one of the best in our inland waters, and its adaptability for life in artificial ponds should make it a favorite with fish culturists.

**98. Calico Bass; Strawberry Bass** (*Pomoxis sparoides* Lacépède).

*Pomoxys sparoides* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 465, 1883; BEAN, Fishes Penna., 102, color pl. 9, 1893.

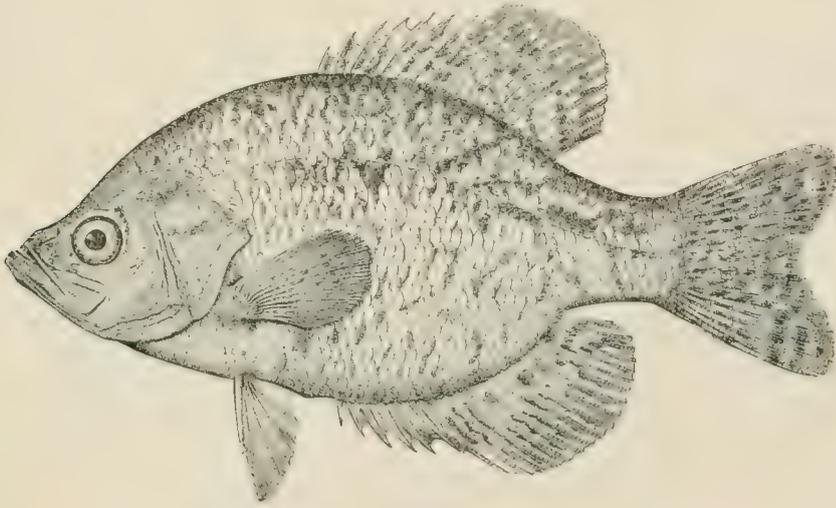
*Pomoxis sparoides* MEEK, Ann. N. Y. Ac. Sci., IV, 312, 1888; BOLLMAN, Rept. U. S. F. C., XVI, 559, pl. 68, fig. 2, 1892; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 987, 1896, pl. CLIV, fig. 416, 1900.

The sides are olivaceous with silvery reflections and mottled with pale green. The dorsal, anal and caudal show pale spots surrounded by green reticulations.

The Calico Bass, on account of its wide distribution and variability, has received a profusion of names. Many of these are variations of the term bass. It is known, for example, as Strawberry Bass, Grass Bass, Lake Bass, Lake Erie Bass, Bank Lake Bass, Silver Bass, and Big-fin Bass. Other names for the species are Strawberry Perch, Chinquapin Perch, Goggle-eye Perch, Silver Perch and Sand

Perch. Still other names of local application are Barfish, Bitter Head, Tin Mouth, *Sac-a-lait*, Lamp-lighter, Razor Back, Goggle-eye, Black Croppie and Lake Croppie. The species is mentioned in the fish laws of Pennsylvania under the name of Lake Erie Bass or Grass Bass.

The distribution of the Calico Bass is naturally extensive, and it has been still farther increased by artificial introduction. The fish has been carried to France, and examples measuring about 8 inches in length were recorded there several years ago. There is, however, some confusion in that country between the Calico Bass and the Common Sunfish, and there is no doubt that some of the latter species have been introduced into Germany under the mistaken belief that they were Calico Bass.



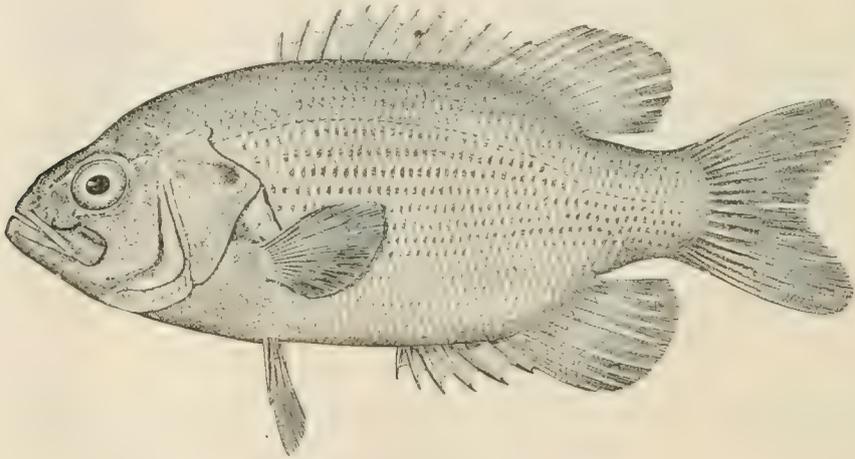
CALICO BASS.

This Bass is indigenous east of the Alleghanias from New Jersey southward to Georgia. It abounds in the Great Lakes region, Mississippi Valley south to Louisiana, most common northward, and occurs in the Missouri. In the Ohio Valley it was rather uncommon till its introduction in large numbers. It was introduced into the Susquehanna River by the Pennsylvania Fish Commission, and has become acclimatized there; also into the Monongahela, the Lehigh, and other waters.

Fishermen of the region about Montezuma informed Dr. Meek that the fish is frequently taken from the canal near that place, where it is known as Calico Bass. The U. S. Fish Commission obtained two examples in Long Pond, at Charlotte, N. Y., August 17, 1894.

This bass grows to a length of about 1 foot and a maximum weight of nearly 3 pounds, but the average weight is about 1 pound. It spawns in the spring, and the close season in some States extends to June 1. Gravid females were caught near

Havre de Grace, Md., in May. These were taken in the Susquehanna and Tidewater Canal, where the species is becoming rather abundant. The food of the Calico Bass consists of worms, small crustaceans and fishes. Though a native of deep, sluggish waters of western rivers and lakes, it readily adapts itself to cold, rapid streams and thrives even in small brooks. The species is suitable also for pond life and may be kept in small areas of water provided they have sufficient depth. It does not prey on other fishes, and its numerous stiff spines protect it from larger predaceous species. It swims in large schools and is often found in comparatively shoal water. The nest-building habits have been described by Duclos from observations made at Versailles, France. This writer unfortunately had under observation both the Calico Bass and the Common Sunfish, and his statements need confirmation. The game qualities of this bass are noteworthy. It is a free, vigorous biter; its endurance is rather remarkable considering its size. As a food fish the species is highly prized, and its increase in eastern rivers is greatly to be desired.



ROCK BASS.

99. Rock Bass; Red-eye (*Ambloplites rupestris* Rafinesque).

*Centrarchus aeneus* DEKAY, N. Y. Fauna, Fishes, 27, pl. 2, fig. 4, 1842, Lake Champlain; Great Lakes; streams of Western New York; Hudson River.

*Ambloplites rupestris* BEAN, Fishes Penna., 105, color pl. 10, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 990, 1896, pl. CLVI, figs. 419, A, B, C; MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. for 1897, 33, 1898; MEARN, Bull. Am. Mus. Nat. Hist., X, 319, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 104, 1900.

Color olive green with a brassy tinge and much dark mottling; the young are pale or yellowish, irregularly barred and blotched with black; adults with a dark

spot at the base of each scale, the spots forming interrupted black stripes; a dark spot on the opercle; soft dorsal, anal, and caudal fins with dark mottlings; iris golden overlaid with crimson.

The Rock Bass is known under a variety of names. Among them are the following: Red-eye, Red-eyed Perch, Goggle-eye and Lake Bass. It is found in Lower Canada, Vermont and throughout the Great Lakes region, West Manitoba, and it is native in Minnesota and Dakota; southward it ranges through the Mississippi Valley to Texas. In the Ohio Valley it is very common, while in the Middle Atlantic States, east of the Alleghanies, it has probably been introduced. Its existence in the Susquehanna has been known for many years. Whether it is indigenous in Pennsylvania waters is uncertain. It has been introduced into some parts of Virginia, while in other portions of that State it is native. It is indigenous in North Carolina. Its distribution in Pennsylvania has been greatly extended by artificial introduction, and it is now well established in the Delaware, especially in its upper waters. DeKay records it from Lake Champlain, the Great Lakes and the larger streams in the western counties of New York. Meek says it is a very common and well-known species in the Cayuga Lake basin. In the Passaic River and other waters it is an introduced species. Evermann and Bean obtained a specimen in Scioto Creek, Coopersville, N. Y., July 19, 1894. In the Lake Ontario region the U. S. Fish Commission collectors secured it at many localities in New York State in 1894 and previous years. The species is found in Chautauqua Lake.

Under circumstances favorable as to water and food supply the Rock Bass grows to a length of 14 inches and a weight of 2 pounds. It increases in depth and thickness with age. The largest example we have examined is one of 2 pounds weight, length 14 inches, from the James River, Va., taken near Richmond. Dr. William Overton reports that Rock Bass weighing  $3\frac{3}{4}$  pounds have been taken in his vicinity at Stony Creek, Va.

In February and March this fish frequents the mouths of small streams, and in summer it seeks shady places under high banks or projecting rocks. The species is gregarious, going in large schools. It thrives where there is not much current and is very well adapted for culture in artificial ponds. It is as common in lakes and ponds as in the streams. Sluggish, pure dark water suits it best.

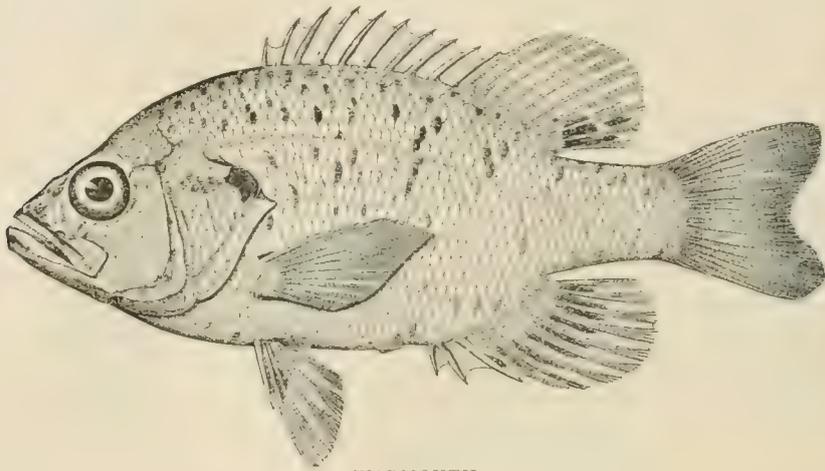
The fishing season begins in June and lasts till the approach of cold weather. The Rock Bass feeds on worms, crustaceans and larvæ of insects early in the season; later its food consists of Minnows and Crawfish. The young feed on insects and their larvæ. The spawning season is May and June, and gravelly shoals are resorted to for depositing the eggs.

The Rock Bass bites very freely and is a fair game fish and excellent for the table. It fights vigorously, but its endurance is not great. Suitable baits are white grubs, crickets, grasshoppers, Crawfish and small Minnows. Common earthworms are also successfully used.

**100. Warmouth ; Goggle-eye** (*Chanobryttus gulosus* Cuv. & Val.).

*Chanobryttus gulosus* JORDAN & GILBERT, Syn. Fish. N. A., 468, 1883; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 992, 1896, pl. CLVII, fig. 421, 1900.

The Warmouth inhabits the eastern United States from the Great Lakes to South Carolina and Texas, ranging west to Kansas and Iowa. It occurs chiefly west or south of the Alleghanies. The fish reaches a length of 10 inches and is a



WARMOUTH.

food species of some importance. It is extremely voracious and, consequently, a favorite for angling. In form and color it varies greatly.

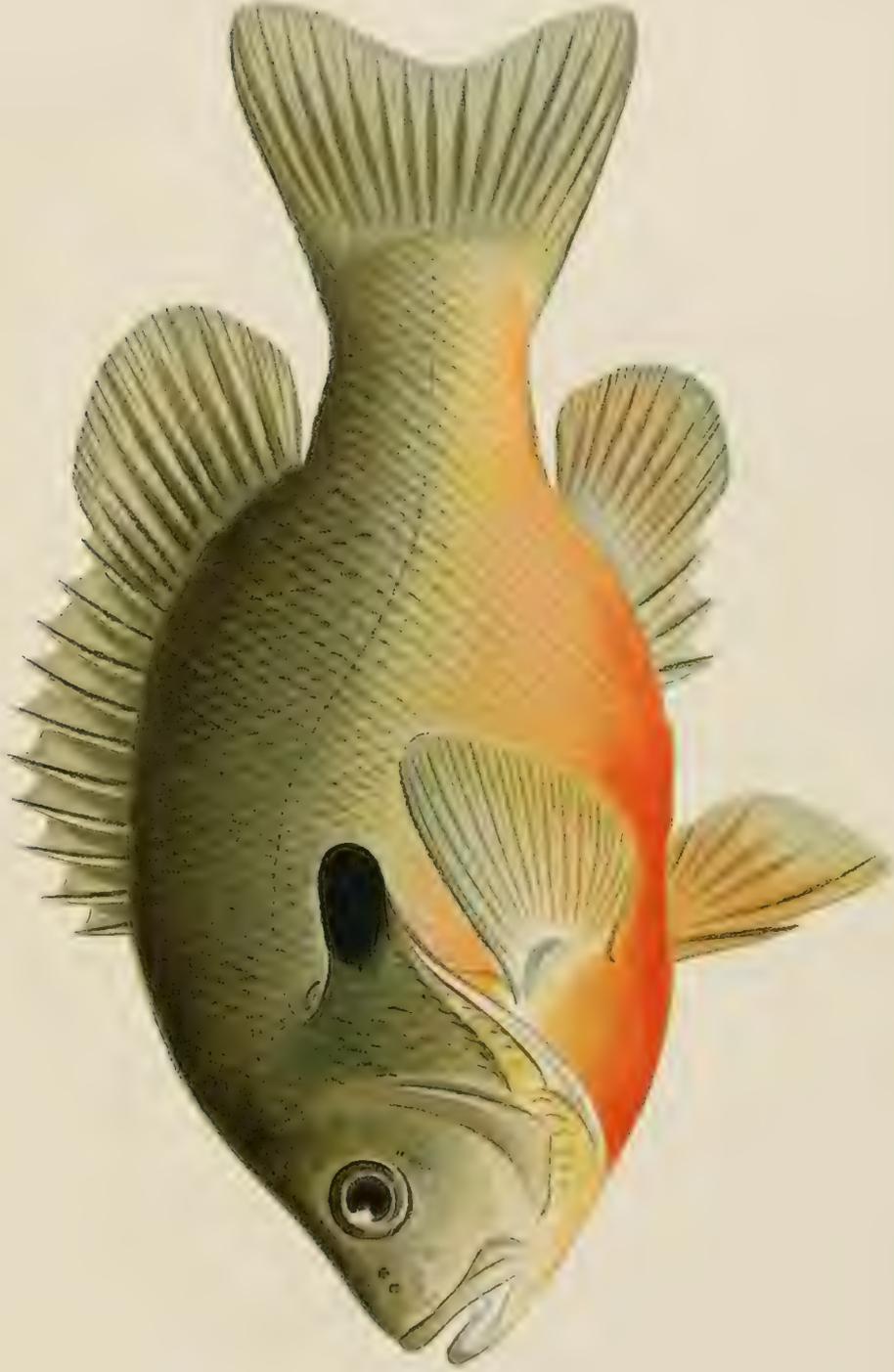
Color in life clear olive green, clouded with darker, usually without red or blue; a dusky spot on each scale more or less distinct; vertical fins mottled with dusky; a faint spot on last rays of dorsal bordered by paler; three oblique dusky bars radiating from eye; belly yellowish.

**101. Green Sunfish ; Red-eye** (*Apomotis cyanellus* Rafinesque).

*Lepomis cyanellus* BEAN, Fishes Penna., 110, pl. 31, fig. 61, 1893; MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888.

*Apomotis cyanellus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 996, 1896.

The Blue-spotted Sunfish, also known as the Green Sunfish and Red-eye, extends from the Great Lakes region, throughout the Ohio and Mississippi Valleys south to



LONG EARED SUNFISH ( LEPOMIS AURITUS )



Mexico. It does not occur in the Middle Atlantic States east of the Alleghanies. Dr. Meek did not find this fish near Ithaca. A few specimens were taken near Montezuma, N. Y. None of the collectors of the U. S. Fish Commission obtained it in the Lake Ontario region.

In spirits the color is pale brown, the fins paler. The opercular flap has a dark spot as described above. In life there is generally a black blotch on the hinder part of the dorsal and anal; the ground color is greenish with a brassy tinge on the sides, the lower parts yellowish; blue spots and gilt borders usually ornament the scales, and faint dark bands are often present. The dorsal, anal and caudal have blue or green markings, and the anal is margined in front with orange. The iris is red and the cheeks are striped with blue.

The species reaches a length of 7 inches, and is an extremely variable one. Prof. Cope refers to it as a good pan fish and states that it is abundant in the Ohio basin. In the Ohio Valley it is one of the characteristic fishes, inhabiting ponds and ascending small streams. It frequents deep holes and the shelter of overhanging roots.

#### 102. Long-eared Sunfish (*Lepomis auritus* Linnæus).

*Labrus appendix* MITCHILL, Am. Month. Mag., II, 247, February, 1818.

*Pomotis appendix* DEKAY, N. Y. Fauna, Fishes, 32, 1842, from MITCHILL; STORER, Hist. Fish. Mass., 14, pl. III, fig. 4, 1867.

*Lepomis auritus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 477, 1883; BEAN, Fishes Penna., 113, pl. 31, fig. 63, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1001, 1896, pl. CLXIX, figs. 425, 425a, 1900; MEARN'S, Bull. Am. Mus. Nat. Hist., X, 319, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 34, 1898.

The Long-eared Sunfish has a very extensive range and is known under many common names, among which are the following: Bream, Red-tailed Bream, Redhead Bream, Red-bellied Bream, Perch, Sun Perch, Red bellied Perch and Redbreast.

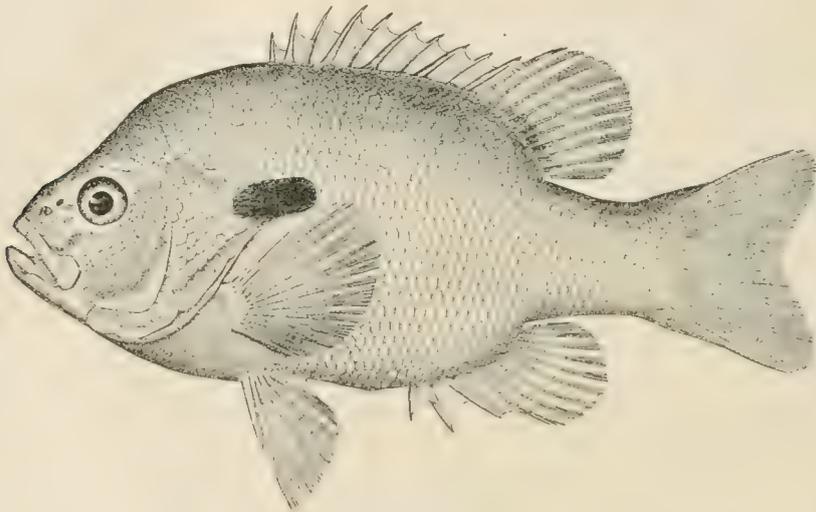
The species is common in streams east of the Alleghanies from Maine to Florida, and in tributaries of the Gulf of Mexico to Louisiana. In the Southern States the typical Long-eared Sunfish is replaced by a variety with larger scales on the cheeks and belly and a dusky blotch on the posterior part of the soft dorsal fin.

Mearns found this Sunfish abundant in the Hudson and in Poplopen's Creek, a tributary of the Hudson; he took it also in Highland Lake. Eugene Smith reported it to be very common in the upper Passaic River, in the Great Swamp and in the Bronx River.

In spirits the color is pale brown; the fins somewhat paler; the ear flap black; a brownish streak in front of the eye and another horizontal one beneath it. In life

the color is olivaceous; the belly, especially in breeding males, orange. The scales on the sides have reddish spots on a bluish ground. Dorsal, anal and caudal usually yellowish. The stripes on the head are bluish.

The Long-eared Sunfish averages about 8 inches when adult and weighs about 1 pound. In the south the size and number of individuals are greatly increased. This fish feeds on worms, insect larvæ, crustaceans, mollusks and small fishes. In the Susquehanna this is one of the most common of the Sunfishes; in the Delaware also it is abundant, and reaches a large size. Though not important commercially, it is taken in large numbers on the hook and is an excellent food fish. It takes any kind



LONG-EARED SUNFISH.

of live bait very readily and furnishes good sport also with the artificial fly. In the Hudson Highlands region, according to Mearns, it is commonly sold in the markets; fishermen take it in fykes, and by angling, using dough, grasshoppers and angle-worms for bait. He has caught it in the most rapid parts of Poplopen's Creek when angling for Brook Trout.

**103. Blue-gill; Blue Sunfish (*Lepomis pallidus* Mitchill).**

*Labrus pallidus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 407, 1815, near New York.

*Pomotis incisor* CUVIER & VALENCIENNES, Hist. Nat. Poiss., VII, 466, 1831, New Orleans;  
DEKAY, N. Y. Fauna, Fishes, 33, 1842 (extra limital).

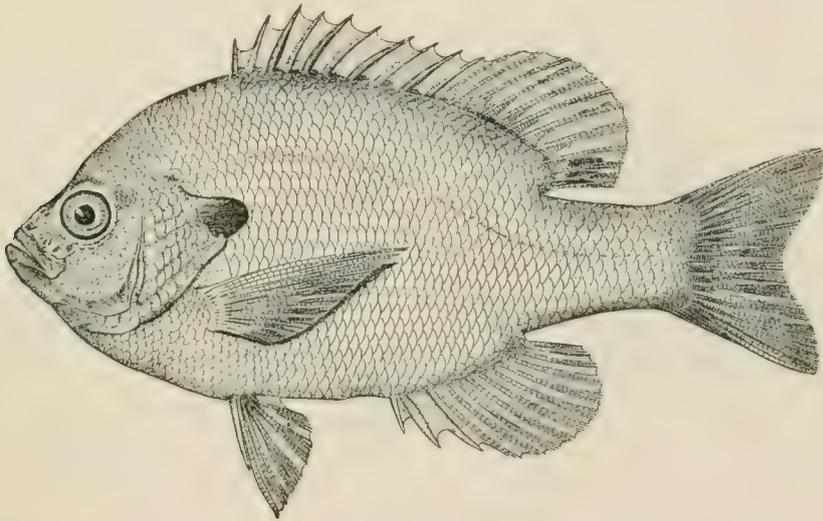
*Lepomis pallidus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 479, 1883; MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888; BEAN, Fishes Penna., 112, pl. 31, fig. 62, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1005, 1896, pl. CLX, fig. 427, 1900.

The propriety of using Mitchill's name *pallidus* for the Blue Sunfish is extremely doubtful. His description can be much more readily referred to a species of

*Enneacanthus*, and the locality "near New York" does not possess this Sunfish among its native species.

The Blue Sunfish, Blue Bream, Copper-nosed Bream or Dollardee is a very widely diffused species and varies greatly in size, color and length of the ear-flap. It is found in the Great Lakes and throughout the Mississippi Valley to Mexico. East of the Alleghanies it ranges from New Jersey to Florida. In Pennsylvania it is abundant only in the western part of the State, including Lake Erie. Dr. Abbott has recorded it from the Delaware River. Dr. Meek says that it is found in the Cayuga Lake basin in small numbers with the Blue Spotted Sunfish, *Apomotis cyanellus*, which he took near Montezuma. It is recorded also from Chautauqua Lake by Dr. Evermann.

The Blue Sunfish grows to a length of nearly 1 foot, and individuals weighing nearly 2 pounds are on record. Adults, however, average 8 inches in length, with a



BLUE-GILL.

weight of less than 1 pound. The size of the individuals depends on the habitat. In large lakes and streams it grows to a greater size than in small bodies of water. In southern waters it attains to a larger size than in northern waters. It lives in ponds as well as in streams and thrives in warm waters. It is considered equal to the Rock Bass as a pan fish and can very readily be taken by hook fishing.

In spirits the color is pale brown, the scales with a pale margin; a dark blotch on the hind part of the soft dorsal; a black opercular flap, its width and length about equal, shorter than the eye. The living fish varies with age from light green to dark green. The young have the sides silvery, tinged with purple and

with many vertical greenish bands, which are sometimes chain-like. The dark blotch of the soft dorsal is often indistinct in the young. In very old individuals the belly is often coppery red.

104. Sunfish; Pumpkin Seed (*Eupomotis gibbosus* Linnæus).

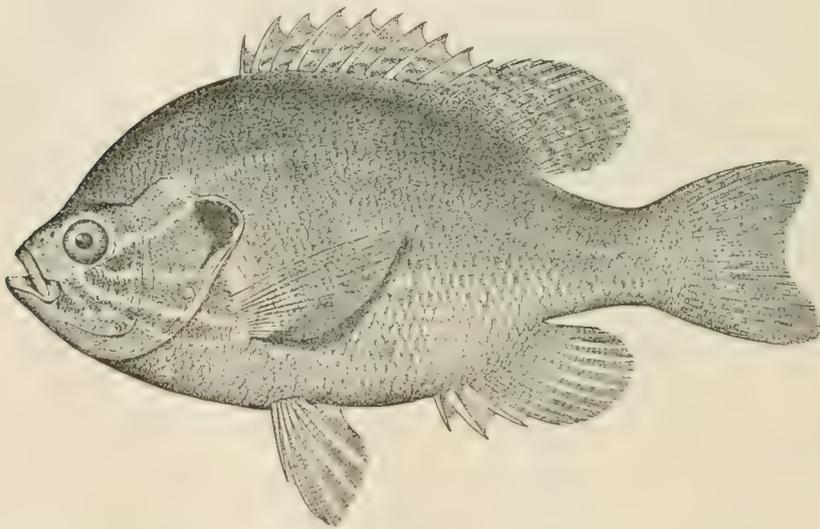
*Morone maculata* MITCHILL, Report in Part, 19, 1814.

*Pomotis vulgaris* DEKAY, N. Y. Fauna, Fishes, 31, pl. 51, 166, 1842.

*Lepomis gibbosus* MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888; BEAN, Fishes Penna., 115, pl. 32, fig. 65, 1893.

*Eupomotis aureus* MATHER, App. 12th Rept. Adirondack Surv. N. Y., 7, 1886.

*Eupomotis gibbosus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1009, 1896, pl. CLXI, fig. 429, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 364, 1897; MEARNs, Bull. Am. Mus. Nat. Hist., X, 320, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 35, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 104, 1900.



SUNFISH.

The Common Sunfish, or Sunny, Pumpkin Seed, Bream, Tobacco Box, and Pond Fish is one of the best known fishes of the United States.

It is found from Maine westward through the Great Lakes region to Minnesota and in the Eastern States south to South Carolina. In western rivers, however, it is seldom found south of the latitude of Chicago. In New York the Sunfish abounds almost everywhere, in the lowlands as well as the highlands and in brackish as well as fresh waters; it has even been taken occasionally in salt water on Long Island. Large individuals have been received from Canandaigua Lake and from lakes in the Adirondacks. Dr. Meek found it very common throughout the Cayuga Lake basin.

The collectors of the U. S. Fish Commission obtained it in almost all the waters visited by them (21 localities) in the Lake Ontario region. Dr. Evermann has recorded it from Chautauqua Lake. It occurs in Lake Champlain and in the basin of the St. Lawrence. Eugene Smith reports it from most of the moraine ponds of Long Island and Staten Island, and in quarry ponds of the Palisades, wherein it is frequently placed by boys. Ponds and lakes in the parks of New York City are well stocked with this species. Mearns reported it as abundant in the Hudson and in all the ponds and slow streams of the Hudson Highlands. Mather recorded it as a common fish in most of the Adirondack waters, the exceptions being Piseco Lake, G Lake, Coald Lake, Seats' Lake, T Lake, Willis Pond, Murphy, Warner and Bug Lakes.

In spirits the color is pale brownish, the opercular flap black with a narrow whitish margin behind and beneath, and the dorsal fin with faint dusky blotches. In life this is one of the most brilliant of Sunfishes, the upper parts being greenish olive with a bluish tinge, the sides profusely spotted with orange, the belly and lower fins orange and the dorsal and caudal fins bluish with orange spots. The cheeks are orange with undulating blue stripes; the opercular flap is black emarginated behind and underneath with bright scarlet.

The Common Sunfish grows to a length of 8 inches and a weight of about  $\frac{1}{2}$  pound. Its food is similar to that of the Long-eared Sunfish; and it is one of the readiest biters known to the angler. The habits of this fish have been described by Dr. Theodore Gill and W. P. Seal. The latter states that the male in the breeding season is readily identified by his brighter coloration, conspicuous ear flaps and a luminous border around the fins while in the water. The nest is a depression in the mud, sand or gravel, hollowed out by means of the fins. In the Potomac he found a number of nests which were located from a few inches to several feet apart. The male watches the nest and drives away all intruders. The eggs are only about  $\frac{1}{32}$  of an inch in diameter and not very numerous. They are attached to stones and aquatic plants. Mr. Seal has reason to believe that the male alone is concerned in building the nest and in the care of the eggs and young.

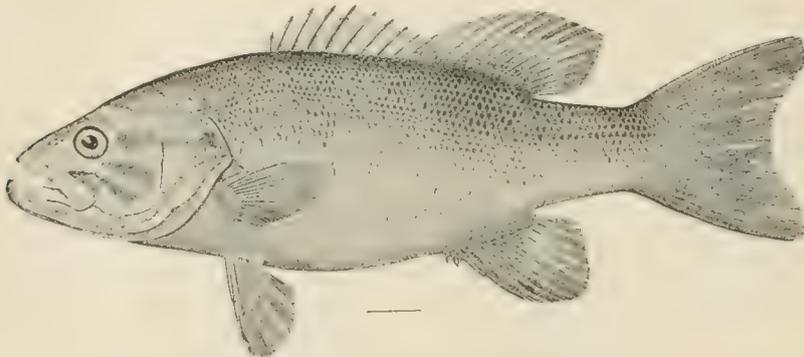
The species is usually hardy in captivity, but is subject to fungus attacks which yield readily to treatment with brackish water. In the aquarium, according to Eugene Smith, the Common Sunfish by incessant attacks often kills associates of many kinds. It is a very gamy fish, common everywhere and is usually found in the company of Shiners, Minnows and Killies. In quarry ponds, of the Palisades, says the same author, the fish will thrive and multiply as freely as the Goldfish, provided there is water enough throughout the year.

**105. Small-mouthed Black Bass** (*Micropterus dolomieu* Lacépède).

*Micropterus dolomieu* MATHER, App. 12th Rept. Adirondack Surv. N. Y., 5, 1886; MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888; BEAN, Fishes Penna., 116, color pl. 11, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1011, 1896, pl. CLXII, figs. 430, 430a, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 364, 1897; MEARNS, id., X, 320, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 35, 1898.

*Centrarchus obscurus* DEKAY, N. Y. Fauna, Fishes, 30, pl. 17, fig. 48, 1842, Onondaga Creek, N. Y.

One of the early names for the Small-mouthed Black Bass is that of Growler, which appears in the writings of Cuvier, who was under the impression that the name was applied because of a noise sometimes produced by this bass. At the time of his writing the name Growler was pretty generally identified with the Black Bass. Among the names applied to this fish by Rafinesque are Lake Bass, Big Bass,



SMALL-MOUTHED BLACK BASS.

Spotted Bass, and Achigan. He also mentions it under the names Painted Tail, Bridge Perch, Yellow Bass, Gold Bass, Brown Bass, Dark Bass, Minny Bass, Little Bass, Hog Bass, Yellow Perch, Black Perch, Trout Perch, Black Pearch, Streaked Head, White Trout and Brown Trout. In the Southern States the Small Mouth is known as the Trout, Perch and Jumper. In Alabama it is called Mountain Trout. Some persons style it the Bronze Backer. The most appropriate name and the one by which it is best known is that of Black Bass or Small-mouthed Black Bass.

This species is indigenous to the upper parts of the St. Lawrence basin, the Great Lakes region and the basin of the Mississippi. East of the Alleghanies it is native to the headwaters of the Ocmulgee and Chattahoochee Rivers, but north of these streams, though not originally an inhabitant of the waters, it has been widely distributed by artificial introduction.

In the St. Lawrence River Evermann and Bean obtained the fish 3 miles below

Ogdensburg, N. Y., July 17, 1894, evidently the young of the year, as the specimen is  $1\frac{3}{4}$  inches long. In Scioto Creek at Coopersville, N. Y., they secured an example  $1\frac{5}{8}$  inches long July 19, 1894. Field assistants of the U. S. Fish Commission, collecting in the Lake Ontario region of New York in 1894 and preceding years, took specimens in many localities.

The species is abundant in Lake Champlain and the St. Lawrence River basin; it is found also in Chautauqua Lake.

Meek did not find this species in the vicinity of Ithaca; near Cayuga and Montezuma it is less common than the Large-mouthed Black Bass. Mather reported the species in Racquette, Forked, White, Fourth, Bisby and Sucker Lakes, Black and Moose Rivers, and in Partlo Pond, St. Lawrence County, in all of which it has been introduced. The fish is not uncommon in Lake Champlain; it is abundant in the vicinity of Caledonia, N. Y. Eugene Smith records it from the Passaic River. The writer has found it abundant in the Bronx. Mearns mentions it from Long Pond, in the Hudson Highlands, where it reaches the weight of 5 or 6 pounds.

This Bass does not grow so large as the Large-mouthed, seldom exceeding 8 pounds in weight and averaging but  $2\frac{1}{2}$  pounds. A fish of the latter weight will measure 15 inches in length, while one of 8 pounds will measure 2 feet.

The Small-mouthed Bass differs most markedly from the Large-mouthed in the size of its jaws, the shallower notch in the dorsal fin and the smaller scales. There are about 11 rows of scales above the lateral line and 7 below it; 72-74 scales in the lateral line.

The young are dull yellowish green, the sides mottled with darker spots, which sometimes form short vertical bars. Three dark stripes on the head; caudal yellowish at the base; a broad black band near middle of tail and a broad whitish margin behind. The dark lateral band characteristic of the Large-mouthed species is not found in the Small-mouth. In the adult the prevailing color is olive green, the stripes on the head remaining more or less distinct.

The food of the Black Bass consists of Crawfish, frogs, insects and their larvæ, Minnows, and other aquatic animals of suitable size. The young can be fed on small fresh-water crustaceans, such as *Daphnia* and *Cyclops*. Among the successful baits for this species are Stone Catfish, Hellgramites and crickets.

The Black Bass prefers rapid water, is extremely active, and frequents clear, pure, swiftly-flowing streams, and thrives at greater elevations than those preferred by the Large-mouthed species. It hibernates in the winter and spawns in the shallows on gravelly bottoms in spring. It follows its prey into shallow water and frequently leaps far out of the water in its efforts to escape from the hook or when frightened

by the sudden approach of an enemy. It swims in schools and is often found in the shelter of sunken logs and in the vicinity of large rocks.

The spawning season begins in March and ends in July. The period of incubation lasts from 7 to 14 days. The eggs are bound together in bands or ribbons by an adhesive substance. They adhere to stones on which they are deposited. The parent fish build nests and protect the eggs and young. In the Delaware the current is more rapid and the temperature lower than in the Susquehanna; hence the Bass spawn earlier in the latter than in the former. The spawning fish have nearly all left their spawning beds in the Susquehanna early in July, but at this time most of the nests in the Delaware are still full of eggs. By some writers it is believed that the female prepares the nest before the male joins her. The males fight for the possession of the female and are said to help the process of ejecting the eggs by biting or pressing the belly of the female. After the eggs are deposited, the female guards the nest from the attacks of the Crawfish and some other fishes. The young are consumed by many birds and by frogs and snakes. Yet, notwithstanding the numerous enemies of the Black Bass, its multiplication has been rapid and enormous.

The Small-mouthed Black Bass ceases to take food on the approach of cold weather and remains nearly dormant through the winter, except in artificially heated water. A number of the young of the year, received from James Annin, Jr., of Caledonia, N. Y., October 6, 1896, scarcely fed at all in the following winter, but when the spring was advanced they fed eagerly and grew rapidly.

**106. Large-mouthed Black Bass** (*Micropterus salmoides* Lacépède).

*Huro nigricans* DEKAY, N. Y. Fauna, Fishes, 15, pl. 69, fig. 224, 1842.

*Micropterus salmoides* MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888; BEAN, Fishes Penna., 118, pl. 32, fig. 66, 1893; Bull. Am. Mus. Nat. Hist., IX, 364, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 1012, 1896, pl. CLXIII, fig. 431, 1900; MEARNS, Bull. Am. Mus. Nat. Hist., X, 320, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 36, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 105, 1900.

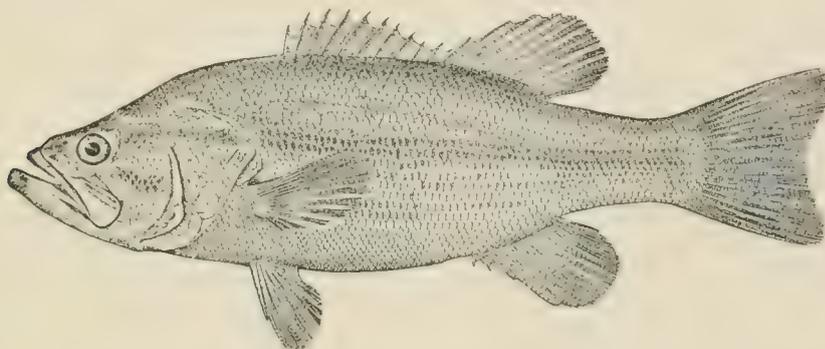
This species may best be distinguished from the Small-mouthed Black Bass by the size of its mouth and the number of rows of scales above the lateral line. The young of the Small-mouthed species, also, never have a dark, lateral band.

Common names for this species are: Oswego Bass, River Bass, Green Bass, Moss Bass, Bayou Bass, Trout, Jumper, Chub and Welshman. Throughout the north it is generally known as Bass, in Virginia and North Carolina as Chub and in Florida and west to Texas as Trout.

The Large-mouthed Bass has a wide distribution, being indigenous to the eastern United States, from Manitoba to Florida and Texas, except New England and the Middle Atlantic States east of the Alleghanies, where it has been extensively introduced. It inhabits the fresh-water ponds, lakes and sluggish streams. It is found also at the mouths of rivers emptying into the Gulf of Mexico, where the water is brackish.

Dr. Meek found the Large-mouthed species scarce near Ithaca and more common near Montezuma and Cayuga. James Annin, Jr., collected the young at Caledonia. The U. S. Fish Commission had it from numerous places in the Lake Ontario region.

Dr. Mearns first observed the species in the Hudson in the autumn of 1882, where the fish were caught in fyke nets during October and November. Eugene Smith records it from all lakes and rivers adjacent to New York City.



LARGE-MOUTHED BLACK BASS.

Young individuals, from  $1\frac{1}{2}$  to 2 inches long, were seined in Bronx River in August, 1897.

The average weight of the Large-mouthed Bass in southern waters is less than 5 pounds, and still less in northern waters. In Florida it attains a large size, as much as 3 feet in length, and a weight of 25 pounds. Its growth and size depend on the waters where it is found, and the natural food supply of small fish, Crawfish and frogs.

It is a very active fish; its movements are affected by seasonal changes and the search for food and places for spawning. In polluted streams the Bass are often compelled by the impurities to seek new haunts in pure water. The young Bass feed on animal food at an early age. The Large-mouthed Bass is said to be more cannibalistic than the Small-mouthed. Small fishes (Minnows) of all kinds, Crawfish, frogs, insects and their larvæ, and aquatic animals of all kinds, suitable in size, make up the diet of this fish. It feeds both at the surface and on the bottom, pursuing its prey with great activity. When surrounded by seines or caught on hooks this

species will often leap 5 or 6 feet out of the water, and its habit of jumping over the cork lines of seines has given it the name of "Jumper."

In cold weather the Bass seeks deep places, often hibernating under rocks, sunken logs and in the mud. Favorite localities are under overhanging and brush-covered banks, in the summer, and among aquatic plants, where the fish lies in wait for its prey.

The spawning season of the Large-mouthed Bass is about the same as that of the Small-mouthed species, beginning in April and lasting till July. Its eggs are adhesive, sticking to stones during the incubation period, which last from one to two weeks according to the temperature of the water. The young Bass remain in the nest a week or 10 days, and at the age of two weeks will measure about  $\frac{3}{4}$  of an inch in length. In suitable waters it is estimated that the Large-mouthed Bass will weigh at the age of three years from 2 pounds to 4 pounds.

The Oswego Bass is even more destructive to fish than *M. dolomieu*. It will eat any fish which it can manage to get into its mouth and will lie on the bottom for days so gorged that it cannot stir. In voracity it is only equaled, but hardly excelled by the Pike. This Bass bears captivity well. (After Eugene Smith.\*)

The young above referred to as coming from Caledonia, N. Y., hibernated and took scarcely any food during the winter, but fed ravenously in spring, summer, and fall. They proved very hardy in captivity.

**107. Pike Perch ; Pike ; Wall-eyed Pike** (*Stizostedion vitreum* Mitchill).

*Perca vitrea* MITCHILL, Am. Month. Mag., II, 247, Feb. 1818, Cayuga Lake, N. Y.

*Lucioperca americana* DEKAY, N. Y. Fauna, Fishes, 17, pl. 50, fig. 163, 1842.

*Lucioperca vitrea* EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 38, 1898.

*Stizostedion vitreum* MEEK, Ann. N. Y. Ac. Sci., IV, 314, 1888; BEAN, Fishes Penna., 127, color pl. 13, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1021, 1896, pl. CLXIV, fig. 433, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 364, 1897.

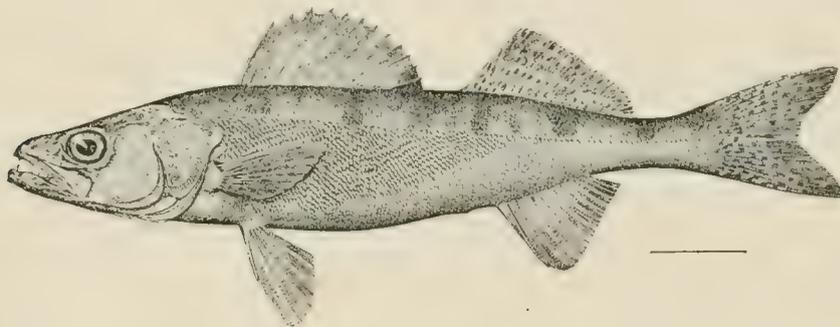
The Pike Perch belongs to the genus *Stizostedion*, which has been distinguished from the Saugers by the structure of its pyloric cæca, which are three in number, nearly equal in size, and about as long as the stomach, and also by the presence of 21 soft rays in the second dorsal, while the Saugers have 18. It may be remarked that all of these characters are more or less variable.

The Pike Perch has received a great many common names. One of the most unsuitable is "Susquehanna Salmon," which is used in Pennsylvania. In the Eastern

\* Proc. Linn. Soc. N. Y. No. 9, p. 36, 1897.

States the species is styled the Perch Pike or the Pike Perch, Glasseye and Wall-eyed Pike. In the Great Lakes region it is known as Blue Pike, Yellow Pike, Green Pike and Grass Pike. In the Ohio Valley and Western North Carolina it is the Jack; in Lake Erie and Canada, the Pickerel; in some parts of the Ohio Valley, the White Salmon or Jack Salmon. The Cree Indians call it the *okow* and the French Canadians *doré* or *picarel*. Among the fur traders of British America it is called the Hornfish.

The Pike Perch or Wall-eyed Pike inhabits the Great Lakes region and extends northward into British America, where it has been recorded as far as 58° north by Dr. Richardson. It ranges south in the Mississippi Valley to Arkansas, and in Atlantic streams to Georgia. According to Dr. Meek the species is found in Cayuga Lake, but is not common. In Lake Champlain it is one of the principal game fishes. James Annin, Jr., of Caledonia, obtained specimens in the Canandaigua Lake region. It has been introduced into numerous lakes by the Fisheries, Game and Forest Com-



PIKE PERCH.

mission of New York. The U. S. Fish Commission secured examples in the Oswego River at Oswego and at Point Breeze in August, 1894.

This species is said to reach a weight of 50 pounds, but the average weight of the market specimens is less than 5 pounds. In the Susquehanna it occasionally reaches 10 pounds or upward in weight. The Pike Perch feeds on the bottom on other fishes, and has been charged even with destroying its own young. It prefers clear and rapid waters, and lurks under submerged logs and rocks, from which it can readily dart on its prey. Spawning takes place in April and May, and in Pennsylvania continues till June. Favorite spawning localities are on sandy bars in shallow water. The period of hatching varies from about 14 to 30 days, depending on the temperature of the water. The eggs vary from about 17 to 25 to the inch, and a single female has been estimated to contain from 200,000 to 300,000. In a state of nature only a small percentage of the eggs are hatched out; the greater proportion

are driven on the lake shores by storms or devoured by fishes on the spawning beds. The number of Pike Perch annually hatched by artificial methods is enormous. This advance is due to improvements in the treatment of adhesive eggs. Formerly these were hatched by placing them on glass plates, to which they readily adhere. Recently it has been found that the sticky substance can be washed off the eggs, after which they are placed in jars and hatched like eggs of the Shad and Whitefish.

"Dexter," in *Forest and Stream*, August 14, 1890, makes the following statement about the habits of this species in the lakes. These fish run up the rivers before or as soon as the ice is out, and after spawning lie off the rivers' mouth feeding on and off the sand flats, as the spring rains bring down plenty of worms, and probably other matter which they feed on. As soon as the water gets warm, they sag off and work along the shores in 10 to 30 feet of water, preferring cobbly bottom; from here they go into very deep water, coming on the reefs to feed, and when the wind blows very hard, or for a day or so after a big blow, you will find them right on top of a reef. I think the wind changes the water over the reefs, making a new current and cooler water, so they come up to feed. They are a bottom fish, and to fish for them successfully one must go to the bottom for them. They are nearly as particular as Salmon Trout about the water they inhabit and consequently rank very high as a food fish, being white, solid and extremely free from bones.

Color olivaceous, mingled with brassy; sides of the head vermiculated; the dorsals, caudal and pectoral with bands; those of the dorsals and caudal not continuous; sides with about seven oblique dark bands, differing in direction; a jet black blotch on the membrane behind the last spine of the dorsal.

The colors of the Pike Perch change remarkably with age. The young have oblique dark bands much like those of the Kingfish of our east coast, and bear little resemblance in the pattern of coloration to the parent. The eye of the living fish is like a glowing emerald. The rate of growth must be rapid. In July, 1888, we took examples from 4 to 6 inches long, some of which seemed to be the young of the year.

This is one of the finest food and game fishes of the United States. Its flesh is firm and white, flaky and well flavored. Commercially the species ranks high in the Great Lakes region, being next in importance to the Whitefish. In angling for the Pike Perch live Minnows are used in preference to all other baits, particularly such as are more or less transparent and with silvery sides, as the Fallfish or Dace, the Corporal Roach, the Redfin and the Gudgeon. On some parts of the Susquehanna, between Columbia and Harrisburg, the favorite mode of capture is by trolling with the spoon with the same kind of tackle as is used for the Black Bass.

In November of 1896 and 1897, Mr. Annin shipped adult individuals from Canandaigua Lake by express without an attendant, and there was scarcely any loss of fish in transportation, though the journey lasts 12 hours.

The Blue Pike of Lake Erie, or White Salmon of the Ohio River, was formerly distinguished by name from the common Pike Perch, but is now considered unworthy of a separate name. This is a very small variety seldom exceeding 15 inches in length and a weight of 2 pounds. The dorsal has 14 spines and 20 rays. The spines are rather lower than in the Pike Perch, the coloration similar, but the adult is bluish or greenish and has no brassy mottling. The fins are darker, and there is a trace of a band along the dorsal, besides the black blotch on the hind portion.

Jordan & Evermann say of this variety: "The name *salmoncum* has been applied to the so-called 'Blue Pike' originally described from the Ohio River, but more common in the Great Lakes, particularly Ontario and Erie. It is smaller and deeper in body than the ordinary *vitreum* and different in color, but it is not likely that any permanent distinctions exist, this species, as usual among fresh-water fishes, varying largely with the environment and with age."

#### 108. Sauger; Sand-Pike (*Stizostedion canadense* Smith).

*Lucioperca canadensis* DEKAY, N. Y. Fauna, Fishes, 19, pl. 68, fig. 221, 1842 (extralimital).

*Stizostedion canadense* MEEK, ANN. N. Y. AC. SCI., IV, 314, 1888; BEAN, Fishes Penna., 130, pl. 34, fig. 70, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1022, 1896, pl. CLXIV, fig. 434, 1900.

Color olivaceous above; sides brassy or pale orange, mottled with black in the form of irregular dark blotches, which are best defined under the soft dorsal. The spinous dorsal has several rows of round black spots on the membrane between the spines; no black blotch on the hind part of the spinous dorsal. Pectorals with a large dark blotch at base; soft dorsal with several rows of dark spots irregularly placed; caudal yellowish with dark spots forming interrupted bars.

The Sauger is known also as Sand Pike, Gray Pike and Green Pike, Pickering, Pickerel and Horse Fish. It is found in the St. Lawrence River and Great Lakes region, the upper Mississippi and Missouri Rivers and in the Ohio, where it is said to have been introduced from the lakes through canals. This is a small fish, seldom exceeding 18 inches in length, and embraces several varieties. It is very common in the Great Lakes and is abundant in the Ohio River. It is doubtful whether it is native to Ohio or introduced. It is also found rarely in Cayuga Lake.

Rev. Zadock Thompson, in his *History of Vermont*, says it is much less common in Lake Champlain than the Pike Perch, but is frequently taken in company with it. It usually swims very near the bottom of the water, and hence it has received the name of Ground Pike (Pike Perch). As an article of food this species is locally held in the same high esteem as the common Pike Perch.

John W. Titcomb of St. Johnsbury, Vt., informed Evermann and Kendall that the Sauger, or Rock Pike, as it is locally called, is caught in seines while fishing for the Pike Perch. It does not grow as large as the latter, and is not much valued as a food fish. The authors mentioned received two examples of the fish from A. L. Collins, of Swanton, Vt., one of them a nearly ripe female  $14\frac{1}{2}$  inches long, weighing three-fourths of a pound, the other an unripe male 15 inches long, weighing three-fourths of a pound. These specimens were believed to indicate that the Sauger spawns earlier than the Pike Perch. The stomach of the male contained a three-inch Minnow, too badly digested for identification, and a number of small insects.

It is very extensively used for food, but is not generally considered equal to the Pike Perch.

**109. Gray Pike ; Sauger ; Sand Pike** (*Stizostedion canadense griseum* DeKay).

*Lucioperca grisea* DEKAY, N. Y. Fauna, Fishes, 19, 1842, Great Lakes; streams and inland lakes of Western New York.

*Stizostedion canadense griseum* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1022, 1896.

This is the common Sand Pike or Sauger of the Great Lakes region and southwestward. It differs from the typical *canadense* chiefly in the smoother opercles and head bones, the fewer opercular spines, and the less complete scaling of the head. The two need fuller comparison and may prove to be distinct species, but this is unlikely. Length, 10 to 18 inches.

**110. Yellow Perch; Ring Perch** (*Perca flavescens* Mitchill).

*Morone flavescens* MITCHILL, Report in Part, 18, 1814.

*Bodianus flavescens* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 421, 1815.

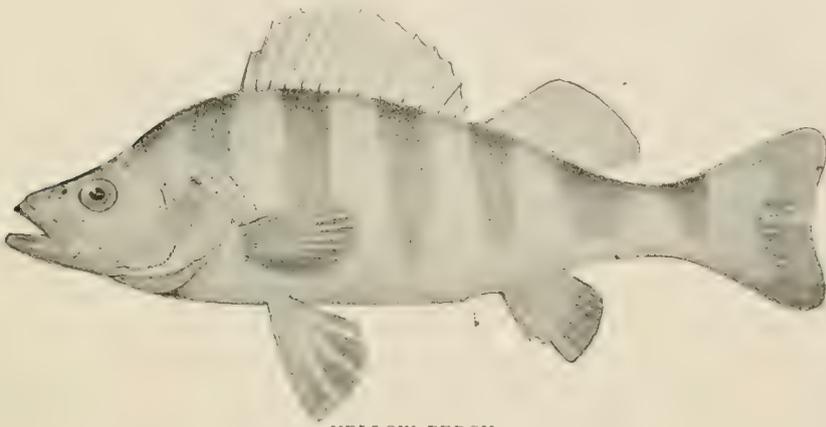
*Perca serrato-granulata* DEKAY, N. Y. Fauna, Fishes, 5, pl. 22, fig. 64, 1842.

*Perca granulata* DEKAY, op. cit. 5, pl. 68, fig. 220, 1842.

*Perca acuta* DEKAY, op. cit. 6, pl. 68, fig. 222, 1842.

*Perca gracilis* DEKAY, op. cit. 6, 1842.

*Perca flavescens* DEKAY, op. cit. 3, pl. 1, fig. 1, 1842; MEEK, Ann. N. Y. Ac. Sci., IV, 314, 1888; BEAN, Fishes Penna., 126, color pl. 12, 1893; EVERMANN & KENDALL, Rept. U. S. F. C. for 1894, 602, 1896; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1023, 1896, pl. CLXV, fig. 435, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 365, 1897; MEARN'S, Bull. Am. Mus. Nat. Hist., X, 320, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 37, 1898.



YELLOW PERCH.

The Yellow Perch, Ringed Perch, or Striped Perch is found throughout the Great Lakes region, rivers and ponds of New England and northwestward, and in streams east of the Alleghanies south to Georgia. It does not occur in the Ohio Valley or southwest, though, after the construction of the Ohio Canal, Kirtland recorded it from the Ohio River. In 1790 Dr. Mitchill transferred some of them from Ronkonkoma to Success Pond, a distance of 40 miles, where they soon multiplied. In 1825 Yellow Perch were transported from Skaneateles to Otisco Lake and Onondaga Lake; in the latter they increased remarkably. In Otsego Lake DeKay caught some weighing nearly 3 pounds. Meek states that the species is common throughout the Cayuga Lake basin. Evermann and Bean took it in the St. Lawrence River, 3 miles below Ogdensburg; also in Scioto Creek, Coopersville, N. Y., July 19, 1894, young specimens  $1\frac{1}{2}$  to  $1\frac{3}{4}$  inches long.

The Yellow Perch is one of the most abundant fishes of Lake Champlain and in the mouths of rivers falling into that lake.

The fish abounds in the parks of New York and Brooklyn. In the Hudson Highlands Dr. Mearns reported it as abundant in the Hudson as well as in all of the larger mountain lakes and ponds. It habitually frequents Poplopen's Creek from its source to its mouth. In the Hudson, he was informed, it is unusual to take specimens weighing more than 1 pound; but in Poplopen's Pond he has taken a number that weighed about 2 pounds each. In the same pond Jerome Denna caught two which weighed  $2\frac{1}{2}$  to 3 pounds each; and a fisherman named Samuel Runnels assured Dr. Mearns that he had taken a Yellow Perch there which weighed  $4\frac{1}{4}$  pounds. The fish continue to feed in that region throughout the winter. Eugene Smith obtained the fish in Greenwood Lake, Orange County, and in Hackensack streams, in Rockland County.

The species reaches a length of 1 foot and weight of 2 pounds. It is one of the best known of our food fishes and has excellent game qualities. Its flesh, however, is rather soft and coarse and is far inferior to that of the Black Bass and other members of the Sunfish family. It is a voracious feeder, its food consisting of small fishes, crustaceans and other animal matter.

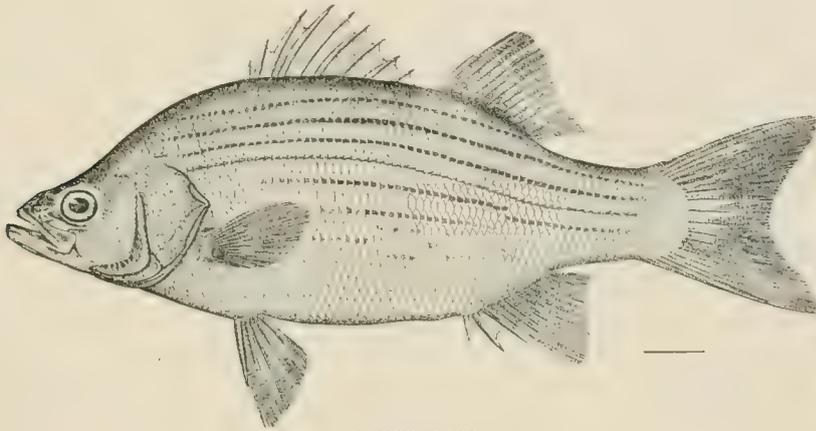
The Yellow Perch spawns early in the spring. The eggs are adhesive and enclosed in thin translucent strips of adhesive mucus. The spawning of this species was described by William P. Seal in *Forest and Stream* of April 17, 1890. The spawning season extends from December to April. Mr. Seal describes the egg mass as having the shape of a long tube, closed at the ends and arranged in folds like the bellows of an accordion. When folded the mass was about 8 to 12 inches long, but was capable of being drawn out to a length of 3 or 4 feet. Spawning in the aquarium took place at night and was observed by William Maynard, who describes it as follows: "The female remained quiet in one spot on the bottom of one of the hatching aquaria tanks, one or more of the males hovering over and about her with pectoral fins vibrating with intense activity. The males would at times lie close alongside of her and at other times endeavor to force themselves under her with the evident intention of assisting in the extrusion of the eggs." Mr. Seal remarks that "the roe when taken from the dead fish not yet ripe is in a single compact mass, covered by a thin membrane; but in spawning the mass separates, one side being spawned before the other." This was noticed in a specimen which had spawned one side and appeared to be unable to get rid of the other. It was stripped from her and artificially fertilized successfully. Mr. Seal believes that the Yellow Perch spawns at the age of one year.

The Yellow Perch thrives moderately in captivity, though susceptible to attacks of fungus, which are easily overcome by the use of brackish water.

**III. White Bass** (*Roccus chrysops* Rafinesque).

*Labrax albidus* DEKAY, N. Y. Fauna, Fishes, 13, pl. 51, fig. 165, 1842, Buffalo.  
*Roccus chrysops* BEAN, Fishes Penna., 132, pl. 34, fig. 71, 1893; Bull. Am. Mus. Nat. Hist., IX, 365, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1132, 1896, pl. CLXXX, fig. 477, 1900; EUGENE SMITH, Proc. Linn. Soc. N. Y., 1897, 38, 1898.

General color silvery, tinged with golden on sides; eight or more blackish longitudinal streaks on sides, those below more or less interrupted.



WHITE BASS.

The following measurements were taken from a specimen obtained by Mr. James Annin, Jr., in Oncida Lake, September 4, 1896:

	INCHES.
Extreme length, - - - - -	12 <sup>1</sup> / <sub>4</sub>
Length to end of middle caudal rays, - - - - -	11 <sup>1</sup> / <sub>2</sub>
Length to end of scales, - - - - -	10
Depth of body, - - - - -	4
Least depth of caudal peduncle, - - - - -	1 <sup>3</sup> / <sub>8</sub>
Length of head, - - - - -	3
Length of snout, - - - - -	5 <sup>5</sup> / <sub>8</sub>
Diameter of eye, - - - - -	9 <sup>9</sup> / <sub>16</sub>
Length of fourth dorsal spine, - - - - -	1 <sup>3</sup> / <sub>8</sub>
Length of second dorsal ray, - - - - -	1 <sup>3</sup> / <sub>4</sub>
Length of second anal ray, - - - - -	1 <sup>3</sup> / <sub>4</sub>
Weight, 16 <sup>1</sup> / <sub>2</sub> ounces.	

The White Bass is sometimes called Striped Bass, and is probably the Silver Bass of Canada. Its center of abundance is the Great Lakes region, but it is also widely distributed over the Ohio and Mississippi Valleys. In Pennsylvania the species is found in Lake Erie and in the tributaries of the Ohio River. The U. S. Fish Commission secured three specimens at Horse Island, Sackett's Harbor, N. Y., June 30. The New Jersey Fish Commission has introduced the fish into Greenwood Lake.

The White Bass weighs from 1 to 3 pounds, and its flesh is considered almost if not equally as good as that of the Black Bass. It prefers the deeper parts of rivers and thrives best in lakes and ponds. In April and May they leave the deeper waters and go in near shore or to the mouths of rivers where they spawn. The spawning period is in May and June.

The White Bass feeds upon Minnows, Crawfish and other fresh-water crustaceans, also minute mollusks or shellfish, and it is said to devour many young Whitefish upon the spawning grounds of that species.

It is a game fish and affords good sport to the angler.

#### 112. Striped Bass; Rock fish (*Roccus lineatus* Bloch).

*Roccus striatus* MITCHILL, Rept. Fish. N. Y. 25, 1814.

*Perca mitchilli* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 413, pl. III, fig. 4, 1815.

*Perca mitchilli alternata* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 415, 1815.

*Perca mitchilli interrupta* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 415, 1815.

*Labrax lineatus* DEKAY, N. Y. Fauna, Fishes, 7, pl. 1, fig. 3, 1842.

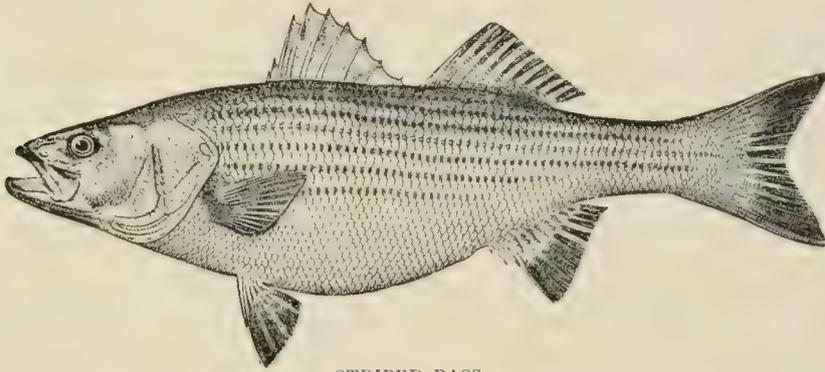
*Roccus lineatus* BEAN, 19th Rept. Comm. Fish. N. Y., 267, pl. XVIII, fig. 22, 1890; Fishes Penna., 131, color pl. 14, 1893; Bull. Am. Mus. Nat. Hist., IX, 365, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1132, 1896, pl. CLXXX, fig. 478, 1900; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 38, 1898; MEARNs, Bull. Am. Mus. Nat. Hist., X, 321, 1898; H. M. SMITH, Bull. U. S. F. C. for 1897, 99, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 105, 1900.

Sides greenish above, silvery below, sometimes with a brassy lustre and marked by seven or eight longitudinal streaks none of which are half as wide as the eye, one of them passing along the lateral line; the lowermost stripe is somewhat below the middle of the depth.

In the southern United States from New Jersey to Florida the Striped Bass is known as the Rock or Rockfish. In the Northern States the name Striped Bass is more generally used than the other, especially along the coast. In the Delaware, Susquehanna and Potomac Rivers it is called Rockfish. Green Head and Squid

Hound are names applied to large individuals found in the sea in New England waters. One of the old names of the fish is Streaked Bass.

Rock fish and Striped Bass, according to Schoepff (1787), are among the early New York names for this highly prized species. Dr. Mitchill (1814) calls it Mitchill's Perch, Striped Basse and Rock fish. DeKay describes it as the Striped Sea Bass. Streaked Bass is another name in use in 1815, and a very interesting account of the fish under this name is published by Dr. James Mease in the first volume of the *Transactions of the Literary and Philosophical Society of New York*. Dr. Mease in this article states that Rock fish weighing from 25 pounds to 60 pounds are called Green-heads. At the time of his writing, the fishing ground for the Philadelphia and New York markets was between Long Branch and Cranberry Inlet, an extent of about thirty miles, and the great places of winter resort were Motetecunk, 30 miles from Long Branch, and the rivers of Elk and Egg Harbor.



STRIPED BASS.

The range of the Striped Bass or Rockfish includes the entire Atlantic coast from the Gulf of St. Lawrence to the Gulf of Mexico, the fish entering rivers and ascending them long distances. In the Alabama River this fish is known to be taken every year and some large individuals have been obtained from that stream. It has been captured also in the lower Mississippi. It is very abundant in the great bays and sounds from North Carolina to Cape Cod. In Albermarle Sound many large individuals are said to occur. In the St. John's River, Florida, according to Dr. Goode, the fish is rather rare. In the vicinity of Pensacola the late Silas Stearns occasionally obtained a specimen of the fish.

The Striped Bass has been introduced into California and has now become fairly acclimated there. In the Delaware and Susquehanna Rivers this is one of the common fishes and it is one of the most highly esteemed.

This is a permanent resident of Gravesend Bay, but the height of the fishery occurs from October 10 to November 10. Large fish, up to 45 pounds, are caught

in May, but the fall fish range from 9 inches to 24 inches in length. In Great South Bay the writer has obtained specimens at Blue Point Cove, Great River, Nichols's Point, and off Widow's Creek. A great haul was made on Lone Hill Middleground about the middle of October, 1901. The fish remains in some of the tributaries of Great South Bay throughout the year. According to Dr. Mearns the species is taken in great numbers in nets set through the ice of the Hudson in winter, and in drift nets by shad fishermen in spring. Large individuals of 60 pounds and upward are sometimes caught in the winter and early spring. He once took a specimen a little above the estuary of Poplopen's Creek, in fresh water.

At the time of Dr. Mitchill's report the greatest run occurred late in the fall, and the great hauls were made during the coldest season, including some very large fish. He saw, however, a dozen at a time weighing 50 pounds each in New York market during very mild weather, in early October.

This fish lives in the sea or in brackish or fresh water indifferently and it has been successfully kept in artificial ponds. In cold, northern waters it becomes ice bound occasionally and is said to hibernate. It prefers cold water, is carnivorous and predaceous, feeding upon small fishes in the streams, consuming especially large quantities of the Alewife or River Herring and the young of the Shad. In the shallow bays along the coasts its food consists of Killifish, Silversides, Anchovies, Lant and other small fishes, besides crabs, squid, clams, mussels and other marine invertebrates. Its movements while feeding depend greatly upon the tides. It is to be found frequently at the mouths of small creeks and in tideways, where it lies in wait for the large schools of small fishes, which constitute its food.

The largest Striped Bass recorded was said to weigh 112 pounds. At Avoca, North Carolina, Dr. Capehart took a Striped Bass weighing 95 pounds. It reaches a length of  $4\frac{1}{2}$  or 5 feet.

Spawning takes place from April to June, either in the rivers or in the brackish waters of bays and sounds. Eggs have been hatched artificially in May on Albermarle Sound. Dr. Capehart took a 58-pound spawning fish April 22, 1891. The eggs are smaller than those of the Shad, and after fertilization they increase greatly in size and become light green in color. This 58-pound fish probably contained more than one-half million eggs. Dr. Abbott has found the young an inch long in the Delaware the second week in June, and by the middle of October some of these had grown to a length of  $4\frac{1}{2}$  inches. The Striped Bass has been kept in a small pool of fresh water and fed upon crabs and oysters, increasing in about eleven months from 6 inches in length to 20 inches. In the aquarium the species is hardy and grows rapidly; it can be kept in good condition almost indefinitely. In a Rhode Island

pond it is stated that Bass weighing  $\frac{1}{2}$  pound to 1 pound in June had reached a weight of 6 pounds in the following October.

In fresh water, salted eel tail is a favorite bait for taking Striped Bass, and the spoon or spinner is also a good lure, but live Minnows are preferred to all other baits. For surf fishing shedder crab well fastened to the hook is a very killing bait.

### 113. White Perch (*Morone americana* Gmelin).

*Morone rufa* MITCHILL, Rept. Fish. N. Y., 18, 1814, New York.

*Morone pallida* MITCHILL, Rept. Fish. N. Y., 18, 1814, New York.

*Bodianus rufus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 420, 1815.

*Labrax rufus* DEKAY, N. Y. Fauna, Fishes, 9, pl. 3, fig. 7, 1842.

*Labrax pallidus* DEKAY, N. Y. Fauna, Fishes, 11, pl. 1, fig. 2, 1842.

*Labrax nigricans* DEKAY, N. Y. Fauna, Fishes, 12, pl. 50, fig. 160, 1842.

*Roccus americanus* BEAN, 19th Rept. Comm. Fish. N. Y., 268, pl. XIX, fig. 23, 1890.

*Morone americana* BEAN, Fishes Penna., 133, pl. 15, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1134, 1896, pl. CLXXXI, fig. 479, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 366, 1897; MEARNS, Bull. Am. Mus. Nat. Hist., X, 321, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y., 1897, 39, 1898; H. M. SMITH, Bull. U. S. F. C., 1897, 99, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 105, 1900.

This is the Perch or River Perch of Schoepff, which he records as an inhabitant of the coasts of New York and Long Island, in and at the mouths of fresh-water streams. Dr. Mitchill (1815) gives it the name of Red Perch, and states that when not in the breeding season it is called Black Perch because its colors are browner and darker. DeKay describes it, in the *Fishes of New York*, as the Ruddy Bass. In Great Egg Harbor Bay individuals taken from salt water are sometimes called Yellow Perch or Peerch.

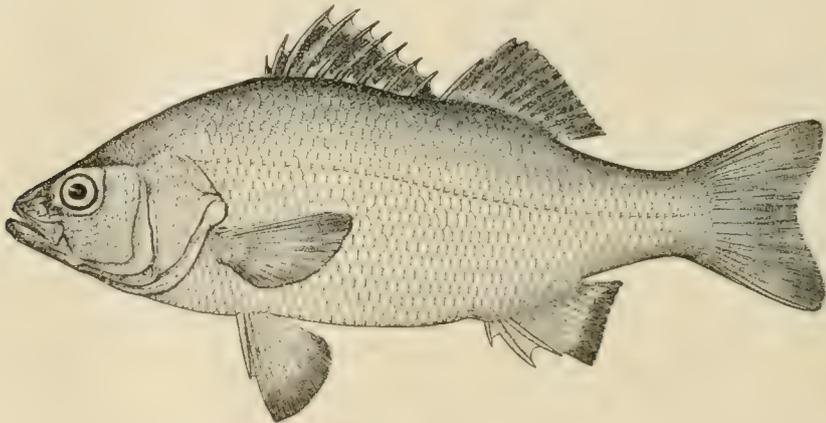
The species is found from Nova Scotia to South Carolina, and inhabits both salt and fresh water. Mitchill saw specimens 14 inches long and nearly 5 inches deep, from Quag, Long Island. There is an important winter fishery for the White Perch at Bellport. It is taken in seines and gill nets. The writer has occasionally found this species in various parts of Great South Bay, for example, at Smith's Point, Whale House Hole, Swan River, also in the east end of Shinnecock Bay, in the fresh water of Head of Creek, near Southampton. The fishermen affirm that when its feeding grounds are disturbed by seining the fish suddenly leave the locality. The White Perch is never plentiful in Gravesend Bay: it is abundant in fresh-water lakes of Central Park, New York, and Prospect Park, Brooklyn. Near Montauk, Long Island, the species is abundant and reaches a large size. Eugene Smith has

found it common in brackish waters near New York, where it occurs all the year; he had it also from fresh water. Mearns states that it remains in the Hudson throughout the year and is taken in abundance in winter in nets set through the ice. In Oscawana Lake, Putnam County, individuals weighing 2 or 3 pounds were reported to him.

In the vicinity of Woods Hole, Mass., the fish is abundant in fresh-water ponds connected with salt water.

It is said that the White Perch formerly extended south to Florida and the Gulf of Mexico, but this is discredited by competent observers. The Perch of Lake Ponchartrain is very likely the species now known in many portions of the Western States as the Fresh-water Drum, *Aplodinotus grunniens*.

The average length of the White Perch is about 9 inches and its weight  $\frac{1}{2}$  pound or less, but numerous specimens measuring 14 inches and weighing 2 pounds or more have been taken, especially in New England waters.

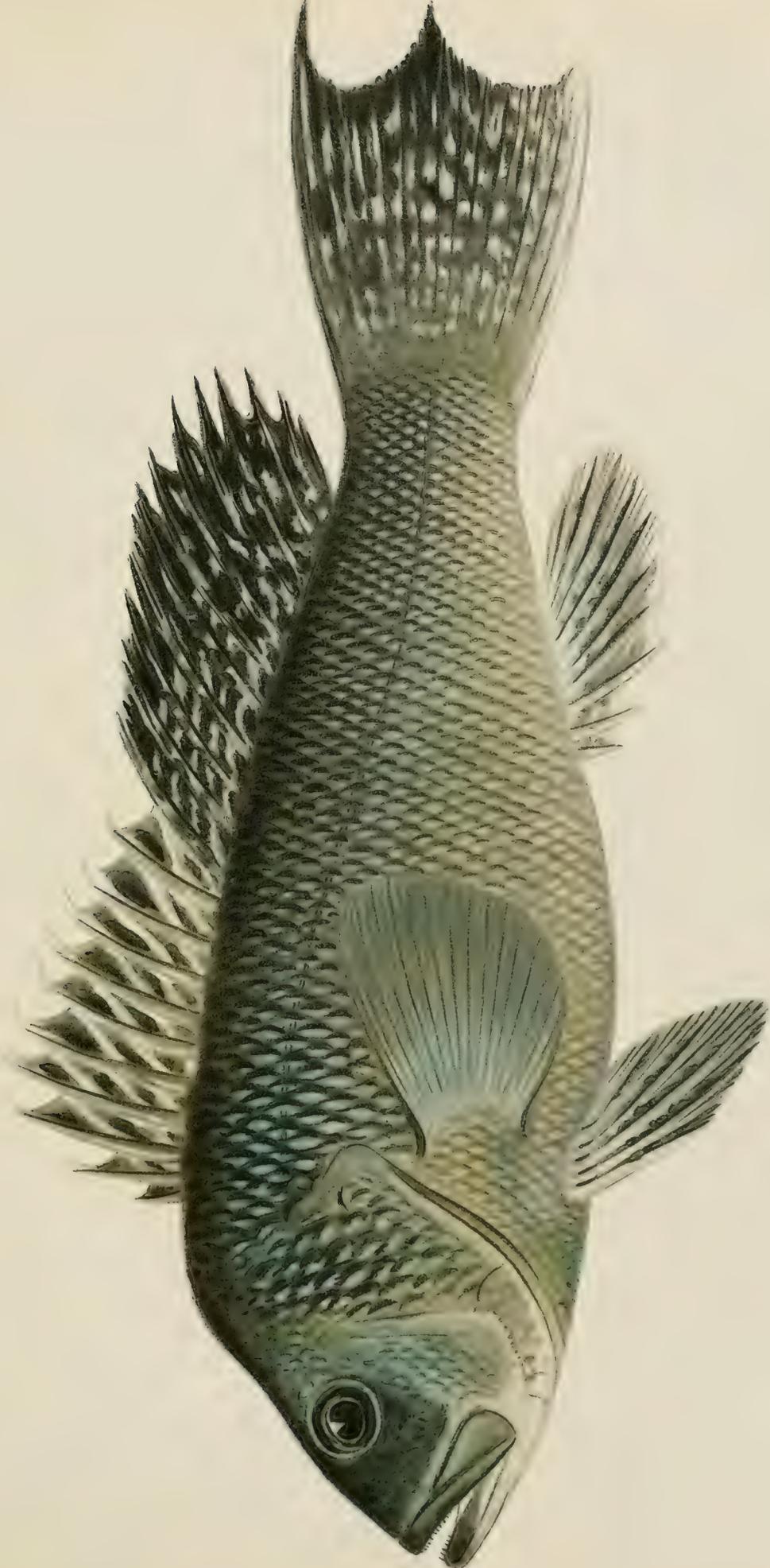


WHITE PERCH.

At the time of Dr. Mitchill's writing the species was a favorite in New York markets, and it is now one of the best known species although probably not ranking among the choicest kinds.

Thad. Norris was one of the most earnest supporters of the White Perch, and has published interesting observations concerning its habits. Comparatively little, however, is known about its life. It is an associate of the Striped Bass, and, according to Dr. Abbott, resembles this species in its feeding habits. It differs from the Striped Bass in its tendency to seek warm waters.

The White Perch is a lover of brackish water, and may be found in tidal creeks in vast numbers associated with Mummichogs, Silversides and Eels, feeding upon Shrimp and Minnows. Spawning takes place in May and June. According to Pro-



SEA BASS | *CENTROPRISTES STRIATUS*



fessor John A. Ryder, the egg of the White Perch is very adhesive, and on this account is troublesome to hatch artificially. In the experiments made by him the eggs were taken upon cotton yarn, which was drawn up through a funnel into which the eggs and milt had been squeezed from the spawning fish. The cord, covered with the adhering eggs, was then wrapped upon a wooden reel and sent under cover of damp cloths to the central station, where they arrived in fine condition, almost every egg being impregnated. This system was devised and carried out under the superintendence of Col. M. McDonald. After reaching the central station the cotton cord with the adhering eggs was cut into lengths of 10 or 12 inches and suspended in the glass hatching jars. The development was soon interfered with by the growth of fungus. When the wooden reel with the adhering eggs was introduced into a wide aquarium fungus also attacked the eggs as before but the results were somewhat more favorable. With the water at 58° to 60° F. the eggs hatched out in 6 days.

The White Perch congregates in large schools and is one of the freest biters among fishes. The shrimp is one of the best baits, though worms, sturgeon eggs, Minnows and strips of cut fish with silvery skin are equally effective. Dr. Abbott has known as many as 20 dozen to be taken with a line in a few hours, and Spangler mentions catches of six or seven hundred in a day by two rods, the fish ranging in weight from  $\frac{3}{4}$  to  $1\frac{1}{4}$  pounds.

Eugene Smith, on several occasions, found a long, green, brackish-water alga (*Euteromorpha*) in stomachs of White Perch, indicating that they sometimes eat vegetable matter, though perhaps only for the minute organisms found upon it.

In captivity the fish is very susceptible to fungus attacks, but the parasite is readily killed by changing the water supply from salt to fresh, or vice versa.

#### 114. Sea Bass; Black Fish (*Centropristes striatus* Linnæus).

*Perca varia* MITCHILL, Rept. Fish. N. Y., 11, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 415, pl. 3, fig. 6, 1815, New York.

*Centropristes nigricans* DEKAY, N. Y. Fauna, Fishes, 24, pl. 2, fig. 6, 1842; BEAN, 19th Rept. Comm. Fish. N. Y., 266, pl. XVII, fig. 21, 1890.

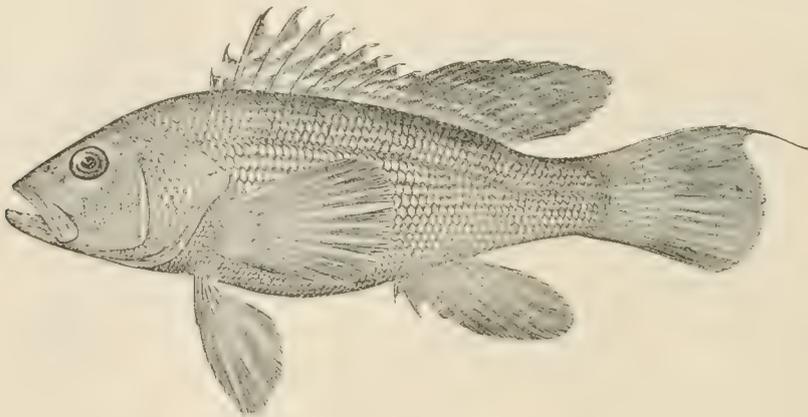
*Centropristes striatus* JORDAN & EIGENMANN, Bull. U. S. F. C., VIII, 391, pl. 64, 1890; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1199, 1896, pl. CXC, fig. 500, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 366, 1897; H. M. SMITH, Bull. U. S. F. C., 1897, 100, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 105, 1900.

Dusky brown or black, adults often bluish, more or less mottled, with traces of pale longitudinal streaks along the rows of scales; young greenish, often with a dark

lateral band, sometimes broken up forming cross-bars; dorsal fin with several series of elongate, whitish spots, forming interrupted lines; other fins dusky, mottled.

The Sea Bass is the *Perca varia* of Mitchill, *Fish. N. Y.* p. 415. Common names given by this author are Sea Basse, Black-Harry, Hanna Hills and Blue fish. Schoepff (1787) gives the New York name as Black fish; DeKay has it as the Black Sea Bass, also Black Bass and Black fish. Dr. Storer records the Massachusetts name of Black Perch. Other common names on the coast are Black Will (Middle States) and Rock Bass (New Bedford).

The Sea Bass is found from Vineyard Sound southward, its southern limit not being accurately determined, but probably not extending below Cape Hatteras. The southern form, which was described by Linnæus from South Carolina, may be distinct from the northern, and if so it should be designated by the Linnæan name *atraria*.



SEA BASS.

The northern form has been found occasionally north of Cape Cod, at Nahant, Salem, and Beverly Bar. Dr. Smith reported it as very common at Woods Hole in 1898, where it arrives in May and departs from the inshore waters about October 1, being most abundant from July to September. It spawns there in June. The young are first seen about August 1. The maximum weight is 6 pounds. In 1900 the Sea Bass was said to be remarkably scarce at Woods Hole. According to the observers of the Fish Commission this fish is decreasing rapidly in numbers. Hand-lining, even on the spawning grounds off Hyannis was remarkably poor and young fish were less numerous than usual. As a rule the first adults appear in their seasonal migration during the first or second week in May, when the water has reached a temperature of 48° to 50° F. However, in spite of the cold of 1900, they appeared at Cuttyhunk and Menemsha Bight on April 28—with one exception the earliest

arrival recorded in 25 years. Formerly the young were abundant everywhere, but at present they are restricted to a few localities—Katama Bay, Quisset Harbor and Wareham River. The first fry were seined July 31 and measured  $\frac{3}{4}$  of an inch in length. On October 20, young fish 2 to 3 inches long were very plentiful in Katama Bay.

In 1884 the writer obtained young examples only, and these in moderate numbers, at Fire Island near the end of September. In 1890 a few individuals were observed in a net at Islip. In 1898, adults were taken in abundance off shore at Southampton in August and half-grown specimens were secured from a pound at Islip. Young Sea Bass were rather common at Point of Woods, Great South Bay, Clam Pond Cove, Fire Island Inlet, Oak Island Beach, and Nichols's Point. In the summer of 1901, early July to the middle of October, only a few young individuals were taken, and these were secured in eel pots off Widow's Creek, Great South Bay.

The Sea Bass makes its appearance in Gravesend Bay in May. It is not abundant. The young in October are found in the eel grass, measuring from  $1\frac{1}{2}$  to 2 inches in length. The species is well adapted to life in aquarium tanks during all but the coldest months.

The Sea Bass is distinguished for its voracity and its persistent biting. The young are found in the channels of shallow bays and about wharves and landings. Large fish frequent the off-shore banks where the bottom is rocky. A famous locality is Five Fathom Bank, off the coast of New Jersey. In the shallow waters of Great Egg Harbor Bay, hundreds of small-sized Sea Bass may be taken in a day, and it is difficult to find a locality which is free from them. Their food consists of shrimps, crabs, sea worms, squid, small fishes and all other animals of suitable size. The species is sluggish in its habits and resembles the Tautog in its tendency to hide in rock crevices. The Sea Bass breeds in the summer months and the young grow rapidly. The eggs have been hatched artificially, and when it becomes desirable the fry can be produced in vast quantities. The eggs are  $\frac{1}{26}$  of an inch in diameter and hatch in 5 days in water at the temperature of  $59^{\circ}$  or  $60^{\circ}$  F. At Woods Hole, Mass., they are deposited in June.

This is a valuable food fish, reaching a length of 18 inches and the weight of 6 pounds.

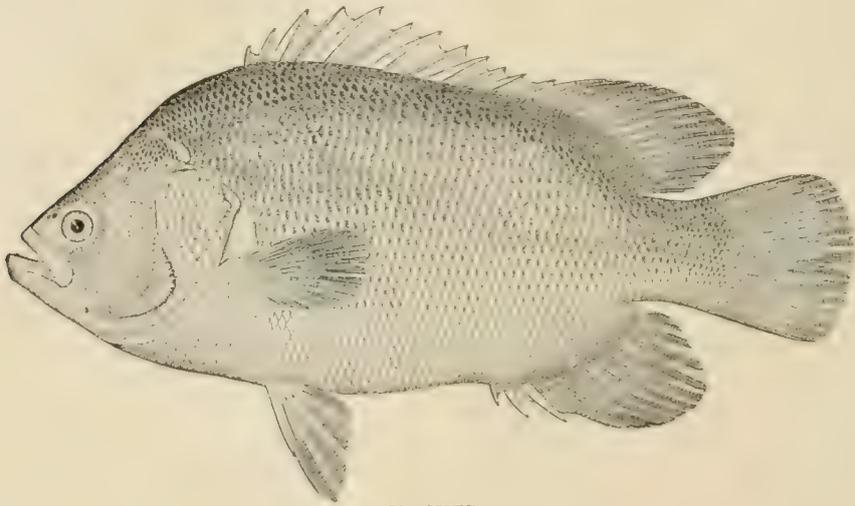
115. Flasher; Triple-tail (*Lobotes surinamensis* Bloch).

*Holocentrus surinamensis* BLOCH, Ichth., pl. 243, 1790, Surinam.

*Bodianus triurus* MITCHILL, Trans. Lit. & Phil. Soc., I, 418, pl. III, fig. 10, 1815, Powles Hook, N. J.

*Lobotes auctorum* GÜNTHER, Cat. Fish. Brit. Mus., I, 338, 1859.

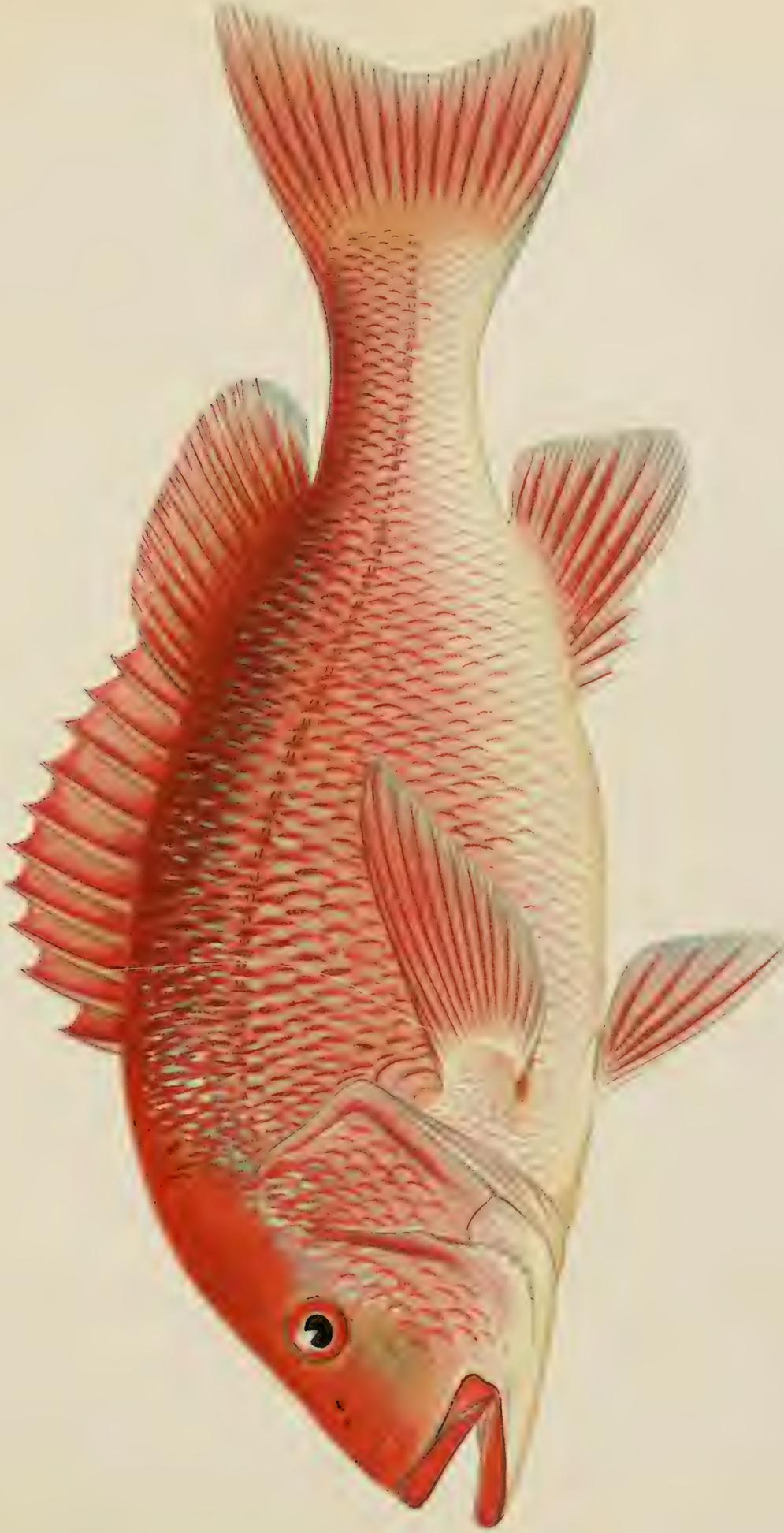
*Lobotes surinamensis* CUVIER & VALENCIENNES, Hist. Nat. Poiss., V, 319, 1830; DEKAY, N. Y. Fauna, Fishes, 88, pl. 18, fig. 49, 1842, New York; HOLBROOK, Ichth. S. C., ed. 1, 159, pl. 23, fig. 2, 1856; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 555, 1883; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1235, 1896, pl. CXCIV, fig. 510, 1900; H. M. SMITH, Bull. U. S. F. C. 1897, 100, 1898; SHERWOOD & EDWARDS, Bull. U. S. F. C. 1901, 28, 1901, Narragansett Bay.



FLASHER.

Blackish above, silvery gray on the sides, often blotched and tinged with yellow; fins dusky gray, sometimes mingled with yellow.

The Flasher is a large species, found in all warm seas, ranging on our coast from Cape Cod to Panama; it reaches the length of 3 feet and is used for food. At Woods Hole, according to Dr. Smith, it is very rarely taken. Specimens were secured, however, in August, 1873, December, 1875, September 20, 1886, and in August, 1890. The individual obtained in 1886 was caught in a trap at Menemsha, Martha's Vineyard. The Rhode Island Fish Commission has a specimen weighing 6 pounds and measuring 22 inches, which was taken September 10, 1900, in a trap off Prudence Island, Narragansett Bay. The example described and figured by Mitchill was taken at Powles Hook, N. J. According to Mitchill specimens weighing 4 or 5 pounds were occasionally secured, and the fish was sometimes called Black Grunt. DeKay knew the fish only from the accounts of it given by Mitchill and Holbrook.



RED SNAPPER ( NEOMÄNIS BLACKFORDI ).



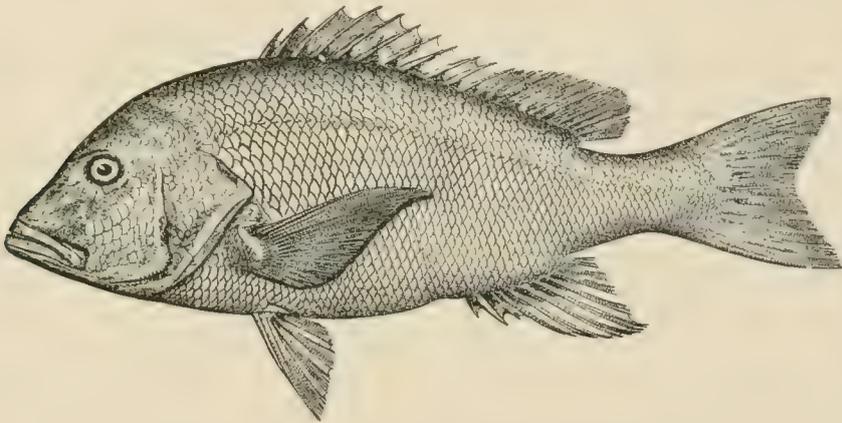
**116. Red Snapper** (*Neomænis blackfordi* Goode & Bean).

*Lutjanus blackfordii* GOODE & BEAN, Proc. U. S. Nat. Mus., I, 176, 1878 (full description of adult); II, 137, 138, 1879, characters and measurements of young; GOODE, Game Fishes N. A., 16, 1878, with colored plate.

*Lutjanus blackfordi* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 549, 1883; BEAN, 19th Rept. Comm. Fish. N. Y., 263, pl. XVI, fig. 20, 1890.

*Neomænis aya* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1264, 1898, pl. CXCVII, fig. 516, 1900 (not *Bodianus aya* BLOCH, Ichth., 227, 1790); H. M. SMITH, Bull. U. S. F. C. 1897, 100, 1898.

Color uniform scarlet. Center of scales lighter, also the belly, which is silvery; inside of axil of pectoral darker maroon.



RED SNAPPER.

On October 26, 1887, Mr. E. G. Blackford, Fish Commissioner of the State of New York, forwarded to the National Museum a young Red Snapper, four and one half inches long, which was caught in Great South Bay, at Bay Shore, Long Island. This is the smallest Red Snapper that we have obtained, and it is the first record of the occurrence of the species so far north. The specimen has been catalogued as 39,213 of the National Museum Fish Register.

As in other young fishes the size of the eye, the length of the head and the colors are different from these characters in the adult.

A description of the colors of the fresh fish follows:

A dark band nearly as wide as the diameter of the eye is placed immediately in front of the spinous dorsal; it fades out about the median line of the body. Three similar bands, and of like size, under the dorsal, separated by narrow interspaces and fading out below. The fourth band contains a blotch as large as the eye, which passes slightly beneath the lateral line. A fifth band is under the last third of the

soft dorsal and continues backward to the caudal, not descending below the lateral line. The second and third bands are traversed vertically by a narrow median stripe of the rosy body color. Membrane of dorsals and caudal with a narrow black edge. Spine and external ray of ventral milk white. Anal rosy, except membrane of first two spines and last three rays, which is milk white.

The Red Snapper has become one of the most famous fishes of our northern markets, and is always attractive on account of its large size, brilliant color, and the excellence of its flesh. We know that the species is to be found on our east coast from Cape Cod to the Carribbean Sea. It is rare, however, north of Cape Hatteras and the principal fisheries are located off the coasts of Georgia and Florida, and in the Gulf of Mexico.

When the Red Snapper was named in honor of Mr. Eugene G. Blackford, in recognition of his invaluable contributions to the science of ichthyology, the describers of the species had carefully considered the question of nomenclature and satisfied themselves that none of the names known to them could with certainty be associated with this fish. Various earlier names have been suggested from time to time by several authors as possibly available for the species. In 1883 Dr. D. S. Jordan considered it to be the *L. campechianus*, described by Poey in 1860. This, however, is a species with much smaller scales if the description be accurate. The type has not been examined by any one in the United States so far as I am informed. A little later Dr. Jordan suggested that the name *Lutjanus vivanus* of Cuv. & Val. should be accepted for the Red Snapper; but my examination of the types of this species in the Museum of Paris showed it to be a small *Lutjanus*, and very distinct in every way from *L. blackfordi*. In recent lists Dr. Jordan has adopted the specific name *aya* of Bloch, published in 1787 in the *Ausländische Fische*. This name was used for a species of *Lutjanus* more than twenty years ago by Dr. Theodore Gill.

I will now state what may be learned from the literature concerning the *aya*. The *Bodianus aya* of Bloch is distinctly based upon the *Acara aya* of Maurice, Prince of Nassau, as set forth in his Mss, tome 2, page 351. The plate published by Bloch is copied from a drawing by Prince Maurice, and his description is drawn from the same source. The fish which formed the subject of the description and illustration by the Prince of Nassau was the *aya* or *garanha* of Brazil, a red species, said to attain to a length of 3 feet. The *aya* is distinctly described as having 9 spines and 18 articulated rays in the dorsal. It is represented as having 40 scales in the lateral line, and the scales are said to be ornamented with silvery, submarginal stripes. Bloch was informed that the fish was known to the French, Germans and

English as the *aya* and to the Brazilians as the *garanha*. Elsewhere in the description the general color is said to be red, the back dark red, and the belly silvery. This is all the information to be derived from Bloch's account of the species, and if the data mentioned are to be relied upon, the fish is certainly not our Red Snapper. We have no other knowledge concerning the *aya* of Brazil. It has not been shown that our species ranges so far south and several red forms resembling *L. blackfordi* are associated with it. Various interpretations of the *aya* have appeared in ichthyological works. Dr. Günther, in his *Catalogue of Fishes in the British Museum*, vol. I, page 198, adopts the name for a small-scaled *Lutjanus*, which has 65 scales in the lateral line and 32 in a transverse series. Of this he has a fine specimen from South America. A very curious translation of the earlier descriptions of the *aya* is to be found in Lacépède's account of the species, which is given below. The diagnostic characters are stated as follows :

Nine spines and 18 articulated rays in the dorsal; 1 spine and 8 divided rays in the anal; the caudal crescent-shaped; each opercle terminating in a long and flat spine; the general color red; the back blood color; the belly silvery.

The author, in another part of his *Natural History of Fishes*, writes :

A figure of the *aya* has been published by Marcgrave, Piso, Willughby, Johnston, Ruysch, the prince of Nassau [Maurice] and Bloch, who has copied the drawing of Prince Maurice. It is found in lakes of Brazil. It frequently reaches a length of 1 meter, and it is so plentiful that large numbers of this species are salted or sun-dried for export. It may be very desirable and, perhaps, sufficiently easy to acclimatize this large and beautiful *bodianus*, the flesh of which is very agreeable to the taste, in the fresh waters of Europe, and particularly in lakes and ponds of France.

### 117. Pig Fish; Hog Fish (*Orthopristis chrysopterus* Linnæus).

*Labrus fulvomaculatus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 406, 1815, New York.

*Haemulon fulvomaculatum* DEKAY, N. Y. Fauna, Fishes, 84, pl. 7, fig. 21, 1842, New York.

*Orthopristis chrysopterus* BEAN, Bull. U. S. F. C., VII, 142, pl. III, fig. 11, 1888; BEAN, Bull. Am. Mus. Nat. Hist., IX, 366, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1338, 1898, pl. CCX, fig. 541, 1900.

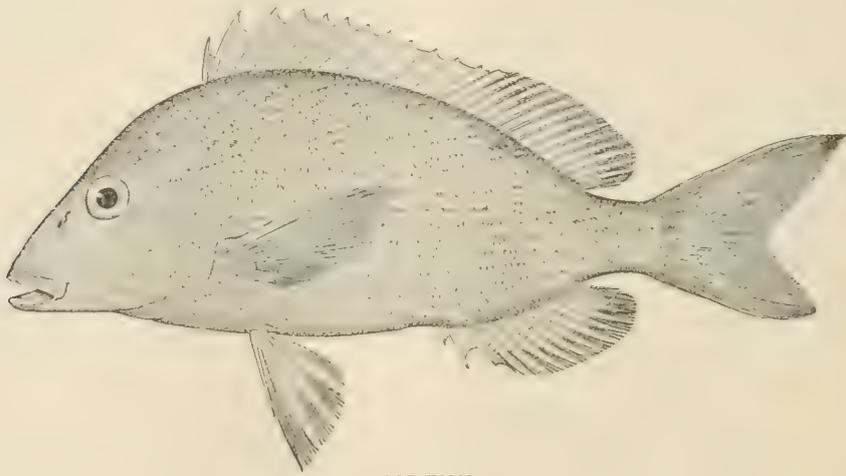
Light brown. silvery below; sides with numerous orange colored and yellow spots; those above the lateral line in oblique series, those below in horizontal; vertical fins with similar spots; head bluish with yellow spots; angle of mouth and gill membranes with orange.

The Pig Fish ranges along the Atlantic coast from New York southward; adult

individuals are rarely seen even as far north as New Jersey, but the young are common.

At Beesley's Point, N. J., August 10, 1887, many young individuals were taken in the seine. D. XII, 16; A. III, 13; scales, 75.

A dark stripe beginning on nape and dividing sends one branch along the back on each side not far from dorsal outline; a dark stripe from eye to root of caudal; cheeks and opercles with several narrow orange stripes; a narrow orange stripe between the two dark body stripes and another below the lower dark stripe; below the second orange stripe are numerous orange spots, not continuous. These specimens are from less than 1 inch to more than 2 inches long.



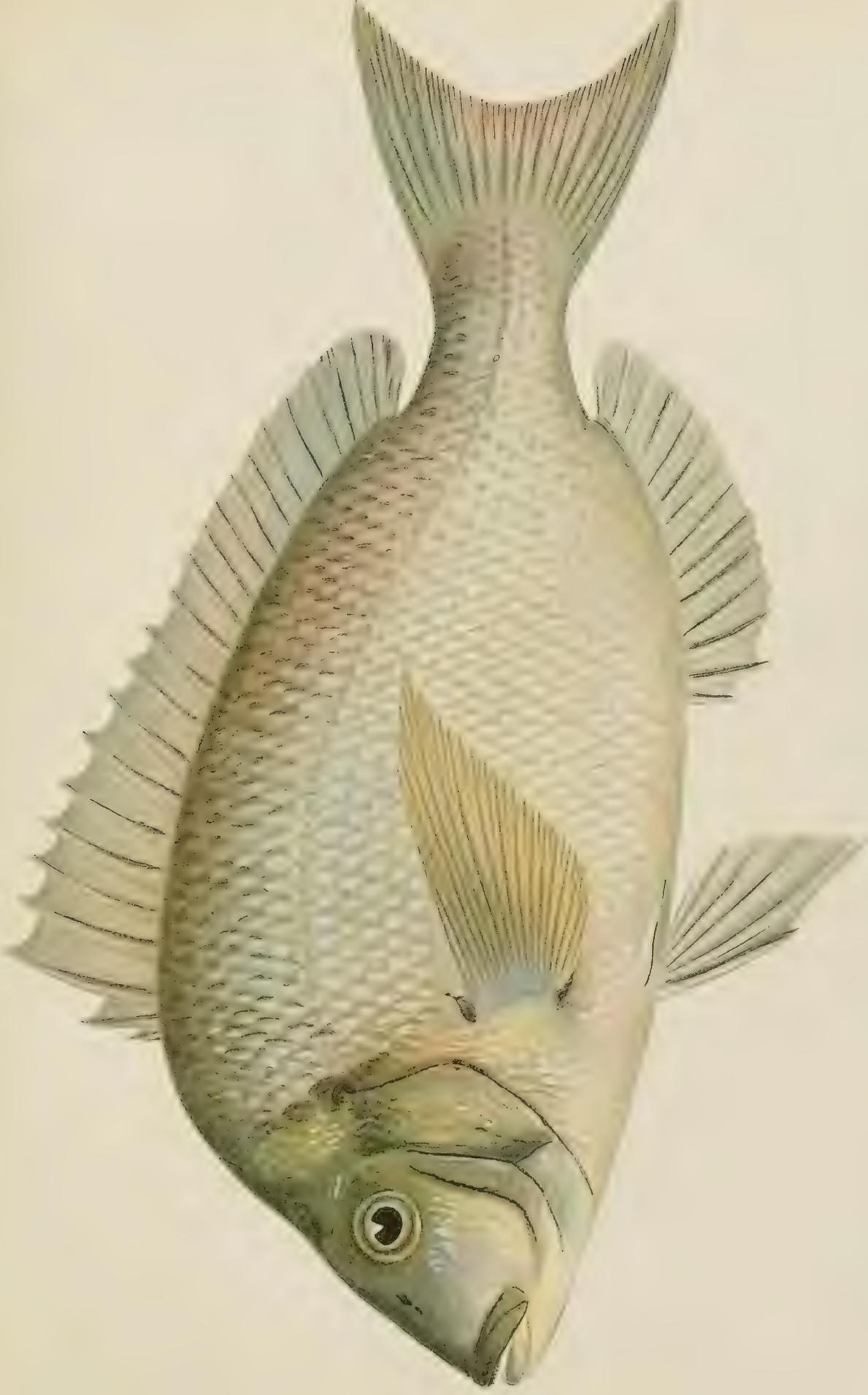
PIG FISH.

Young examples were seined at Somers Point, August 13, and abundantly at Ocean City, August 16. The croaking sound made by these little fishes is quite noticeable.

September 5, Mr. W. S. Keates brought in two examples which had been caught on a hook with clam bait; these are  $5\frac{1}{4}$  inches long, and much larger than the average size. Specimens from  $4\frac{1}{2}$  to 5 inches long were caught at Beesley's Point August 23; in these there is only a trace of the black lateral stripe along the median line, and the sides have several broad, dark bands.

September 9 an individual  $5\frac{1}{3}$  inches long was taken at Beesley's Point. This species is unknown to the fishermen. One angler described its croaking as resembling the quacking of a duck.

Several examples were taken in Gravesend Bay, October 24, 1894. DeKay mentions it as a rare fish, but occasionally appearing, he was informed, in New York Harbor in considerable numbers. He states that it is a very savory food.



SCUP; PORGY | STENOTOMUS CHRYSOPS



**118. Scup; Porgy; Sand Porgee** (*Stenotomus chrysops* Linnæus).

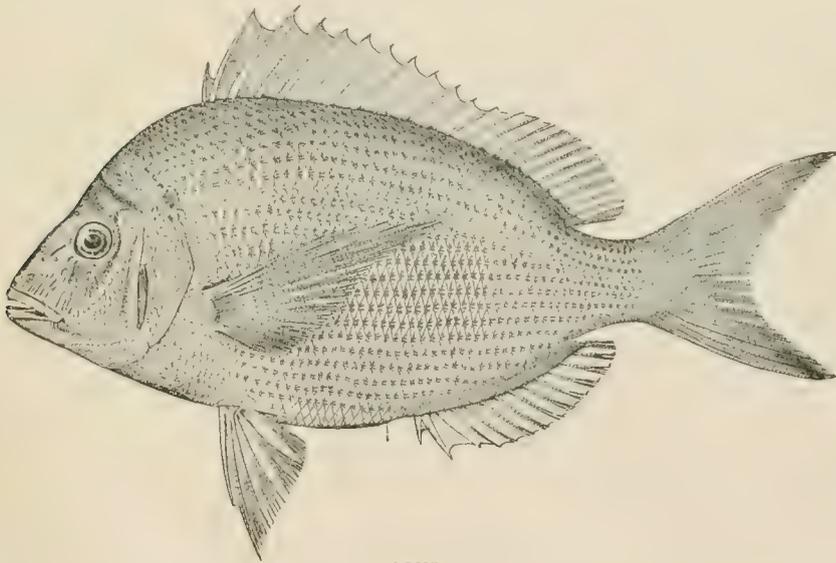
*Labrus versicolor* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 404, pl. III, fig. 7, 1815, New York.

*Sargus arenosus* DEKAY, N. Y. Fauna, Fishes, 91, pl. 22, fig. 67, 1842, Long Island; young.

*Pagrus argyrops* DEKAY, op. cit. 95, pl. IX, fig. 25, 1842; adult.

*Diplodus argyrops* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 557, 1883.

*Stenotomus chrysops* BEAN, Bull. U. S. F. C., VII, 142, 1888; 19th Rept. Comm. Fish. N. Y., 261, pl. XIV, fig. 18, 1890; JORDAN & FESLER, Rept. U. S. F. C. 1889 to 1891, 507, 1893; BEAN, Bull. Am. Mus. Nat. Hist., IX, 366, 1897; H. M. SMITH, Bull. U. S. F. C. 1897, 100, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1346, 1898, pl. CCXI, fig. 544, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 106, 1900; SHERWOOD & EDWARDS, Bull. U. S. F. C. 1901, 28, 1901.



SCUP.

Color silvery, with bright reflections, dusky above, upper part of head deep brown; dorsal horn color, the last rays with a yellowish tinge; axil of pectoral dusky; young with five or six dusky bars; iris golden, mottled with silvery and brownish. Length, about 1 foot.

The Scup is one of our best known fishes. In many places it is better known under the name Porgee. Mitchill and DeKay described it as the Big Porgee. Another spelling for the same name is Pogy. Scup is an abbreviation of Scuppaug, which in turn is a shorter form for the Narragansett name, Mishcuppaug. The name Fairmaid, which is said to be given to the Scup on the Virginia coast, does not rightfully belong to this species, but rather to the Sailor's Choice (*Lagodon*). The

name Fairmaid is regularly applied to the latter species at Cape Charles, Va., according to B. A. Bean. In Norfolk, Va., Mr. Bean heard the name Maiden for the young of the common Scup.

The Scup seldom migrates north of Cape Cod, although it has been taken occasionally off Cape Ann. Attempts to introduce it into Massachusetts Bay have been unsuccessful.

The Scup comes into our northern waters in great schools, the large spawning fish coming first, making their appearance in New York waters in May. The species feeds upon small crustaceans, mollusks and annelids, and is one of the readiest biters along the coast. The fishery fluctuates greatly; in certain years the fish is comparatively scarce, and in others it is extremely abundant. It is caught in pounds and traps, and remains in Great South Bay until cold weather sets in. It has been taken on Cape Cod as late as December 10. Sometimes a sudden cold spell kills the fish in large numbers.

In 1890 we found only a few specimens at Fire Island and at East Island, late in September, and on October 1 a few examples were taken in a trap at Islip. In 1898 adults were taken in moderate numbers off Southampton August 3. Half-grown specimens were obtained at Islip August 18. A single young individual was seined at Nichols's Point September 1, and a moderate number of young, about 2 inches long, were secured at the east side of Fire Island Inlet September 16. In 1901 small Scup, about 6 inches long, were obtained in a gill net August 13, and in Watt's Pound, July 31, in Clam Pond Cove.

The Scup arrives in Gravesend Bay in May, and is taken as late as November. In captivity it lives until December, and in properly heated water it can be kept indefinitely. It is thrifty, and is seldom in bad condition.

At Woods Hole, Mass., according to Dr. Smith, the fish appears about May 1 and leaves about October 15 or 20, being most abundant in June and July. Spawning occurs during first part of June, and young  $\frac{1}{2}$  inch to  $\frac{3}{4}$  inch long are observed by the middle of July. The eggs are  $\frac{1}{26}$  inch in diameter and hatch in 4 days at a mean temperature of 62° F. In 1900 the Scup arrived off Newport April 21, at Cutty Hunk April 26, and at Woods Hole May 1. Hundreds of young are killed there annually by a sudden fall of temperature. The growth of the young is recorded by Sherwood & Edwards as follows: July 3, length  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches; August 2,  $1\frac{1}{2}$  to 2 inches; September 6, 2 to 3 inches; September 29, 3 to 4 inches; November 1, 4 inches. The largest individuals observed weighed 3 pounds.

The young are devoured in large numbers by Cod, Weakfish, Bluefish and other predaceous species.

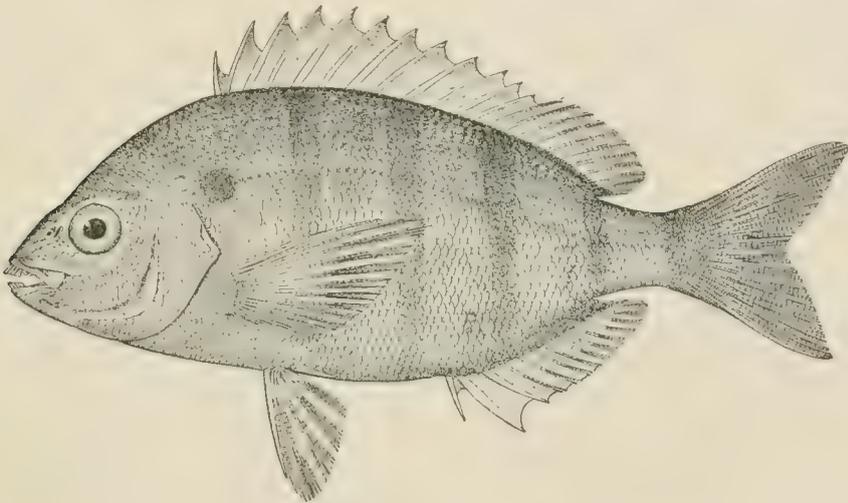
**119. Sailor's Choice** (*Lagodon rhomboides* Linnæus).

*Sargus rhomboides* DEKAY, N. Y. Fauna, Fishes, 93, pl. 71, fig. 228, 1842, copied from CUVIER & VALENCIENNES.

*Lagodon rhomboides* HOLBROOK, Ichth. S. C., ed. 1, 56, pl. 8, fig. 1, 1856; ed. 2, 59, 1860; BEAN, 19th Rept. Comm. Fish. N. Y., 263, 1890; Bull. Am. Mus. Nat. Hist., IX, 366, 1897; H. M. SMITH, Bull. U. S. F. C. 1897, 101, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1358, 1898, pl. CCXV, fig. 552, 1900.

The Sailor's Choice feeds upon small invertebrates and Minnows. It is caught with the hook and in cast nets and seines.

Brownish, white below; sides of head and body with horizontal stripes of light



SAILOR'S CHOICE.

blue and golden; six or seven very faint darker vertical bands, disappearing with age; vertical fins yellowish, with bluish stripes; a dark axillary spot.

This is called the Salt Water Bream by Schœpff and the Rhomboidal Porgee by DeKay. In Chesapeake Bay it is the Fairmaid. It is also called Pin fish, Squirrel fish, Porgee, Yellow Tail and Shiner. In Great South Bay the name of the fish was unknown to the fishermen, and this is true in Great Egg Harbor Bay, where the young are not uncommon in summer.

In Gravesend Bay it is not a common fish, but is found occasionally in summer.

A single individual was obtained at Fire Island October 1. The Sailor's Choice occurs as far north as Cape Cod, but it is not present in sufficient numbers to be considered among the important food fishes; south of Cape Hatteras, where it is

abundant, it is valuable for food, and in many places is considered superior to Sheepshead; this is especially so in the St. John's River.

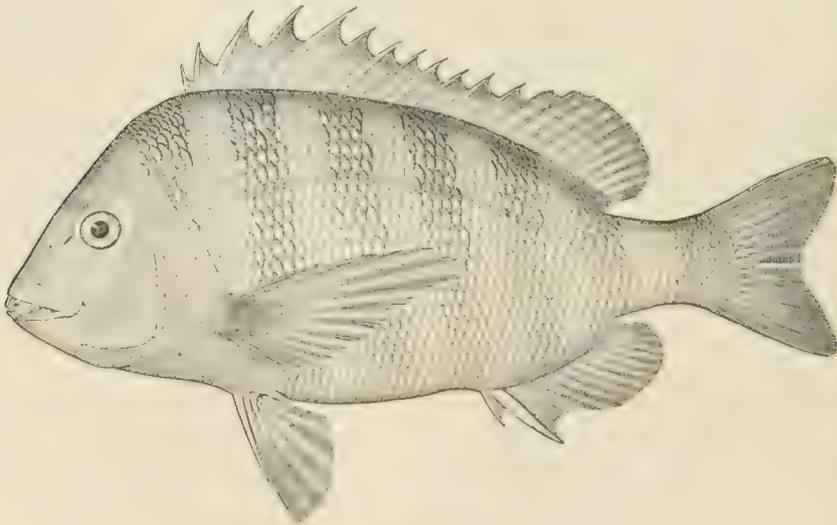
The eggs are described as pale blue in color and as large as mustard seed. Spawning takes place in the Gulf of Mexico in winter or spring. The colors of the fish are very beautiful, the sides being ornamented with golden stripes on a pearly white ground and having numerous dark vertical bands.

120. **Sheepshead** (*Archosargus probatocephalus* Walbaum).

*Sparus ovis* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 392, pl. 2, fig. 5, 1815, New York.

*Sargus ovis* DEKAY, N. Y. Fauna, Fishes, 89, pl. 8, fig. 23, 1842.

*Archosargus probatocephalus* BEAN, Bull. U. S. F. C., VII, 142, pl. III, fig. 10, 1888, Somers Point, N. J., young; 19th Rept. Comm. Fish. N. Y., 262, pl. XV, fig. 19, 1890; Bull. Am. Mus. Nat. Hist., IX, 366, 1897; H. M. SMITH, Bull. U. S. F. C. 1897, 101, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1361, 1898, pl. CCXVI, fig. 554, 1900.



SHEEPSHEAD.

Grayish, with about eight vertical black bands, which are about as broad as the interspaces; dorsal dusky; ventral and anal black; base of pectoral dusky; the dark bands are most distinct in the young.

The Sheepshead ranges along the coast from Cape Cod to Texas; it is very rare as far north as Woods Hole, Mass., but in southern waters it is still abundant. The species reaches a length of 30 inches and the weight of 20 pounds; it is one of the most valuable of our food fishes and is highly prized for its game qualities.

In August, 1887, the Sheepshead was known to have bred in Great Egg Harbor Bay, N. J., where about 20 young individuals, measuring from 1 inch to  $1\frac{1}{4}$  inches, were seined between August 10 and September 9. Adults at that time were present in the bay, but they were scarce. The bottom was covered with algæ and convenient hiding places were found under the sod banks.

The fish is very unusual in Gravesend Bay, Long Island: A large individual, weighing 13 pounds, was caught September 16, 1897, at Coney Island. That example proved hardy in captivity, and the Sheepshead generally can be easily kept if the water temperature be properly maintained.

The Sheepshead was at one time common in Great South Bay. For this statement we have the authority of Mr. Erastus Gordon, of Patchogue, and the following account from Dr. Mitchill's *Fishes of New York* will substantiate the fact: "The Sheepshead swims in shoals and is sometimes surrounded in great numbers by the seine. Several hundreds have often been taken at a single haul with the long sweeping nets in use at Raynortown, Babylon and Fire Island. They even tell of a thousand brought to land at a draught. . . . This fish is sometimes speared by torchlight in the wide and shallow bays of Queens County and Suffolk. His term of continuance is only during the warmest season; that is, from the beginning of June to the middle of September. . . . I have, however, known him to stay later; for one of the most numerous collections of Sheepshead I ever saw in the New York market was on October 4, 1814; I have seen them as late as the 17th."

Scott, in 1875, referred to Fire Island as a good locality for Sheepshead fishing, and also mentions superior feeding places in the South Bay and about the wreck of the *Black Warrior*, near the Narrows.

We did not obtain the Sheepshead in Great South Bay, and believe it occurs there very rarely at the present time, although fishermen still seek them in a few localities, and, I am informed, occasionally catch one. Dr. Smith says not one has been seen or heard of in Vineyard Sound or Buzzards Bay since 1894; but formerly it was quite common and was often caught while line fishing for Tautog and Scup.

**121. Weak Fish ; Squeteague** (*Cynoscion regalis* Bloch & Schneider.)

*Roccus comes* MITCHILL, Rept. Fish. N. Y., 26, 1814, New York.

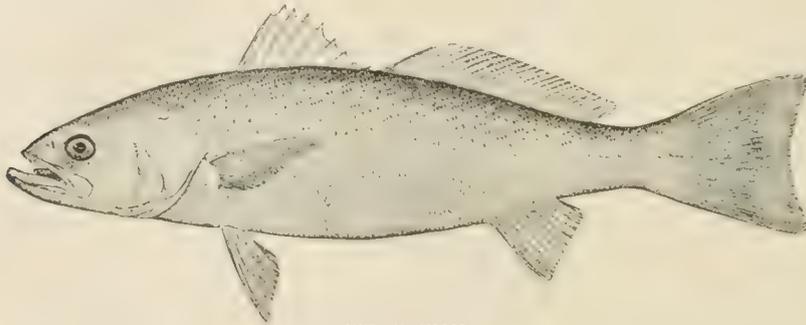
*Labrus squeteague* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 396, pl. 2, fig. 6, 1815, New York.

*Otolithus regalis* DEKAY, N. Y. Fauna, Fishes, 71, pl. 8, fig. 24, 1842.

*Cynoscion regale* BEAN, Bull. U. S. F. C., VII, 140, pl. II, fig. 6, 1888; 19th Rept. Comm. Fish. N. Y., 257, pl. XIII, fig. 15, 1890.

*Cynoscion regalis* BEAN, Bull. Am. Mus. Nat. Hist., IX, 367, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1407, 1898, pl. CCXX, fig. 562, 1900; H. M. SMITH, Bull. U. S. F. C. 1897, 101, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 106, 1900; SHERWOOD & EDWARDS, Bull. U. S. F. C. 1901, 29, 1901.

Silvery, darker above and marked with many small, irregular dark blotches, some of which form undulating lines running downward and forward; back and head with



WEAK FISH.

bright reflections; dorsal and caudal fins dusky; ventrals, anal, and lower edge of caudal yellowish, sometimes speckled. The young show traces of a few dusky bands on the sides, one under the spinous dorsal being most plainly marked, and extending to below the median line.

The Weak fish, so called in Dr. Mitchell's *Fishes of New York*, appears also in his report as the Squeteague and Checouts, the former being a Narragansett Indian name and the latter derived from the Mohegans. The Narragansett name is sometimes spelled Scuteeg. Chickwick is the Connecticut name for the species; on Cape Cod, because of the sound produced by the fish, it is called the Drummer; large Weak fish in Buzzards Bay are termed Yellow fins. In Great Egg Harbor Bay the name Blue fish is applied to it, notwithstanding the presence of the real Blue fish (*Pomatomus*). On our southern coast we hear the name Trout, with its variations, Grey Trout, Sea Trout, Shad Trout, Sun Trout and Salt-water Trout. The latter name is used to distinguish it from the Fresh-water Trout of the Southern States,

which is the Black Bass. Dr. Mitchill thus accounts for the name Weak fish: "He is called Weak fish, as some say, because he does not pull very hard after he is hooked; or, as others allege, because laboring men who are fed upon him are weak by reason of the deficient nourishment in that kind of food." DeKay explains the name from the feeble resistance the fish makes on the hook and the facility with which it breaks away from it by reason of its delicate structure. At the time of DeKay's writing in 1842, and for some years previously, the Weak fish were present on our coast in diminished numbers. The Blue fish were then present in abundance and the disappearance of the Weak fish was supposed to be connected with the reappearance of the Blue fish. A similar observation was made by Dr. Storer on the Massachusetts coast. Again, at Woods Hole, Mass., in 1900, the Weak fish were remarkably abundant, the traps at Menemsha having taken 10,000 in a single day; the Blue fish, on the other hand, were unusually scarce during the entire season, not over 50 having been recorded from the adjacent bay and sound.

The Weak fish ranges from the Bay of Fundy to the east coast of Florida. It fluctuates in abundance from year to year. The late Capt. N. E. Atwood is authority for the statement that in 1845 the weekly supply in the New York markets was not above 1,000 pounds.

The earliest arrival in New York in 1889 was on May 12, at Great Hills, Gifford, Staten Island. During the latter part of August, 1889, the west channel of Great South Bay furnished great numbers of Weak fish. The young were found in Blue Point Cove late in September; also some half-grown individuals. The fish are in their finest condition during the fall migration in September and October.

In 1901 young Weak fish were seldom taken in Great South Bay, and only two localities — Duncan's Creek and Smith's Point — furnished them in very small numbers. Adult fish, however, were remarkably abundant, and were caught in many parts of the bay.

The species feeds in the channels upon Shrimp, Crabs and small fish. In Great South Bay we found them eating large quantities of Anchovies, and the same observation was made in one of the inlets of Great Egg Harbor Bay, N. J. The fish enters the mouths of rivers and migrates freely with the tide.

The species swims in large schools near the surface and is very voracious, destroying the young even of its own kind. A specimen of about 4 pounds, taken at Islip, October 1, 1890, had in its stomach a Weak fish weighing about 6 ounces. Fish of 4 pounds and a little larger were moderately abundant at this date.

Weak fish spawn in New York waters in May, and at Cape Cod about the first of June. The egg is  $\frac{1}{28}$  inch in diameter and hatches in two days at an average tem-

perature of 60° F. It is buoyant, and, under natural conditions, is subject to the influence of wind and current. The spawning season is evidently prolonged in some localities; in Great Egg Harbor Bay, for example, young Weak fish only 1½ inches long were taken in August, that is, several months after spawning begun. The most favorable tide for catching this species is generally considered the latter half of the flood and first half of the ebb. At night the Weak fish runs up the creeks to feed in the salt meadows, and will take the hook freely.

Some of the best baits for the Weak fish are the common Shrimp, Soft or Shedder Crabs, pieces of Clam and common Mussel, the white skin of the throat of Weak fish, and sometimes the eye of this species; other good baits are Silversides and Anchovies. In Great South Bay the fish are taken extensively in pound nets and in gill nets. The gill nets are set in the shape of a horseshoe, and the attending sloop sails back and forth across the open end of the horseshoe, one of the crew meanwhile beating the deck with his heels to frighten the fish into the nets. This method, called drumming, is in great disfavor among those who follow other modes of fishing.

The Weak fish endures captivity very well and can be kept during winter in water of the proper temperature. The species is said to reach the weight of 30 pounds.

**122. Spotted Weak Fish; Sea Trout** (*Cynoscion nebulosus* Cuv. & Val.).

*Labrus squeteague* var. *maculatus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 396, 1815  
New York; not *Labrus maculatus* BLOCH.

*Otolithus carolinensis* DE KAY, N. Y. Fauna, Fishes, 72, 1842, extra limital; HOLBROOK,  
Ichth. S. C., ed. 1, 133, pl. 19, fig. 2, 1856.

*Cynoscion nebulosus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1409, 1898, pl.  
CCXXI, fig. 563, 1900.

Body silvery with bright reflections; numerous black spots on back, beginning under the spinous dorsal; soft dorsal and caudal similarly spotted, the largest spots smaller than pupil; anal fin dusky.

The Spotted Weak fish is a better food fish than the common northern species; it ranges from New York to Texas, but is rare north of Virginia.

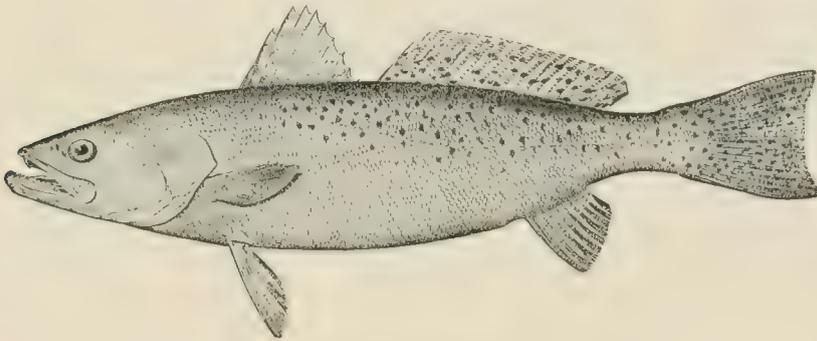
123. Yellow Tail ; Silver Perch (*Bairdiella chrysura* Lacépède).

*Bodianus argyroleucus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 417, pl. 6, fig. 9, 1815, New York.

*Corvina argyroleucas* DEKAY, N. Y. Fauna, Fishes, 74, pl. 18, fig. 51, 1842, New York.

*Homoprion xanthurus* HOLBROOK, Ichth. S. C., ed. 1, 170, pl. 24, 1856 (not *Leiostomus xanthurus* LACÉPÈDE).

*Bairdiella chrysura* GOODE, Fish. & Fish. Ind. U. S., I, 375, pl. 126, 1884; BEAN, Bull. U. S. F. C., VII, 141, pl. I, fig. 9, 1888; 19th Rept. Comm. Fish. N. Y., 259, 1890; Bull. Am. Mus. Nat. Hist., IX, 367, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1433, 1888, pl. CCXXII, fig. 566, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 106, 1900.



SPOTTED WEAK FISH.

Greenish above, silvery below, each scale with series of dark punctulations through the center, usually very conspicuous, sometimes obscure, these forming narrow somewhat irregular streaks along the sides; fins plain, the caudal yellowish.

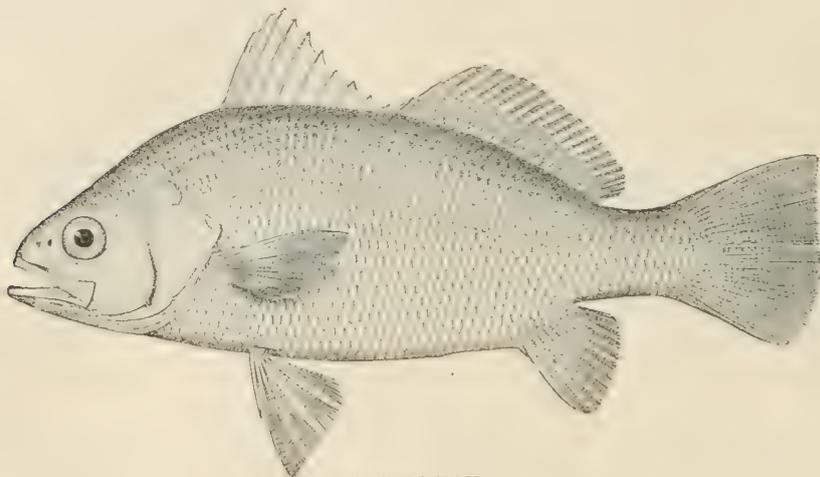
Dr. Mitchill describes this fish as the Silver Perch, and DeKay explains the origin of this name from the resemblance which the Yellow Tail bears in its appearance and habits to the common White Perch. At Pensacola, Fla., the name Mademoiselle is applied to the species. In Great South Bay we heard the name Lafayette given it, but this belongs more properly to the Spot, *Liostomus xanthurus*.

The Yellow Tail occurs on our coast from Cape Cod to Florida. It was a common fish in Great South Bay in September, 1890, and during the early part of October, occurring at Blue Point Cove, at the Blue Point Life Saving Station, Great River Beach and Fire Island. It is frequently taken in the pounds. In 1898 the young were found in abundance at Nichols's Point, Great South Bay, September 1. In 1901 the species was not observed at all during a season extending from the middle of July to the middle of October.

The breeding season must continue into early summer, as many young fish from

1 inch to 2½ inches long were obtained in Great Egg Harbor Bay, N. J., early in August.

The young of the Silver Perch are found every summer in Gravesend Bay, and adults are to be seen occasionally. On September 8, 1896, Mr. DeNyse took an example 1¼ inches long with a shrimp net, in eel grass back of the flats at extreme low tide. Pools containing 2 feet of water are common here, and many species of fish become imprisoned in them. In August Mr. W. I. DeNyse has captured a half dozen adult *Hippocampus* in such localities. On October 5, 1896, and again in the fall of 1897, the Silver Perch was obtained in the bay.



YELLOW TAIL.

The species seldom exceeds 10 inches in length, but is regarded as an excellent pan fish, and is secured in enormous numbers.

**124. Red Drum ; Channel Bass (*Sciaenops ocellatus* Linnæus).**

*Sciana imberbis* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 411, 1815, New York.

*Corvina ocellata* DEKAY, N. Y. Fauna, Fishes, 75, pl. 21, fig. 61, 1842, New York ; HOLBROOK, Ichth. S. C., ed. 1, 149, pl. 21, fig. 2, 1856.

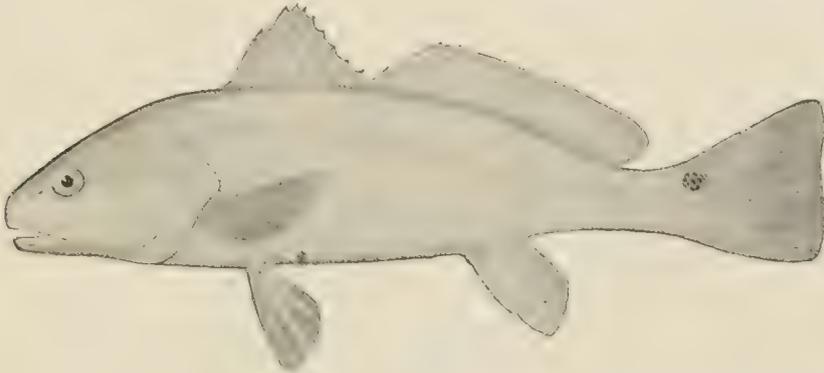
*Sciaenops ocellatus* BEAN, Bull. Am. Mus. Nat. Hist., IX, 367, 1897, New Jersey ; H. M. SMITH, Bull. U. S. F. C. 1897, 101. 1898 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1453, 1898, pl. CCXXXII, fig. 567, 1900.

The Red Drum is one of the largest of the food fishes of the southern waters, reaching the length of 5 feet and the weight of 75 pounds. It inhabits the Atlantic coast from New York to Texas, and has once been taken near Cape Cod.

A Red Drum, or Spotted Bass, weighing 14 pounds, was obtained by Mr. E. G. Blackford from New Jersey, and was purchased alive for the New York Aquarium.

When last observed by me (December 11, 1897) it was in the central pool, and apparently, in perfect health. It swam sometimes immediately under the Sand Shark. Its food consists of large pieces of Herring, which it takes readily.

The only specimen known to have been taken at Cape Cod was caught in a trap in Buzzards Bay at the breakwater in 1894. The example is 34 inches long and weighs about 14 pounds. On account of the ocellated markings at the base of the caudal fin it has sometimes been called the Branded Drum.



RED DRUM.

**125. Spot; Lafayette** (*Leiostomus xanthurus* Lacépède).

*Leiostomus xanthurus* DEKAY, N. Y. Fauna, Fishes, 70, 1842, extra limital.

*Leiostomus xanthurus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 574, 1883.

*Leiostomus xanthurus* BEAN, 19th Rept. Comm. Fish. N. Y., 260, 1890; Bull. Am. Mus. Nat. Hist., IX, 367, 1897.

*Leiostomus xanthurus* EUGENE SMITH, Proc. Linn. Soc. N. Y., 1897, 39, 1898.

*Leiostomus xanthurus* MEARNS, Bull. Am. Mus. Nat. Hist., X, 321, 1898.

*Mugil obliquus* MITCHILL, Rept. Fish. N. Y., 16, 1814, New York.

*Leiostomus obliquus* DEKAY, N. Y. Fauna, Fishes, 69, pl. 60, fig. 195, 1842.

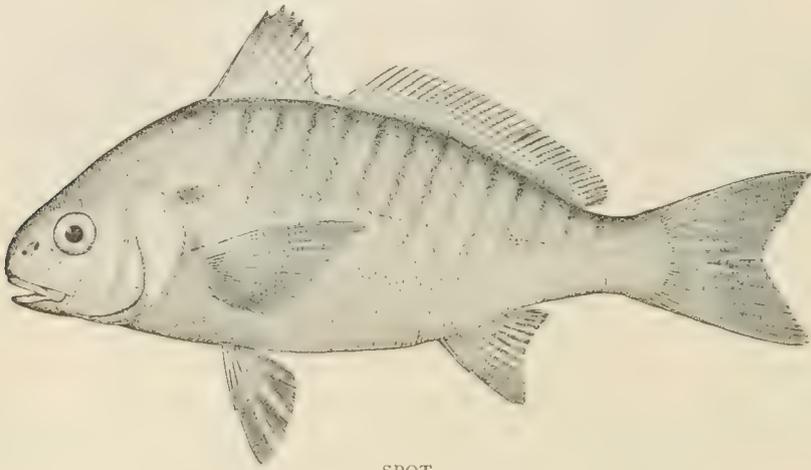
Color bluish above, silvery below; about 13 to 15 narrow dark lines extending from the dorsal fins downward and forward to below the lateral line; a roundish black humeral spot about two-thirds as long as the eye; fins plain olivaceous.

This little fish was formerly known on the New York coast as Lafayette. Mitchill calls it the Little Porgee. According to DeKay its appearance on the New York coast in the summer of 1824 happened to coincide with the arrival of General Lafayette, and his name was bestowed upon the species. The name Spot is derived from the presence of a dark blotch about as big as the eye near the root of the pectoral fin. Other names for the species are Goody, Oldwife, Roach and Chub.

The Spot is found from Cape Cod to Florida and is sometimes abundant as far north as New York. In Great South Bay several specimens were taken early in October in Great River. A single example was seen among some fishes taken in a pound net at Islip, October 1, 1890. In 1898 the species was not obtained by the writer, and in 1901 only a few specimens, mostly adults, were secured at Quantic Bay, Duncan's Creek and Widow's Creek.

Rather common in Gravesend Bay from July to as late as December, and is well adapted to captive life. It is mostly abundant usually in September.

Dr. Mearns states that the fish, locally known as the Sand Porgee, is of frequent occurrence in summer in the Hudson River and its estuaries. H. M. Smith records



SPOT.

it as common in the fall in the vicinity of Wood's Hole, Mass., leaving in October or November, when the water temperature reaches 45° F. All the specimens observed there were about 6 inches long.

It is a small fish, seldom exceeding 10 inches in length, but is one of the favorites among the pan fishes. The Spot feeds upon the bottom on small invertebrates, and can be taken readily with hook and line. In Great South Bay it is caught in seines and pound nets. It ascends creeks into brackish water and is a common associate of the White Perch. In Great Egg Harbor Bay it is extremely common in summer and is sometimes known as Porgee.

**126. Croaker** (*Micropogon undulatus* Linnæus).

*Bodianus costatus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 417, 1815, New York.

*Micropogon costatus* DEKAY, N. Y. Fauna, Fishes, 83, pl. 72, fig. 230, 1842.

*Micropogon undulatus* DEKAY, N. Y. Fauna, Fishes, 84, 1842, extra-limital.

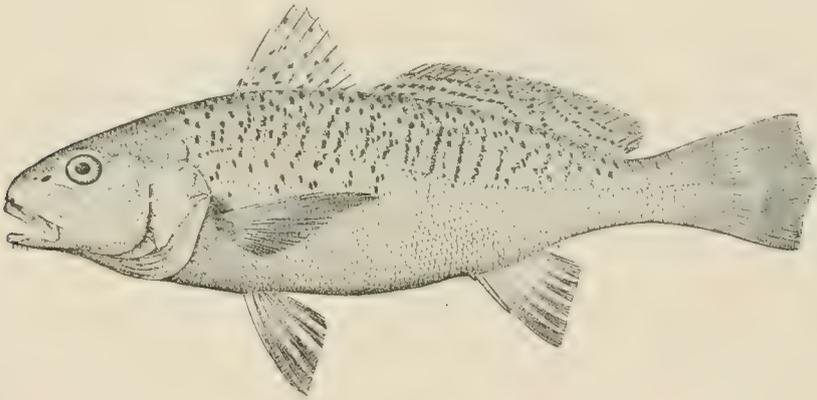
*Micropogon undulatus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 575, 1883.

*Micropogon undulatus* BEAN, Bull. Am. Mus. Nat. Hist., IX, 368, 1897.

*Micropogon undulatus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1461, 1898, pl. CCXXIV, fig. 570, 1900.

Color grayish silvery, with bright reflections; sides and back with narrow, irregular, undulating lines of dots; dorsal fins with three lines of dots along base.

The Croaker inhabits the east coast of the United States, ranging from Cape Cod to Texas; it is not very common north of the Chesapeake. It grows to the



CROAKER.

length of 15 inches and is an important food fish. The fish was described by Mitchill but was unknown to DeKay from personal observation. Although known in Gravesend Bay, the species is a very uncommon one there. Mr. W. I. DeNyse informs me that several individuals were taken there in September, 1902. The only specimen recorded at Woods Hole, Mass., is 15 inches long; it was taken in a trap at the breakwater in Buzzards Bay on September 9, 1893.

**127. King Fish ; Whiting ; Sea Mink** (*Menticirrhus saxatilis* Bloch & Schneider).

*Sciena nebulosa* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 408, pl. 3, fig. 5, 1815.

*Umbrina alburnus* DEKAY, N. Y. Fauna, Fishes, 78, pl. 7, fig. 20, 1842.

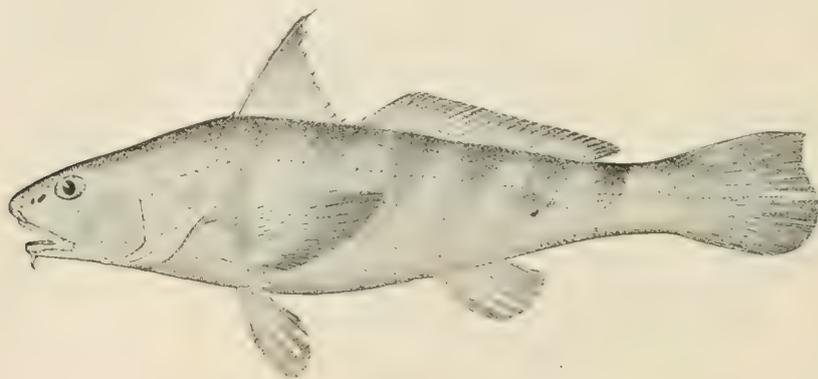
*Menticirrhus nebulosus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 577, 1883.

*Menticirrhus saxatilis* BEAN, 19th Rept. Comm. Fish. N. Y., 259, pl. XII, fig. 16, 1890.

*Menticirrhus saxatilis* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 1475, 1898.

*Menticirrhus saxatilis* BEAN, 52d Ann. Rept. N. Y. State Mus., 106, 1900.

Color dusky gray above, sometimes blackish, the back and sides with distinct dark oblique cross-bands running downward and forward, the anterior one at the nape extending downward, meeting the second and thus forming a v-shaped blotch on each side ; a dark lateral streak bounding the pale color of the belly, most dis-



KING FISH.

tinct posteriorly, and extending on lower lobe of caudal ; inside of gill cavity scarcely dusky ; pectorals dark.

The King fish, according to DeKay, was so named by the early English colonists because of its excellent flavor. The name Hake is given to it in New Jersey and Delaware ; in the Chesapeake it is sometimes called Black Mullet ; in North Carolina, the Sea Mink ; in the South it is the Whiting or Bermuda Whiting ; on the Connecticut coast it is known as the Tomcod.

The King fish occurs northward to Cape Ann and south to the Gulf of Mexico. Large individuals are not common as far north as Cape Cod, but the young may be seen in moderate numbers in the summer months. They occur in abundance throughout Great South Bay, and near the inlet their number is increased. We have collected them at the mouth of Swan Creek, in Blue Point Cove, at the Blue Point Life Saving Station, Oak Island and Fire Island. An individual was obtained October 7th in the bay, and others were found during September. Adult King fish

used to be common in Great South Bay, but in 1884 they were rare, according to Mr. Erastus Gordon, of Patchogue. In 1898 only one adult was taken by the writer, and that was found in Clam Pond Cove, August 26. Young were seined at Fire Island Inlet, Nichols's Point, Howell's Point, Blue Point Cove, and in Peconic Bay. In 1901 large King fish were not uncommon in Great South Bay, but the young were unusually rare, only two specimens, measuring from  $3\frac{3}{4}$  to 4 inches, having been obtained; these were seined at Duncan's Creek September 14.

The King fish was formerly abundant in Gravesend Bay, but it seldom occurs there now.

The species evidently breeds at Woods Hole, Mass. Dr. Smith says that adults full of spawn are common there in June, and uncommon after July 15. The young, about an inch long, appear in the middle of July, and the young are numerous on sandy beaches during the summer and until early October, when they leave, having attained a length of 4 or 5 inches. Some of the young are almost entirely black, while others of the same size, taken at the same time, show the color markings of the adults. The maximum weight there is about 2 pounds.

The species is a favorite in New York waters and well merits its reputation as a choice food fish. It takes the baited hook very readily. Hard clam, cut small, shedder crab, black mussels and various kinds of fish are good baits. It goes in schools and associates with the Weak fish.

### 128. Drum (*Pogonias cromis* Linnæus).

*Pogonias fasciatus* DEKAY, N. Y. Fauna, Fishes, 81, pl. 14, fig. 40, 1842.

*Mugil grunniens* MITCHILL, Rept. Fish. N. Y., 16, 1814, New York.

*Mugil gigas* MITCHILL, Rept. Fish. N. Y., 16, 1814, New York.

*Labrus grunniens* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., 1, 105, 1815.

*Sciena fusca* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., 1, 409, 1815, New York.

*Pogonias chromis* DEKAY, N. Y. Fauna, Fishes, 80, 1842.

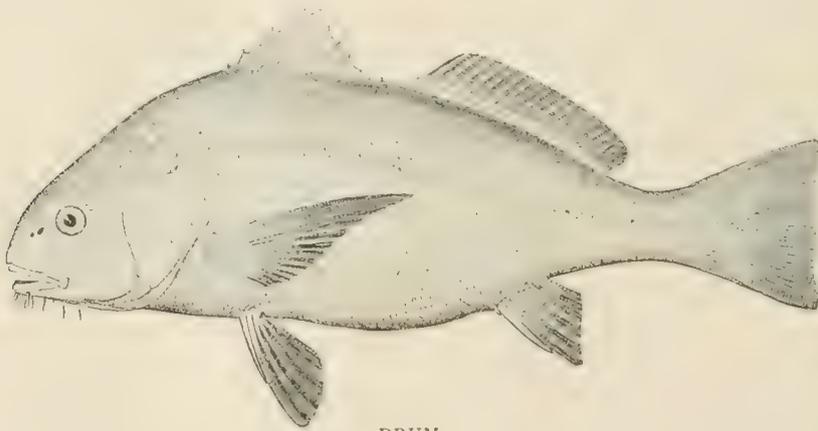
*Pogonias chromis* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 568, 1883.

*Pogonias chromis* BEAN, 19th Rept. Comm. Fish. N. Y., 261, pl. XIII, fig. 17, 1890.

Color grayish silvery, with five dark broad bars, three of which extend upon the dorsal fins, these bars disappearing with age; usually no oblique dark streaks along rows of scales above; fins dusky.

Dr. Mitchill describes the Drum under the names Black Drum and Red Drum. The Black Drum which he described weighed 34 pounds. He had a specimen of 80 pounds, and states that he was credibly informed of one that weighed 101 pounds. The species, according to Dr. Mitchill was taken abundantly during the summer

with line and net. The name Drum, he says, is derived from the drumming noise made by the fish immediately after being taken out of water. "He swims in numerous shoals in the shallow bays on the south side of Long Island, where fishermen during the warm season can find them almost like a flock of sheep; is a dull sort of fish." The Red Drum he considered merely a variety of the Black Drum. Dr. DeKay says of the species, which he calls the Big Drum: "They are gregarious, and frequently taken in great numbers by the seine during the summer along the bays and inlets of Long Island." DeKay adopted a different specific name for the young of this species, and called it the Banded Drum. Other names for this stage given by DeKay are: Grunter, Grunts, Young Drum and Young Sheepshead. He saw the young in September, and states that it is found in New York waters also in October and November. The adults, according to DeKay, are a coarse food, but the young are considered a great delicacy.



DRUM.

The Drum is occasionally taken on our coasts as far north as Cape Cod; southward it extends to the Gulf of Mexico.

The Drum is an occasional summer visitor in Gravesend Bay. In the fall of 1896 14 young individuals, 8 inches long, were brought from there alive to the aquarium, and lived until February 10, 1897, when the low temperature of the water (38°) killed them. In the fall of 1897 none were seen in the bay.

In the vicinity of Woods Hole, Mass., the Drum is very rare. Dr. Smith records the first one as having been taken May 7, 1874, and it has been observed only three or four times since. The recent specimens have been caught in traps at Quisset Harbor in the latter part of September or early in October; these specimens weighing each  $4\frac{1}{2}$  or 5 pounds. The largest Drum recorded was taken at St. Augustine Fla., and weighed 146 pounds. The large fish are not much valued for food, but small ones are said to be excellent.

**129. Fresh-water Drum; White Perch** (*Aplodinotus grunniens* Rafinesque).

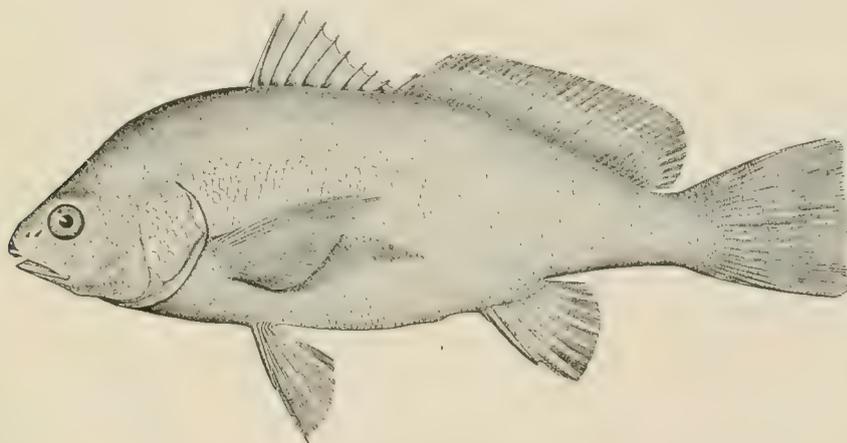
*Aplodinotus grunniens* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1484, 1898, pl. CCXXVI, fig. 574, 1900.

*Haploidonotus grunniens* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 567, 1883.

*Corvina oscula* DEKAY, N. Y. Fauna, Fishes, 73, pl. 21, fig. 63, 1842, Lakes Erie and Ontario.

The color is grayish, darker on the back; lower parts silvery. Young specimens have dark spots along the rows of scales, forming oblique lines.

The Fresh-water Drum has received a great number of common names. In the Ohio Valley and South it is known as the White Perch; in the Great Lakes region it is called Sheepshead or Fresh-water Drum on account of its resemblance to the Salt-water Drum. At Buffalo and Barcelona, New York, it is known as Sheepshead.



FRESH-WATER DRUM.

The name Crocus, used on lakes of Northern Indiana, is a corruption of Croaker, a name of a marine fish of the same family. In the Southern States the name Drum is generally applied to the species, and in addition the terms Thunder Pumper, Gaspergou and Jewel-head are used. Gaspergou is a term used in Arkansas, Louisiana and Texas. The names Drum, Croaker and Thunder Pumper have reference to certain sounds produced by the fish, either by means of its air bladder or by grinding together the large molar-like teeth in the pharynx. The name Jewel-head probably refers to the otoliths or ear bones, frequently called lucky stones, which are found in the skull of this species. In Texas, adjacent to Mexican territory, occurs the name Gaspagie, a variation of the name Gaspergou.

The Fresh-water Drum is widely distributed; it occurs in Lake Champlain and the entire Great Lakes region, the Ohio and Mississippi Valleys southward to Texas. The U. S. Fish Commission obtained a specimen at Point Breeze, N. Y., on Lake

Ontario. DeKay reported it as very common in Lake Erie, and called Sheepshead at Buffalo. At the time of his writing the fish was scarcely ever eaten. It is found principally in large streams and lakes, and rarely enters creeks and small rivers. In Western Texas the species is rare. In the wilds of Texas, New Mexico and Northern Mexico Mr. Turpe has found this fish in clear limestone streams emptying into the Rio Grande.

This species is usually found on the bottom, where it feeds chiefly on crustaceans and mollusks, and sometimes small fishes. It is especially fond of Crawfish and small shells, such as *Cyclas* and *Paludina*. Mr. Turpe mentions water plants as forming part of its food, and states that it will take a hook baited with worms or small Minnows.

The Fresh-water Drum grows to a length of 4 feet and a weight of 60 pounds, but the average market specimens rarely exceed 2 feet in length, and in many parts of the West much smaller ones are preferred. Nothing is recorded about the breeding habits of this species, and as to its edible qualities there is the greatest difference of opinion. Some writers claim that its flesh is tough and coarse, with a disagreeable odor, especially in the Great Lakes. Individuals from the Ohio River and from more southern streams are fairly good food fish, while in Texas Mr. Turpe considers it one of the most excellent of the fresh water fishes, comparing favorably with Black Bass. Mr. Ridgway, of the National Museum at Washington, pronounces the species from the Wabash River in Indiana a fine table fish, although, he says, other people there consider it inferior. Richardson described what is supposed to be a deformed specimen of this Drum under the name of Malashegany, which he had from Lake Huron. He described it as a firm, white, well-tasting fish, but never fat and requiring much boiling.

**130. Bergall; Cunner; Chogset; Nipper** (*Tautogolabrus adspersus* Walbaum).

*Tautoga cœrulea* MITCHILL, Rept. Fish. N. Y., 24, 1814, New York.

*Labrus chogset* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 402, pl. 3, fig. 2, 1815, New York.

*Labrus chogset fulva* MITCHILL, l. c. 403, 1815, New York.

*Crenolabrus uninotatus* DEKAY, N. Y. Fauna, Fishes, 174, pl. 29, fig. 90, 1842.

*Ctenolabrus adspersus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 599, 1883.

*Ctenolabrus adspersus* BEAN, 19th Rept. Comm. Fish. N. Y., 251, pl. IV, fig. 6, 1890.

*Tautogolabrus adspersus* BEAN, Proc. U. S. Nat. Mus., 87, 1880; Bull. Am. Mus. Nat. Hist., IX, 368, 1897; 52d Ann. Rept. N. Y. State Mus., 107, 1900; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., II, 1577, 1896, pl. CCXXXVI, fig. 595, 1900.

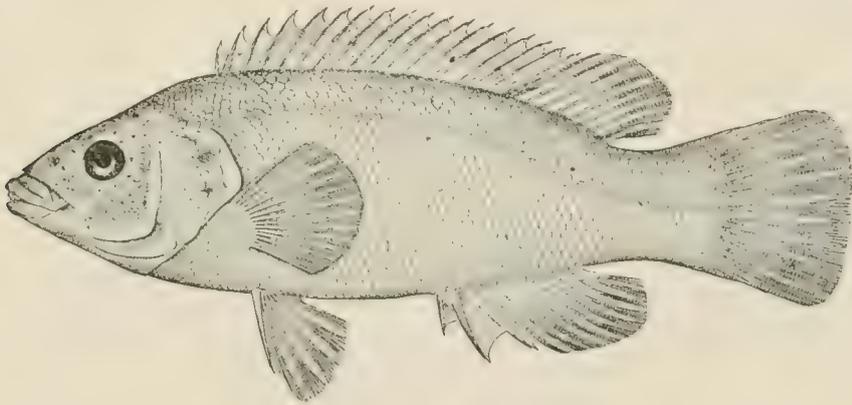
Color bluish or brownish, usually with a brassy luster on sides; head and back sometimes spotted with brassy; young with darker blotches and markings, and

often with a black blotch near the middle of the dorsal fin. Some individuals are yellowish and the young are often green.

The Cunner is known also as Chogset and Bergall (this changed to Bengal in Great Egg Harbor Bay, N. J.). Mitchill gives the name of Blue fish as in use in New York in 1815; Perch, Sea Perch and Blue Perch are New England names given for this fish. Names used with reference to its bait-stealing propensities are: Nipper and Bait-stealer.

The Cunner is common from Labrador to at least as far south as New Jersey.

The Bergall is found in Gravesend Bay throughout the year. In 1898 the writer found it in Peconic Bay and the adjacent Scallop Pond; south side of Great South Bay opposite Patchogue; Fire Island Inlet; Blue Point Cove and Duncan's Creek.



BERGALL.

In 1899 young examples were taken at Water Island ocean beach, June 6. In 1901 young of a yellow color and only  $1\frac{3}{8}$  inches long, were seined in a creek near Fire Island Inlet August 15. Half-grown and adults were caught at a wreck on Tobey's Flat August 14, and at Smith's Point August 23.

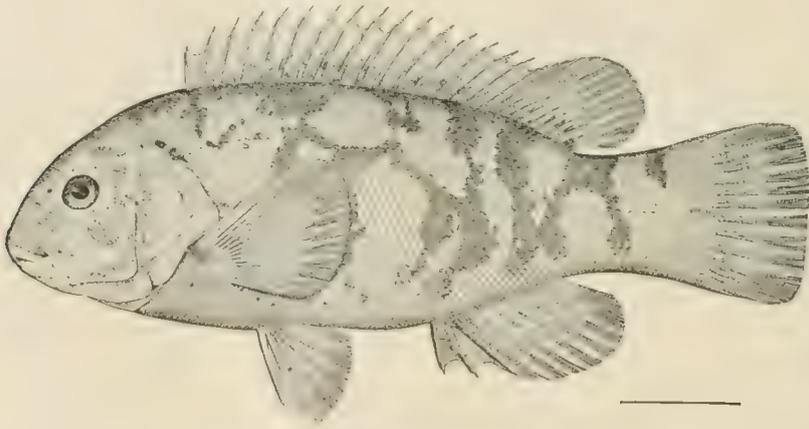
At Woods Hole, Mass., the Cunner is very abundant and remains during the entire year. Thousands perish from cold every winter. The fish spawns in June. The egg is about  $\frac{1}{26}$  inch in diameter, buoyant, and has been hatched in the tidal cod-jar in five days in water of a mean temperature of  $56^{\circ}$  F. By August 1 the young an inch long are observed. Outside of Gayhead and Cuttyhunk the fish reaches a weight of  $2\frac{1}{2}$  pounds, but the usual weight is from  $\frac{1}{4}$  to  $\frac{1}{2}$  pound. In February, 1901, thousands of Cunnners were killed by extreme cold at Wood's Hole.

The Cunner endures captivity very well, individuals having been kept three years or longer. The species is usually associated with the Tautog or Black fish; in many places it proves a great annoyance to fishermen. In some parts of New

England the fish is highly esteemed, but farther south it is not in high repute, the hard scales and stiff, sharp spines making it inconvenient to prepare for cooking.

Dr. Mitchill describes a yellow variety of the Cunner, and DeKay has considered the young, which has a black spot on the exterior portion of the dorsal fin, as a distinct species, named by him the Spotted Bergall.

The young vary greatly in color. We have seen some dull brown, others that were yellowish, and still others of a bright green. Dusky bands are characteristic, also, of the young stages. Examples were taken at Blue Point Cove, and at Fire Island. The Cunner is a permanent resident, and does not retreat into deep water except in very cold weather. Its spawning takes place in June and July. The species is fished for with the hook, and is taken in nets, which are baited and set among the rocks. The catch of the Irish Cunner boats of Boston has been estimated at about 300,000 pounds annually.



BLACK FISH.

**131. Black Fish ; Tautog (*Tautoga onitis* Linnæus).**

*Tautoga niger* MITCHILL, Rept. Fish. N. Y., 23, 1814, New York.

*Labrus tautoga* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 399, 1815, Long Island.

*Tautoga americana* DEKAY, N. Y. Fauna, Fishes, 175, pl. 14, fig. 39, 1842.

*Tautoga onitis* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 600, 1883 ; BEAN, 19th Rept. Comm. Fish. N. Y., 252, pl. V, fig. 7, 1890 ; Bull. Am. Mus. Nat. Hist., IX, 368, 1897 ; 52d Ann. Rept. N. Y. State Mus., 107, 1900 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., II, 1578, 1896, pl. CCXXXVII, fig. 596, 1900.

Color blackish, greenish, frequently pale bluish or bluish black, with metallic reflections. Often with irregular bands of a deeper hue. Lips, lower jaw and abdomen lighter, sometimes pale, sprinkled with black points, and sometimes of the same color as the rest of the body. Eye greenish.

This is better known in New York as the Black fish; farther south it is styled Chub or Salt-water Chub, Moll, Will, George and Oyster fish. Mitchill gives the name Tautog as of Mohegan origin. He publishes for the species the names Toad, Black fish and Runner. The Mohegan name Tautog, according to DeKay, is said to mean black. The fish is found from Nova Scotia to Virginia. It occurs in all parts of Great South Bay visited by us. Some of the localities at which it was taken are the following: Blue Point Cove and Life Saving Station, Great River Beach and Fire Island. The name used at Patchogue is Black fish. We saw a few Tautog among the fishes caught in a trap at Islip, October 1, 1890. In 1898 specimens were obtained in Peconic Bay, at Blue Point Cove, Islip, Nichols's Point and Fire Island Inlet; young individuals were taken July 29, August 25, September 1 and 16. Following is a list of localities in which the Tautog was sparingly taken in Great South Bay in 1901: Clam Pond Cove, July 19; Fire Island Inlet, August 15; Cherry Grove, August 17; Smith's Point, August 23; Mouth Swan River, September 25; Off Widow's Creek (young), September 28; Off Swan River (young), October 8 and October 11.

Dr. Mitchill gives a most entertaining account of the habits and mode of capture of this well-known species. At the time of his writing, in 1814, the price varied from 8 to 12 cents a pound.

### 132. Spade Fish; Triple Tail; Angel Fish (*Chætodipterus faber* Broussonet).

*Chatodon oviformis* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 247, pl. V, fig. 4, 1815, New York.

*Ephippus gigas* DEKAY, N. Y. Fauna, Fishes, 99, pl. 23, fig. 71, 1842, New York.

*Ephippus faber* DEKAY, N. Y. Fauna, Fishes, 97, pl. 23, fig. 68, 1842.

*Chatodipterus faber* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 613, 1883; BEAN, 19th Rept. Comm. Fish. N. Y. 253, pl. VI, fig. 8, 1890; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., II, 1668, 1896; IV, pl. CCXLVII, fig. 619, 1900.

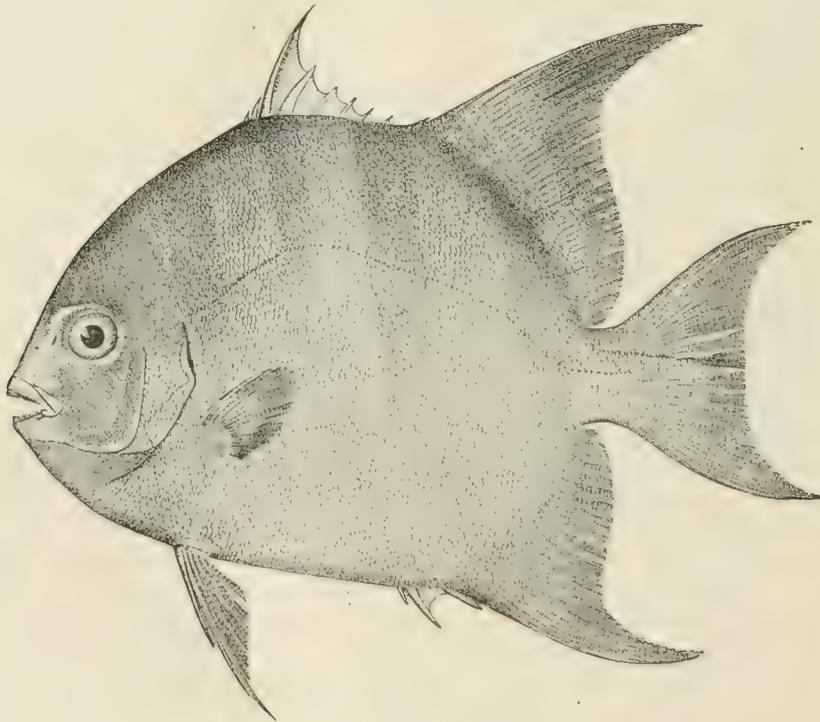
Grayish; a dusky band across the eye to the throat; a second similar band, broader, beginning in front of the dorsal and extending across the base of the pectoral to the belly; a third band narrower, extending to the middle of the sides from the base of the fourth and fifth dorsal spines; a fourth broader band from the last dorsal spines to anal spines, the remaining bands alternately short and long; all of these bands growing obscure and disappearing with age; ventrals black.

The Moon fish is the Sheepshead *Chætodon* of Mitchill, and the Banded *Ephippus* of DeKay. Dr. Mitchill records it as taken at the east end of Long Island, July 27, 1815. DeKay, in his *New York Fauna*, has the following concern-

ing the species: "About twenty years since, they were caught here in seines in great numbers and exposed in the market for sale. Some of them were 18 inches long. Those described by Mitchill were captured in 1815 and 1817. The popular names of Three-tailed Sheepshead and Three-tailed Porgee were given them by the fishermen in allusion to their prolonged dorsal and anal fins . . . Schoepff states that it is called Angel fish in South Carolina."

The species is called Spade fish in the States bordering the Gulf of Mexico.

The Moon fish has occasionally been taken as far north as Cape Cod. Dr. Smith records it as a very rare straggler in Vineyard Sound, Mass. A specimen was



SPADE FISH.

obtained in 1889, and three have been observed since. All were taken in traps at Menemsha in August and September. The fish were uniform in size and about 16 to 18 inches long. The species reaches a length of 2 to 3 feet. Southward it is recorded as far as Guatemala. It occurs in the West Indies. In Chesapeake Bay it is moderately common.

As a food fish this species is highly prized by those who are familiar with its qualities.

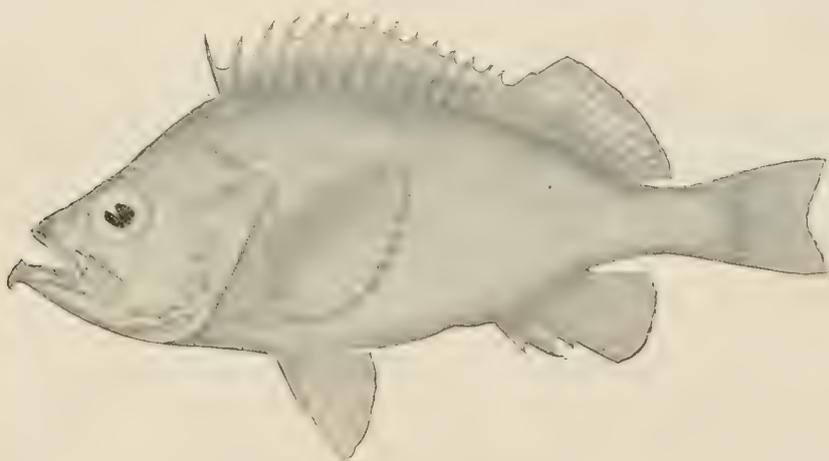
133. Rosefish ; Norway Haddock (*Sebastes marinus* Linnæus).

*Sebastes norvegicus* DEKAY, N. Y. Fauna, Fishes, 60, pl. 4, fig. 11, 1842, off New York in deep water ; STOREY, Hist. Fish. Mass., 38, pl. VII, fig. 1, 1867.

*Sebastes marinus* GOODE & BEAN, Oceanic Ichth., 260, pl. LXIX, fig. 248, 1896 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1760, 1898, pl. CCLXVIII, fig. 653, 1900.

Orange red, nearly uniform, sometimes a dusky opercular blotch, and about five vague dusky bars on back. Peritoneum brownish.

The Rosefish is abundant at the hundred-fathoms line off the south coast of New England, and has been found in depths of 180 fathoms. It breeds abundantly in late summer at these depths, and there is no reason to believe that the young rise



ROSEFISH.

to the surface. The fry were caught by the bushel in the trawl net of the U. S. Fish Commission steamer *Fish Hawk*.

The species was originally described from Norway by Linnæus. Cuvier had specimens from Miquelon, Newfoundland. Day mentions a number of localities of its capture about the British Isles, but it is rare south of Faroe Islands. It occurs on the southwest coast of Spitzbergen, and on the Norwegian coast it is found everywhere from Christiana around to the Varanger-Fiord. It also occurs in Greenland, and from Labrador, as a shore form, as far south as Cape Cod, and in deeper water as far south as New Jersey.

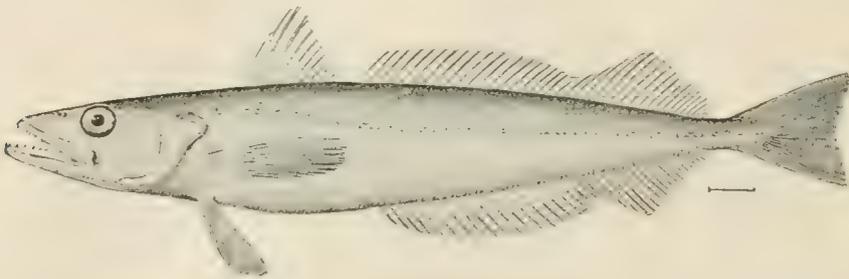
In the Woods Hole region it was taken on the shore on December 20, 1895, in Great Harbor. Seven or eight specimens, 3 inches long, were found in a hole on a flat, where they had been left by the tide ; four or five of these had been stranded and were dead ; the others were alive when captured. Fishermen claim that they

sometimes catch these fish in traps very late in fall at Provincetown. (After Smith.)

DeKay has the following remarks upon the fish :

This is a very rare fish in our waters. It is called by our fishermen Red Sea Perch, and they say it is only found in deep water. By the fishermen of Massachusetts it is known under the various names of Rosefish, Hemdurgon and Snapper. Fabricius states that it is a rather agreeable food, but meager. It feeds on Flounders and other fish, and takes the hook readily.

The species reaches the length of 2 feet ; it is frequently to be found in the Boston markets, and is seen occasionally in the markets of New York with the skin removed, on account of the hard scales.



WHITING.

134. Whiting; Silver Hake (*Merlucius bilinearis* Mitchill).

*Stomodon bilinearis* MITCHILL, Rept. Fish. N. Y., 7, 1814.

*Gadus merlucius* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 371, 1815.

*Gadus albidus* MITCHILL, Jour. Ac. Nat. Sci. Phila., I, 409, 1817.

*Merlucius albidus* DEKAY, N. Y. Fauna, Fish., 280, pl. 46, fig. 148, 1842.

*Merlucius bilinearis* BEAN, 19th Rept. Comm. Fish. N. Y., 249, pl. IV, fig. 5, 1890; GOODE & BEAN, Oceanic Ichth., 386, fig. 330, 1896; H. M. SMITH, Bull. U. S. F. C., 1897, 107, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2530, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 109, 1900.

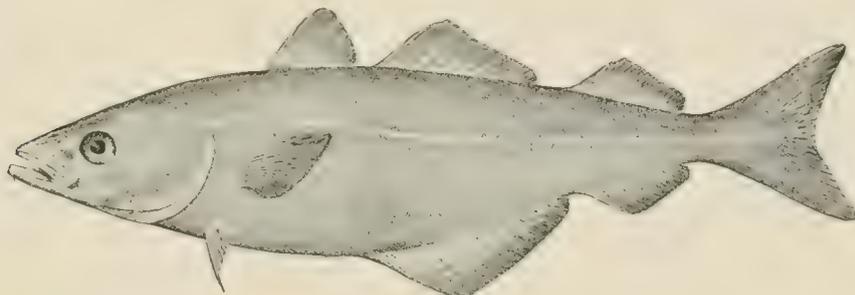
Grayish, darker above, dull silvery below; axil and edge of pectoral somewhat blackish; inside of opercle dusky silvery; inside of mouth dusky bluish; peritoneum nearly black.

The Whiting is known by the additional names of Hake and Silver Hake. Mitchill describes it as the Hake, *Gadus merlucius*. He states that it is caught with the other Cod. DeKay called it the American Hake. He styles it a rare fish in the waters of New York, and, when caught, always associated with the common Cod. The specimen described by DeKay was taken in November off Sandy Hook. In

his *New York Fauna*, he mentions Mitchill's description of a specimen which measured 21 inches in length.

The Whiting ranges from Labrador to Virginia. Young examples have been found even farther south in very deep water. This fish occurs in Gravesend Bay in spring and fall. In Great South Bay no individuals were seen by the writer during the summer, but an individual was obtained late in the fall by Capt. Thurber. October 28, 1898, several examples were received from the Atlantic, off Southampton.

According to Dr. Smith, the species is abundant every fall at Woods Hole, Mass., and some years it is common in summer. The fish swims close to the shore, and is caught in considerable numbers at Buzzards Bay at night with spears. Large individuals weighing 5 or 6 pounds are caught in traps. The young, measuring  $2\frac{1}{2}$  to 3 inches long, are seined in the fall about Woods Hole. The names in use for the fish



POLLACK.

in that locality are Silver Hake, Whiting, and Frostfish. In Massachusetts Bay the Whiting is a frequent visitor to the shores and is probably a resident of the middle depths. The young are frequently trawled in deep water.

### 135. Pollack (*Pollachius virens* Linnæus).

*Gadus purpureus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 370, 1815.

*Merlangus purpureus* DEKAY, N. Y. Fauna, Fish., 286, pl. 45, fig. 147, 1842.

*Merlangus carbonarius* DEKAY, N. Y. Fauna, Fish., 287, pl. 45, fig. 144, 1842.

*Merlangus leptoccephalus* DEKAY, op. cit. 288, pl. 45, fig. 146, Long Island.

*Pollachius virens* BEAN, Bull. Am. Mus. Nat. Hist., IX, 371, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2534, 1898; IV, pl. CCCLIX, fig. 886, 1900.

Greenish brown above; sides and below somewhat silvery; lateral line pale; fins mostly pale, sometimes a black spot on the axil.

The Pollack is a native of the North Atlantic. It is common northward on both coasts, and extends south to France and New Jersey. Mitchill described the fish under the name of the New York Pollack. DeKay mentions it under several

names, the New York Pollack, the Coalfish, and the Green Pollack. DeKay says the fish is taken with the common Cod, but is by no means common on the coast of New York. He saw a specimen weighing 17 pounds, and measuring 38 inches in length. In another description he states that the Coalfish is often taken off the harbor of New York in company with the Cod, and is known as Pollack and Black Pollack. The third form under which the fish was known to DeKay was described by him from a specimen captured by hook out of a large school in Long Island Sound. The Pollack enters Gravesend Bay in the fall. In captivity it is a ravenous feeder. It requires cold water and will not endure high temperatures.

DeKay states that the fish flipped in the same manner as the Menhaden, and was at first supposed to be of that species. The school seemed to be very timid, for, on a very slight noise in the boat, they all disappeared.

Dr. Smith states that adult Pollack appear in Vineyard Sound, Great Harbor, Woods Hole, Mass., in May, following the run of Cod. They depart when the temperature of the water reaches 60° or 65°. In April there is a run of Pollack measuring from 1 to 1½ inches long. By June, when these fish leave, they have reached a length of 4 inches. In fall there is a small run of Pollack 7 or 8 inches long. The average weight of adults in that locality is about 10 pounds, the largest one seined having weighed 14 pounds. In Massachusetts Bay this is an extremely abundant species, and constitutes an important food resource.

### 136. Tomcod; Frostfish (*Microgadus tomcod* Walbaum).

*Gadus tomcodus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 368, 1815.

*Cadus pruinosus* MITCHILL, Rept. Fish. N. Y., 4, 1814.

*Morrhua pruinosus* DEKAY, N. Y. Fauna, Fish., 278, pl. 44, fig. 142, 1842.

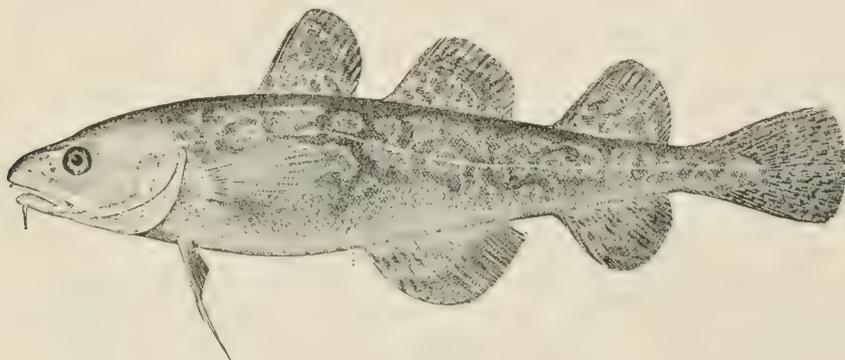
*Microgadus tomcodus* BEAN, 19th Rept. Comm. Fish. N. Y., 248, pl. 111, fig. 3, 1890.

*Microgadus tomcod* BEAN, Bull. Am. Mus. Nat. Hist., IX, 371, 1897; MEARN, Bull. Am. Mus. Nat. Hist., X, 322, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y., 1897, 40, 1898; H. M. SMITH, Bull. U. S. F. C., 1897, 107, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2540, 1898; IV, pl. CCCLX, fig. 890, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 109, 1900.

Color olive brown with reticulations and blotches of darker; sides and back profusely covered with dark punctulations; under parts lighter; dorsal, caudal and anal fins with dark blotches; pectorals and ventrals dusky.

This fish is very generally known in New York waters under the name of Frostfish. It ranges from Nova Scotia to Virginia, and is excessively common in shallow bays in cold weather. The name Frostfish is derived from the fact that it appears

after frosts have set in. The species ascends fresh-water rivers far above the limits of tide, and may be transferred suddenly from salt water to fresh without inconvenience. It spawns in the early part of winter, and is present at this time in such large numbers as to make its capture with dip nets comparatively easy. The Frostfish is the commonest member of the Cod family in New York waters. Its size is small, but, from the fact that it occurs in such abundance, it is an important market species. It is subject to great variations in color; Dr. Mitchill enumerates among its varieties five forms: the Brown, Yellow, Yellowish White, Mixed Tomcod and the Frostfish. DeKay has published the statement that he has known the Frostfish to be taken out of the water along the shores of Long Island in great numbers with a common garden hoe. He was informed that the species occasionally ascends the Hudson as far as Albany. In Great South Bay we found large numbers of Tomcod,



TOMCOD.

which were covered with a lernæan parasite. The same thing has been observed frequently at Woods Hole, Mass., and other northern localities. We found the species in nearly all parts of the bay late in September in moderate numbers, and more plentiful at Fire Island October 1.

July 29, 1898, a few young Tomcod were seined in Peconic Bay, near Southampton. In Gravesend Bay the fish is a fall and winter visitor. It does not live in captivity in summer. Dr. Mearns has found this fish in the Hudson River, where it is usually called Frostfish by the fishermen, who catch many of them in their fyke and ice nets during fall and winter. It bites readily and is esteemed as an article of food. Dr. Mearns has found it during the entire year, and in August has found young Tomcod fully an inch or two in length. He states that this fish is very often found in eel grass along shore, half dead, floating on the surface, but able to swim a little. Mr. Eugene Smith says that the Tomcod runs up stream into nearly pure fresh water in the vicinity of New York City. At Woods Hole, Mass., it is abundant in winter, coming about October 1 and remaining till May 1. It

spawns in December. In Massachusetts it is a resident species, entering brackish waters; it is common about the wharves and bridges in summer and is taken with nets and hooks in winter, in company with the Smelt.

The Tomcod reaches the length of about 10 inches. It is an important food fish and its eggs have been hatched artificially by the New York Forest, Fish and Game Commission in large numbers.

137. Cod (*Gadus morrhua* Linnæus).

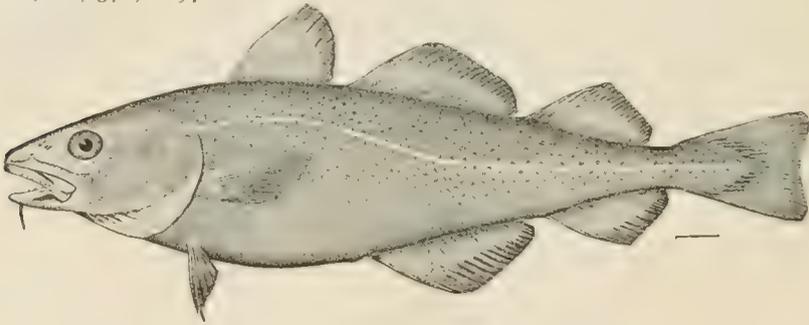
*Gadus callarias* MITCHILL, Rept. Fish. N. Y., 5, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 367, 1815; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2541, 1898; IV, pl. CCCLXI, fig. 891, 1900.

*Gadus arenosus* and *rupestris* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 368, 1815.

*Morrhua americana* DEKAY, N. Y. Fauna, Fish., 274, pl. 44, fig. 140, 1842.

*Gadus morhua* MITCHILL, Rept. Fish. N. Y., 6, 1814.

*Gadus morrhua* GÜNTHER, Cat. Fish. Brit. Mus., IV, 328, 1862; GOODE & BEAN, Bull. Essex Inst., XI, 8, 1879; Oceanic Ichth., 354, 1896; BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897.



COD.

Color olive or yellowish brown; numerous dark brown spots on the body; fins dark.

The Cod is an inhabitant of the North Atlantic and the North Pacific. It is a very important food fish and grows to a large size. Individuals weighing about 100 pounds have occasionally been taken. Mitchill has described this fish under several names—the Torsh, or Common Cod, or Rock Cod of New York. DeKay calls it the American Cod. In November, 1897, the Cod was abundant in Gravesend Bay. It thrives in captivity during the winter and spring, but cannot be kept during the warm months without cooling the water. In Vineyard Sound, according to Dr. Smith, the Cod appear about April 1 to about April 15, when the Dogfish drive them away. After the middle of October the Cod come again but in less numbers than in the spring, remaining till the first wintry weather. The fish spawns during

the late fall and winter. The young are first observed at Woods Hole about the first of April, when fish about 1 inch long are seined. Most of the young leave by June 15, having attained a length of from 3 to 4 inches. No Cod are seen between small fish of that size and fish weighing from 1½ to 2 pounds, which are caught in traps in the spring. Off the coast of New England Cod are very abundant in the deep waters, and they come up to the shoals and near the shores to spawn, from November about Cape Ann till February on Georges Banks.

**138. Haddock** (*Melanogrammus aeglefinus* Linnæus).

*Gadus aeglefinus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 370, 1815.

*Morrhua aeglefinus* DEKAY, N. Y. Fauna, Fish., 279, pl. 43, fig. 138, 1842.

*Melanogrammus aeglefinus* BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2542, 1898; IV, pl. CCCLXI, fig. 892, 892a, 1900.



HADDOCK.

Dark gray above, whitish below; lateral line black; a large dark blotch above the pectorals; dorsals and caudal dusky.

Mitchill described the Haddock under the name *Gadus aeglefinus*. DeKay also describes the fish and gives a figure of it in his *New York Fauna*. He states that it is nearly as common in the New York markets as the Cod, and during the summer it is even more abundant than the Cod.

The Haddock inhabits the North Atlantic on both coasts, ranging south to France and to North Carolina. Off Cape Hatteras it occurs in the deeper water. It is an important food fish, and reaches a moderately large size, attaining to a length of nearly 3 feet.

At Woods Hole, Mass., it was reported by Prof. Baird in 1871. Dr. Smith, however, says it is not found in Vineyard Sound or Buzzard's Bay, but is common 6 or 7 miles off Gay Head, and the ocean side of Martha's Vineyard. In Massachusetts Bay it is a common resident species.

139. **Burbot ; Lawyer ; Ling** (*Lota maculosa* LeSueur).

*Gadus maculosus* LESUEUR, Jour. Ac. Nat. Sci. Phila., I, 83, 1817, Lake Erie.

*Gadus lacustris* MITCHILL, Am. Month. Mag., II, 244, February, 1818.

*Lota inornata* DEKAY, N. Y. Fauna, Fish., 283, pl. 45, fig. 145, 1842, Hudson River.

*Lota compressa* DEKAY, op. cit. 285, pl. 78, figs. 244, 245, 1842.

*Lota maculosa* DEKAY, op. cit. 284, pl. 52, fig. 168, 1842; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., —, 1883; MEEK, Ann. N. Y. Ac. Sci., IV, 315, 1888, Cayuga Lake; BEAN, Fishes Penna., 138, pl. 35, fig. 75, 1893; EVERMANN & KENDALL, Rept. U. S. F. C., 1894, 603, 1896; BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897, Canandaigua Lake; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2550, 1898; IV, pl. CCCLXIV, fig. 897, 1900.

The color is dark olivaceous, reticulated with blackish ; the lower parts yellowish or dusky ; the dorsal, anal and caudal fins with a narrow dark edge.



BURBOT.

The American Burbot was first described by LeSueur from Lake Erie in 1817, and also from Northampton, Conn., under a different name. This common fish has received a great many names, including the following: Marthy, Methy, Losh, Eelpout, Dogfish, Chub Eel, Ling, Lawyer, Lake Cusk, Fresh-water Cod, Aleby Trout and Mother-of-Eels.

The southern limit of this fish appears to be Kansas City, Mo.; according to Prof. Cope, it has been once taken in the Susquehanna near Muncy, Lycoming County; it is extremely common in the Great Lakes; westward it ranges to Montana and northward throughout British Columbia and Alaska to the Arctic Ocean; it is most abundant in the Great Lakes and lakes of New York, New England and New Brunswick; it abounds also in rivers and lakes of Alaska.

The Burbot was sent from Canandaigua Lake by Mr. James Annin, Jr., in November, 1897. It is hard to transport and still harder to keep alive in captivity, being especially liable to attacks of fungus.

Dr. W. M. Beauchamp, writing from Baldwinsville, N. Y., April 9, 1879, said that the Burbot is found in Seneca River and is abundant in Oneida Lake; that it is

caught with a hook and is seldom eaten, though there is a way of making it palatable.

According to Dr. Meek it is found rarely in Cayuga Lake.

The average length of this species in the Great Lakes region is about 2 feet; in Alaska, according to Dr. Dall, it reaches a length of 5 feet and occasionally weighs 60 pounds; the size of the fish depends chiefly on the amount of food accessible to it.

It is stated that the Burbot is usually found in deep water on mud bottom, except during the spawning season in March, when it frequents hard or rocky bottoms. The eggs are small and numerous, and are believed to be deposited in deep water; Dr. Dall estimates that some individuals contain several millions of eggs; in Alaska the eggs are of a creamy yellow color, and the fish are found full of spawn from November to January. From the observations mentioned it will be seen that the spawning period extends at least from November to March; according to Dr. Dall the males are usually much smaller than the females and have a smaller liver; in some males he found two or three gall bladders opening into a common duct, but he never observed this phenomenon in the female; the eggs are laid separate or loose on the bottom of the river. According to Baron Cederström, a medium-sized female of the European Burbot, which is a near relative of the American species, contained about 160,000 eggs; in the European Burbot some eggs are clear, some yellowish and others almost colorless; the period of incubation occupies from three to four weeks; the eyes appear in 15 or 16 days; the embryos swim by quick movements of the pectorals, usually toward the surface of the water, whence they fall passively to the bottom.

The Burbot is extremely voracious, and feeds on bottom fishes and crustaceans. It destroys the Pike and such spiny fishes as the Yellow Perch and Sunfish. In Alaskan rivers it feeds on Whitefish, Lampreys and other species; large stones have sometimes been found in its stomach. Mr. Graham took a stone weighing a pound from the stomach of a Burbot.

In the Great Lakes region the Burbot is considered worthless for food; occasionally the livers are eaten; in Lake Winnebepesaukee, when caught through the ice in winter, the fish is highly esteemed; in the fur countries the roe is an article of food; on the Yukon River the liver is eaten and the flesh is liked by some persons; in Montana the Burbot is in great demand for food; the quality of the flesh appears to depend chiefly on the nature of the habitat of the fish.

This is the only member of the Cod family permanently resident in the fresh waters of America.

140. Hake; White Hake (*Urophycis tenuis* Mitchill).

*Gadus tenuis* MITCHILL, Rept. Fish. N. Y., 5, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 372, 1815, New York.

*Phycis tenuis* DEKAY, N. Y. Fauna, Fish. 293, 1842; BEAN, 19th Rept. Comm. Fish. N. Y., 248, pl. III, fig. 4, 1890; BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2555, 1898; IV, pl. CCCLXV, fig. 901, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 109, 1900.

Brownish, lighter and yellowish below; fins very dark. Distinguished from *P. chuss* chiefly by the smaller scales.

DeKay calls the Hake the American Codling, adopting Mitchill's common name for the species. He says it appears to feed chiefly on smaller crustacea; that it is very abundant at some seasons, but most abundant in the early part of autumn; and varies in weight from 3 pounds to 30 pounds. He states that it is called indis-



WHITE HAKE; COMMON HAKE.

criminatedly Hake and Codling by New York fishermen. Small individuals were seined in Mecox Bay August 2, 1898, and a very young example was received from Southampton September 11. This was caught in the Atlantic. In Great South Bay small examples were found sparingly at Blue Point Cove and Fire Island late in September.

The Hake, according to Dr. Smith, is known also as White Hake and Squirrel Hake in the vicinity of Woods Hole, Mass. Fish weighing 1 to 1½ pounds are abundant there in November, when a great many of them enter Eel Pond. Young fish 1 inch long and upward associate with Pollack in spring and are also found throughout the summer in considerable numbers. They are also obtained in summer at the surface, under gulf weed and eel grass.

As a rule the Common Hake will not live in water of a temperature above 60° F., but one individual survived the summer temperature in 1897, and became plump and sleek after the arrival of cold weather. In summer it was much emaciated, and suffered greatly from fungus attacks.

It is abundant on our shores from Labrador to Virginia, and its young are among the commonest of the surface fishes in our bays and sounds, during the summer months. The Hake reaches a weight of 40 pounds, but in the markets the average weight is only about 10 pounds. The species frequents muddy bottoms and is local in its habits. Its food consists of crabs and other crustaceans, besides small fishes.

The chief fishery for Hake takes place in the fall and winter months, and they will take the hook at night as well as during the day. Trawl lines are the usual implements of capture.



SQUIRREL HAKE.

141. Squirrel Hake (*Europhycis chuss* Walbaum).

*Gadus longipes* MITCHILL, Rept. Fish. N. Y., 5, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 372, pl. I, fig. 4, 1815, New York.

*Phycis chuss* BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897.

*Urophycis chuss* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2555, 1898; IV, pl. CCCLXV, fig. 902, 1900.

Brownish above, sides lighter and tinged with yellowish; thickly punctulate with darker; below pale; inside of mouth white; vertical fins somewhat dusky; anal fin margined with pale; lateral line not dark.

According to Jordan and Evermann, this fish is sometimes called Codling. It inhabits the Atlantic coast from the Gulf of St. Lawrence to Virginia, being very common northward. It is sometimes found in waters as deep as 300 fathoms. The Squirrel Hake occurs occasionally in Gravesend Bay; it lives usually in the deep water off shore.

At Woods Hole, Mass., according to Dr. Smith, it is abundant in May and June, and in October and November. It fills the traps and causes the fishermen much annoyance, as they cannot sell the fish. Its weight there is from 2 to 5 pounds. In Massachusetts Bay it is less abundant than the Common Hake. It was described and figured by Storer in 1867, under the name *Phycis filamentosus*.

142. Cusk (*Brosme brosme* Müller).

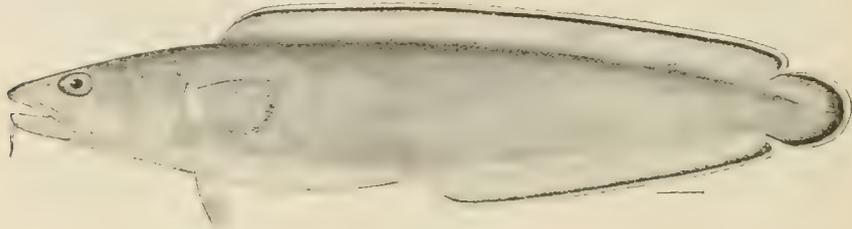
*Brosmius vulgaris?* DEKAY, N. Y. Fauna, Fish. 289, pl. 44, fig. 143, 1842.

*Brosmius brosme* GOODE & BEAN, Oceanic Ichth., 385, fig. 329, 1896.

*Brosme brosme* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2561, 1898.

Color, brownish above, the sides yellowish, sometimes mottled with brown; young uniform dark slate, or with transverse yellow bands; vertical fins bordered with blackish, and with a white edge.

The Cusk is described and figured by DeKay, but he did not see the fish and copied his information from Storer and others. Storer mentions a specimen weighing 20 pounds, but the fish grows even larger. It inhabits the North Atlantic, ranging southward to New Jersey and Denmark. It is an important food fish.



CUSK.

According to Dr. Smith, it was formerly not uncommon in Vineyard Sound, and was caught with Cod in April and May. It has been very rare for more than 20 years, though a few are still taken in April. The average weight of individuals in those waters is 5 pounds, and the maximum weight from 12 to 13 pounds. It is known also as Ling. In Massachusetts Bay and vicinity the Cusk is a common resident on the inshore fishing grounds, where it occurs in great abundance, lurking among the stones, but it is soon caught up by the fishermen after the discovery of a new bank.

**143. Halibut** (*Hippoglossus hippoglossus* Linnæus).

*Pleuronectes hippoglossus* MITCHILL, Rept. Fish. N. Y., 10, 1814; Trans. Lit. & Phil. Soc. N. Y., 1, 386, 1815.

*Hippoglossus vulgaris* DEKAY, N. Y. Fauna, Fish., 294, pl. 49, fig. 157, 1842; STORER, Hist. Fish. Mass., 192, pl. XXX, fig. 1, 1867; GOODE, Fish. & Fish. Ind. U. S., I, 189, pl. 54, 1884.

*Hippoglossus hippoglossus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2611, 1898; IV, pl. CCCLXXI, fig. 918, 1900.

Color, nearly uniform dark brown; blind side white.

The Halibut lives in all northern seas, ranging southward to Sandy Hook, or beyond, and occasionally to the Farallones off San Francisco.

The Halibut was described by both Mitchill and DeKay under its present name. DeKay says that the capture of the Halibut on the shores of Nantucket at one time



HALIBUT.

afforded employment to 80 vessels of from 60 to 80 tons each. He says the fish is very voracious, swimming near the ground and devouring other flat fishes, as well as shells and crustaceans. It occurs on both shores of the Atlantic as also in the North Pacific, migrating south on the approach of spring and returning in June or July. An individual was found some years ago near Colonial Beach, in the Potomac River. The fish grows to the length of 8 feet or more, and the weight of several hundred pounds. It is a very valuable food fish. In the Pacific, according to Jordan and Evermann, it extends its range southward to the Farallones, off San Francisco.

The Halibut was formerly not very uncommon in Vineyard Sound, where it is now very rare. In 1872 and 1873 V. N. Edwards caught a number weighing 235 or 240 pounds while fishing for Cod. April 16, 1900, a Halibut weighing 100 pounds was caught off Block Island by Cod fishermen, and was taken to Newport. The fish

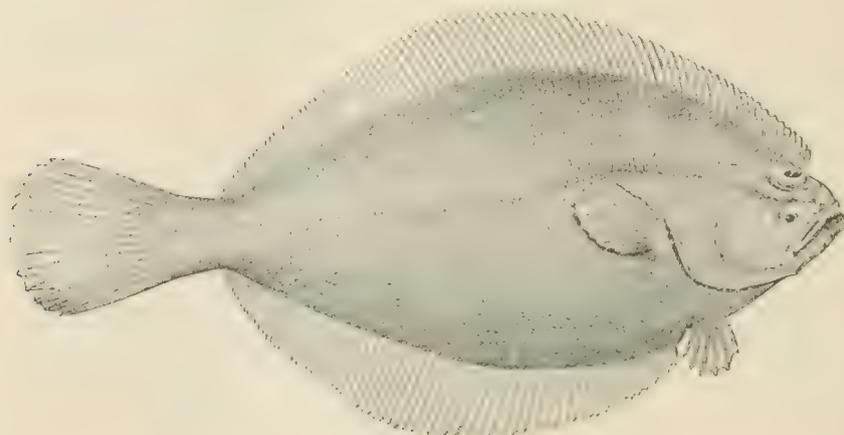
was very abundant at one time in Massachusetts Bay, but is now found chiefly in depths of 100 to 250 fathoms in the slopes of the outer banks. In August, 1878, a Halibut weighing over 200 pounds was caught in Gloucester Harbor.

144. **Rough Dab** (*Hippoglossoides platessoides* Fabricus).

*Platessa dentata* DEKAY, N. Y. Fauna, Fish., 298, 1842, New York markets.

*Hippoglossoides platessoides* GOODE, Fish & Fish. Ind. U. S., I, 197, pl. 55, 1884; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2614, 1898; IV, pl. CCCLXXII, fig. 919, 1900.

Reddish brown, nearly plain. North Atlantic; abundant northward on both coasts.



ROUGH DAB.

DeKay describes this Flounder under the name of the Toothed Flatfish. He said it was extremely common in New York markets, where it is called the Summer Flounder, and that it grows to the length of 25 inches. It is a rather common food fish of the deep waters northward on both sides of the North Atlantic, ranging habitually south to Cape Cod and the coasts of England and Scandinavia. At Woods Hole it is sometimes called Sand Dab and Rusty Flounder. Dr. Smith says it is not common there, but is found some years in winter in inshore waters adjacent to Woods Hole; specimens have been taken in February on lines. One year some were caught in a fyke net in Great Harbor. In Massachusetts Bay it is a common species in the deep waters, approaching the shores in winter.

**145. Summer Flounder** (*Paralichthys dentatus* Linnæus).

*Pleuronectes dentatus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 390, 1815.

*Pleuronectes melanogaster* MITCHILL, op. cit. 390, 1815, New York.

*Platessa ocellaris* DEKAY, N. Y. Fauna, Fish., 300, pl. 47, fig. 152, 1842.

*Paralichthys dentatus* GOODE, Fish & Fish. Ind. U. S., I, 178, 1884 (part); BEAN, 19th Rept. Comm. Fish. N. Y., 246, pl. II, fig. 2, 1890; Bull. Am. Mus. Nat. Hist., IX, 372, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2629, 1898; IV, pl. CCCLXXIII, fig. 922, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 110, 1900.

Blackish olive, mottled and blotched with darker; in life light brown; adults with numerous small white spots on body and vertical fins; sometimes a series of larger white spots along bases of dorsal and anal; about 14 ocellated dark spots on sides, these sometimes inconspicuous, but always present; a series of four or five along dorsal base, and three or four along anal base, those of the two series opposite, and forming pairs; two pairs of smaller, less distinct spots midway between these basal series and lateral line anteriorly, with a small one on lateral line in the center between them; a large distinct spot on lateral line behind middle of straight portion; fins without the round dark blotches.

Is styled Flounder, or Summer Flounder, Turbot Flounder, Toothed Flatfish, Fluke, and, in Great South Bay, it shares the name Flatfish with the *Pseudopleuronectes americanus*. Brail and Puckermouth are names applied to it in Rhode Island. The name Fluke is the one most frequently used on Long Island.

The Fluke is a very abundant fish and is found on the eastern coast from about Cape Cod to the Gulf of Mexico. Centers of abundance are found on the Connecticut coast and on Long Island.

It is a summer visitor in Gravesend Bay, arriving in May or June and leaving when cold weather begins. It frequents the sandy flats for the purpose of feeding on little fishes, which it destroys in large numbers. A Fluke will often be found with eight or 10 little Blackfish in its stomach, and young Mackerel suffer greatly from its depredations. In Great South Bay this fish was found at Blue Point Cove and at Fire Island late in September, and was caught in traps at Islip, October 1, 1890.

Small Fluke were collected in Mecox Bay, Blue Point Cove and at Islip in August, 1898. Adults were obtained at Fire Island Inlet September 16 of that year, when they were abundant. In 1901 the fish were taken at Fire Island Inlet, Blue Point, and Smith's Point. August 1 they were feeding on small Menhaden. The next day they were seen in Wigo Inlet, and again chasing young Menhaden. On

that date more than half a barrel were caught in the inlet near buoy No. 2, with young Menhaden for bait. One of the Fluke disgorged a Sand Lance.

It feeds on small fishes, crustaceans, mollusks and occasionally on sand dollars, and one of its favorite foods is said to be the Squid. This fish is found generally in salt water, but frequently ascends fresh streams. Unlike the Flatfish, it moves off into deep water in winter, and may be found in summer near the shores. The Fluke has the same habit as the Flatfish, of burying itself in the sand when alarmed, or secreting itself from its prey. It is often found feeding about wharves, whose supports furnish it a suitable hiding place from which to dart on small fishes when they are congregated in schools. I have seen large individuals cautiously wriggling their way upward in the concealment of a wharf pile till within easy reach of a shoal of Silversides, when a sudden dart into the midst of the school would result in the capture of a fish, and the Flounder would leisurely sink to digest its victim and prepare for another onslaught. It has been known to reach a weight of 26 pounds. Dr. Goodé has seen individuals measuring 3 feet in length. The fish is caught largely in weirs and traps. It is probable that more of them are taken in Vineyard Sound and in Rhode Island waters than on any other parts of our coast. The fishing season extends from May to October. They are carried alive in well-smacks to the markets. Menhaden is the bait principally used for the capture of the Fluke by hook and line.

**146. Southern Flounder** (*Paralichthys lethostigmus* Jordan & Gilbert).

*Platessa oblonga* DEKAY, N. Y. Fauna, Fish., 299, pl. 48, fig. 156, 1842, New York, not

*Pleuronectes oblongus* MITCHILL.

*Paralichthys acntatus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 822, 1883.

*Paralichthys lethostigmus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2630, 1898.

Color dusky olive, with a few darker mottlings and spots.

This is the fish which was described by Jordan and Gilbert under the name of the Southern Flounder. It inhabits the South Atlantic and Gulf coast of the United States, ranging north to New York. DeKay described and figured it as the Oblong Flounder, which he says grows to the length of 15 to 20 inches and occasionally larger. He states that it is common along the sandy shores of New York, and is procured abundantly in the months of September and October; that it is excellent eating, and usually sells at from 6 cents to 8 cents a pound; that it is tenacious of life and can be preserved in good condition for a long period.

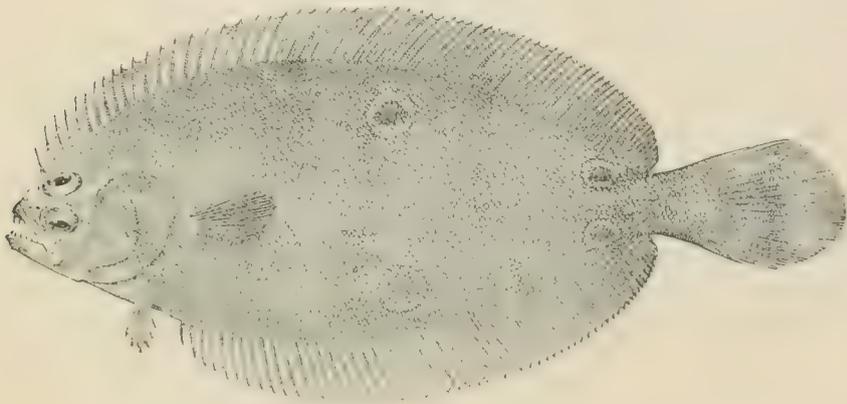
The Southern Flounder is very closely related to the Fluke or Summer Flounder. It is, however, always darker in color and almost uniform, while the Fluke is usually profusely spotted. The character by which it is best distinguished from the Fluke is the number of gill rakers. The Southern Flounder has only 12, of which 10 are below the angle of the first arch, while the Summer Flounder has from 20 to 24, of which from 15 to 18 are below the angle of the first arch.

**147. Four-spotted Flounder** (*Paralichthys oblongus* Mitchill).

*Pleuronectes oblongus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 391, 1815.

*Platessa quadrocellata* STORER, Hist. Fish. Mass., 203, pl. XXXI, fig. 3, 1867.

*Paralichthys oblongus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2632, 1898, IV, pl. CCCLXXIV, fig. 924, 1900.



FOUR-SPOTTED FLOUNDER.

Grayish, thickly mottled with darker and somewhat translucent; four large, horizontal oblong, black ocelli, each surrounded by a pinkish area, one just behind middle of body below the dorsal, one opposite this above anal; two similar smaller spots below last rays of dorsal and above last of anal. Atlantic coast, northward; not abundant.

The Four-spotted Flounder inhabits the coast of New England and New York. It is very common on the coast of New York and the neighboring islands. Mitchill described the fish in 1815. It grows to the length of about 14 inches. Its common name relates to the four large horizontal, oblong black ocelli. At Woods Hole, Mass., according to Dr. Smith, it is common in May and June, scarce at other times. It is most abundant about June, during the run of Scup.

Young fish are rarely observed, but in the fall of 1885 and 1886 large numbers two or three inches long were seen. The average length of adults there is 12

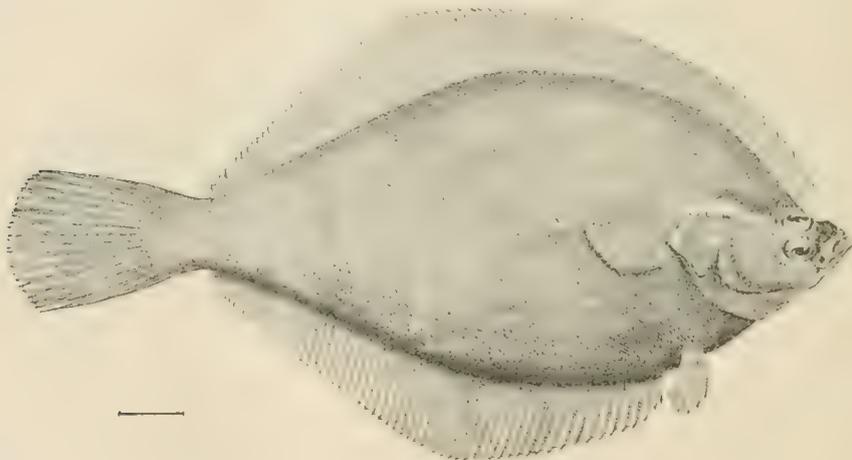
inches. The fish spawns in May, and its eggs have been experimentally hatched at Woods Hole. They are buoyant,  $\frac{1}{26}$  of an inch in diameter, and hatch in eight days in water having a mean temperature of  $51^{\circ}$  to  $54^{\circ}$  F. In 1877 a single example was taken at the mouth of Salem Harbor by the U. S. Fish Commission.

148. **Sand Dab** (*Limanda ferruginea* Storer).

*Platessa ferruginea* DEKAY, N. Y. Fauna, Fish., 297, pl. 48, fig. 155, 1842.

*Limanda ferruginea* GOODE, Fish & Fish. Ind. U. S., I, pl. 49, 1884; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2644, 1898; IV, pl. CCCLXXVII, fig. 929, 1900.

Brownish olive, with numerous, irregular reddish spots; fins similarly marked; left side with caudal fin, caudal peduncle, and margins of dorsal and anal fins lemon yellow. Atlantic coast, chiefly northward.



SAND DAB.

This is also known as the Rusty Dab. It inhabits the coast of North America from Labrador to New York. DeKay calls it the Rusty Flatfish, which he says is a rare species, reported by the fishermen to occur only in deep water. The specimen described by him was 18 inches long. According to Dr. Smith, it is very common in Vineyard Sound and observed by him in water from 10 to 12 fathoms deep, where it may be found throughout the year. There is no fishery, but numbers are caught incidentally while bottom fishing for other species. In Great Harbor a few are taken in fyke nets, only in winter. The average length there is about 14 inches. In Massachusetts Bay it is a common resident species, inhabiting deep waters in summer, and approaching the shores in winter.

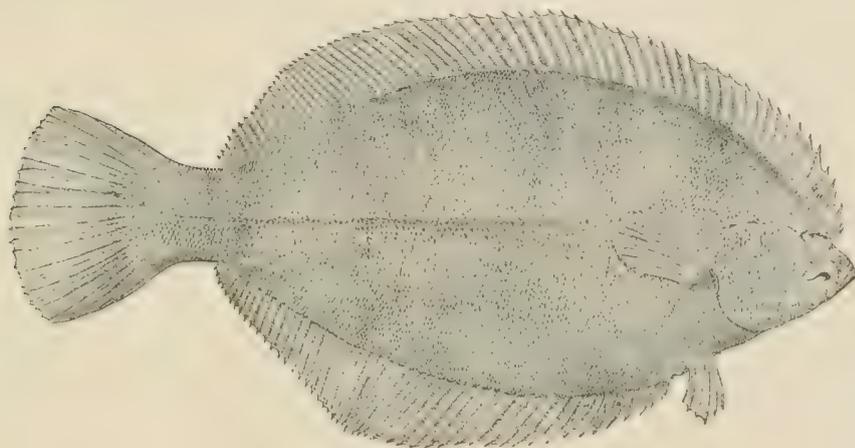
149. Flatfish; Winter Flounder (*Pseudopleuronectes americanus* Walbaum).

*Pleuronectes planus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 387, 1815, New York.

*Platessa plana* DEKAY, N. Y. Fauna, Fish., 295, pl. 48, fig. 154, 1842; STORER, Hist. Fish. Mass., 195, pl. XXX, fig. 2, 1867.

*Platessa pusilla* DEKAY, op. cit. 296, pl. 47, fig. 153, 1842, New York.

*Pseudopleuronectes americanus* GOODE, Fish & Fish. Ind. U. S., I, 182, pl. 44, 1884; BEAN, 19th Rept. Comm. Fish. N. Y., 245, pl. I, fig. 1, 1890; Bull. Am. Mus. Nat. Hist., IX, 373, 1897; H. M. SMITH, Bull. U. S. F. C., 1897, 108, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2647, 1898; IV, pl. CCCLXXIX, fig. 933, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 110, 1900; SHERWOOD & EDWARDS, Bull. U. S. F. C., 1901, 31, 1901.



FLATFISH.

Dark rusty brown, spotted or nearly plain; young olive brown, more or less spotted and blotched with reddish.

The Common Flatfish is equally well known as Flounder or Winter Flounder. It ranges from the Chesapeake Bay to Labrador and appears to be alike abundant in both limits of its distribution. The Flatfish was found in Blue Point Cove, at Blue Point Life-saving Station, and on Fire Island Beach. It was moderately common in all of these localities. The species is a permanent resident of Great South Bay, but undergoes a partial hibernation in the mud in winter, and the adults in summer migrate into deeper and cooler water. A few individuals were observed by me in a fish pound at Islip, October 1, 1890.

Dr. Mitchill describes two color varieties of the Flatfish. One of these had a yellow margin on the lower side, surrounding the white of that side. This border was three-fourths of an inch wide and in striking contrast with the pearl of the con-

tiguous parts within it and the brown of the adjacent fins. The other variety, obtained April 9, 1815, has "a whiteness of the upper side nearly as clear as that of the nether surface over rather more than half its extent. The anterior part is blanched in this manner. The dorsal fin very sensibly partakes of the lighter hue; but its dark brown is tintured with yellow, especially on the rays. Something of the same kind, though less distinct, is observable on the ventral fins, and on about a dozen rays of the anal." The length of this individual was 5 inches and the breadth 3. Dr. DeKay obtained a specimen in April which was reversed and double. "Its color on both sides was uniform bronze, with a white patch on its right side near the chin, almost entirely denuded of scales; it had the singular protuberance over the eye, noticed by Dr. Mitchill in his *melanogaster*."

On the New Jersey coast young individuals are very common in summer, but the adults are rarely found except in the winter.

At Woods Hole, Mass., this is a very abundant permanent resident, frequenting muddy or grassy bottoms. The average weight of those taken in the immediate vicinity of the Fish Commission Station was only 1 pound, but larger fish are found in the deeper water of the sound and bay. In October fish averaging 2 pounds, and apparently migrating, are taken with lines in Vineyard Sound on sandy bottom.

In the markets this species is extremely common in the winter and spring months, and the flesh is delicious even when the eggs are nearly mature. It feeds on small shells, crabs and other invertebrates living in the mud. When at rest it partly submerges itself in the sand or mud, and changes its color to suit its surroundings.

In Long Island bays the Flatfish spawns from February to the end of March, and in July the young have attained to the length of half an inch. At Woods Hole, Mass., according to Dr. Smith, it spawns from February to April. On being transferred to tanks containing running water, many deposit their eggs during the night. The eggs are  $\frac{1}{30}$  of an inch in diameter and very glutinous, sticking together in masses of various sizes. The average number to a fish is 500,000. March 6, 1897, a fish that weighed  $3\frac{1}{2}$  pounds after spawning furnished 30 fluid ounces of eggs, numbering 1,462,000. The eggs hatch in 17 or 18 days, when the mean water temperature is  $37^{\circ}$  or  $38^{\circ}$  F.

# The Future Water Supply of the Adirondack Mountain Region

And its Relation to Enlarged Canals in the State of New York.

BY GEORGE W. RAFTER, CONSULTING ENGINEER.

THE Adirondack Mountain region, extending over an area greater than the State of Massachusetts, comprises within its limits high mountains, many lakes, dense forests, deep valleys, and is, altogether, a region of exceeding interest from whatever point viewed. It is proposed in the present paper to particularly indicate some of its more interesting features, as well as to show what may be expected of the region in the future, when enlarged canals of some sort become a fixed fact.

In a paper on The Relation of Rainfall to the Run-off of Streams, the present writer has shown that a dense forest covering of pine, spruce, hemlock and balsam will increase the water yield over what it would if the area were deforested, anywhere from 4 to 6 inches in depth. This means that the run-off of streams whose catchments are covered with such forests will be from 4 to 6 inches greater over the entire drainage area than it would be if the same area were deforested.

The gradually accumulating proof of this proposition is found in the writer's various papers and reports,\* and is based upon extensive gaging of the New York streams during the last ten years. Rather singularly, aside from gaging made by

\*The following papers and reports are cited :

- (1) Three Reports on Genesee River Storage Surveys. Appendices to Ann. Repts. of State Engr. and Sur., for 1893, 1894 and 1896.
- (2) Two Reports on Upper Hudson Storage Surveys. Appendices to Ann. Repts. of State Engr. and Sur. for 1895 and 1896.
- (3) Water Supply of the Western Division of the Erie Canal. Ann. Rept. of the State Engr. and Sur. for 1896.
- (4) The Economics of the Hudson River. Lecture before the engineering classes of Rensselaer Polytechnic Institute, Feb. 24, 1897.
- (5) Paper on Stream Flow in Relation to Forests. Proc. Am. Forestry Assn., Vol. XII (1897). Also, reprint in Ann. Rept. of Fisheries, Game and Forest Commission (1896), published in 1898. Reprint, 1898.

John B. Jervis, in 1835, of Madison and Eaton brooks, the State of New York had never made any gagings, a fact which can hardly be placed to the credit of the authorities of this State. Measurements of Croton River had, however, been made by the City of New York since about 1868. Oatka Creek, a tributary of Genesee River, with a catchment area of 27.5 square miles above the point of measurement, was gaged by the present writer from April, 1890, to November, 1892. In 1895 a survey of the Upper Hudson River was authorized, of which the writer was placed in charge. It so happened that his previous experience had been extensively along the line of gaging streams, and he accordingly very early devoted considerable attention to this matter. Inquiry soon developed the fact that The Duncan Company, at Mechanicville, had kept gagings of the flow of Hudson River since October, 1887. This matter was immediately examined into, new gages set, and additional refinement introduced in the work, which has been continued to the present time, with the result that the gagings of the Hudson River form one of the best long time series of a large river thus far made in the United States. The catchment area at Mechanicville is 4,500 square miles.

The catchment area of Hudson River is, as per final determination for the Board of Engineers on Deep Waterways, 4,507 square miles.\* This, however, is so slight a difference as to render it inadvisable to be taken into account, since the error is only about 0.15 of one per cent.

Gages were also established at Fort Edward on the Hudson River, and at Warrensburg on Schroon River. At the time of establishing the gagings at Warrens-

(6) Paper on Natural and Artificial Forest Reservoirs of the State of New York. 3rd. Ann. Rept. of Fisheries, Game and Forest Commission (1897), published in 1899. Reprint, 1899.

(7) Water Supply and Irrigation papers of the United States Geological Survey, Nos. 24 & 25. Water Resources of the State of New York, Parts I and II, 1899.

(8) Paper on the Application of the Principles of Forestry and Water Storage to the Mill Streams of the State of New York. Proc. 22nd Ann. Meeting of Pulp and Paper Assn. (1899).

(9) Paper on Indian River Dam. By Geo. W. Rafter, Wallace Greenalch and Robert E. Horton. Engineering News, May 18, 1899. Reprint, 1899.

(10) Paper on Data of Stream Flow in Relation to Forests. Lecture before engineering classes Cornell University, April 14, 1899. Trans. of Assn. of Civil Engrs. of Cornell University, Vol. VII, 1899. Reprint, 1899.

(11) A Report on a Water Supply from the Adirondack Mountains for the City of New York. Appendix E, of An Inquiry into the Conditions Relating to the Water Supply in the City of New York, by the Merchants' Assn., 1900.

(12) Report to the Board of Engineers on Deep Waterways, On the Water Supply of Enlarged Canals Through the State of New York. Appendix 16, pp. 571-950 (1901).

(13) Paper on The Relation of Rainfall to the Run-off of Streams. Water Supply and Irrigation papers of the U. S. Geological Survey, No. 80 (1903).

\* See writer's Report on Water Supply to Board of Engineers on Deep Waterways, p. 581.

burg, in 1895, the dam at that place, over which the gagings are made, was practically water tight; but within the last two or three years there is considerable leakage. The later gagings are, therefore, somewhat less accurate than the earlier ones. The writer visited Warrensburg in October, 1895. At that time the mill was not running, and, due to the fact that the dam at the foot of Schroon Lake was closed tightly, very little water was running in Schroon River. The water in the dam at Warrensburg stood about four feet below the crest. The bed of Schroon River below said dam, was very nearly dry, the flow not exceeding one to two cubic feet per second. The writer has not seen this dam in several years, but reports indicate that the leakage may now be anywhere from 30 to 50 cubic feet per second. The dam at Fort Edward had very little leakage when the station at that point was established in 1895.

In 1898, the writer undertook an investigation for the Board of Engineers on Deep Waterways as to possibilities of water supply for the enlarged canals through the State of New York. The scope of this investigation was exceedingly broad. It showed that a water supply of from 1,200 to 1,600 cubic feet per second would be required for the proposed canal. This water, it was also found, must be drawn from some stream whose head waters lay high in the Adirondack plateau, which, so far as precise information in regard to water resources, was practically an unknown land. In order to gain information as to the water yielding possibilities of the region, its flood flows, etc., the writer established the following gaging stations:

NAME OF STATION.	SIZE OF CATCHMENT IN SQUARE MILES.
1. Seneca River at Baldwinsville, - - - - -	3,103.0
2. Oswego River at Fulton, - - - - -	4,915.0
3. Chittenango Creek at Bridgeport, - - - - -	306.9
4. Oneida Creek at Kenwood, - - - - -	59.0
5. Wood Creek, near mouth, - - - - -	126.5
6. Fish Creek, West Branch, at McConnellsville, - - - - -	186.7
7. Fish Creek, East Branch, above Point Rock, - - - - -	104.3
8. Salmon River about one mile above Falls, - - - - -	190.5
9. Mohawk River at Ridge Mills, - - - - -	152.5
10. Nine Mile Creek, 1 mile below Stittsville, - - - - -	62.6
11. Oriskany Creek, State Dam, Oriskany, - - - - -	144.3
12. Oriskany Creek at Colemans, - - - - -	140.7
13. Saquoit Creek at New York Mills, - - - - -	51.5
14. West Canada Creek at Middleville, - - - - -	518.7
15. Mohawk River at Little Falls, - - - - -	1,306.0
16. East Canada Creek at Dolgeville, - - - - -	255.6
17. Garoga Creek, three miles above mouth, - - - - -	80.8

NAME OF STATION.		SIZE OF CATCHMENT IN SQUARE MILES.
18.	Cayadutta Creek below Johnstown, - - - - -	40.0
19.	Schoharie Creek, State Dam, Fort Hunter, - - - - -	946.7
20.	Mohawk River at Rexford Flats, - - - - -	3,384.9
21.	Hudson River at Mechanicville, - - - - -	4,506.7
22.	Hudson River at Fort Edward, - - - - -	2,800.0
23.	Schroon River at Warrensburg, - - - - -	565.0
24.	Black River at Huntingtonville, - - - - -	1,888.6*

Of the foregoing stations, that on Hudson River at Mechanicville, Hudson River at Fort Edward, and Schroon River at Warrensburg, had been established, as just detailed, in 1895, in connection with the Upper Hudson Storage Surveys. The station on Black River, at Huntingtonville, had been established in March, 1897, by the Watertown Water Works, the data of which were placed at the writer's disposal by the Board of Water Commissioners of the City of Watertown. Aside from these four stations, the foregoing were established in 1898, in connection with the deep waterways work.

On the completion of the deep waterways work, in 1899, these stations were turned over to the U. S. Geological Survey, the understanding being that gagings would be carried out at them for several years. This condition was made because of the writer's opinion that they offered an exceedingly good opportunity to determine whether or not the run-off of streams is measurably influenced by the density of forests. Several of the streams included in the list lie to the south of the Mohawk River and are tributary to that stream. These issue from a highly cultivated country, very largely deforested. There are also several of them which lie to the north of the Mohawk, issuing from a country still chiefly in forest. The geology, however, is quite different. To the north the streams mostly flow over Laurentian granite, while to the south their head waters are in the Chemung and Catskill formation, a compact sandstone.†

In 1900, a small appropriation was obtained from the Legislature, and since that date the gagings work has been done jointly by the State of New York and the U. S. Geological Survey.

For various reasons there has been considerable change in these stations, and at present time gagings are kept at the following places:

\* Some of these areas are approximate only, due to the inaccuracy of available maps.

† The geology of these several streams, together with that of Hudson, Genesee, Croton, and other catchment areas, is discussed at length in the paper, *The Relation of Rainfall to the Run-off of Streams*, and is, therefore, only slightly touched upon here. The interested reader is referred to that paper for full details.

	NAME OF STATION.	SIZE OF CATCHMENT IN SQUARE MILES.
1.	Genesee River at Rochester, - - - - -	2,365*
2a.	Oswego River, High Dam, Oswego, - - - - -	5,000
2b.	Oswego River at Minetto Cable Station, - - - - -	4,990
2c.	Oswego River at Fulton, - - - - -	4,916
3.	Seneca River at Baldwinsville, - - - - -	3,103
4a.	Skaneateles Outlet at Willow Glen, - - - - -	74
4b.	Skaneateles Outlet at Jordan, - - - - -	93
5.	Oneida River at Brewerton, - - - - -	1,265
6.	Black River at Watertown, - - - - -	1,889
7.	Black River at Felt's Mills, - - - - -	-
8.	Salmon River at Pulaski, - - - - -	264
9.	Chenango River at Binghamton, - - - - -	1,582
10.	Susquehanna River at Binghamton, - - - - -	3,982
11.	West Canada Creek at Twin Rock Bridge, - - - - -	352
12.	Mohawk River at Ridge Mills, - - - - -	153
13.	Oriskany Creek at Oriskany State Dam, - - - - -	144
14.	Saquoit Creek at New York Mills and Yorkville, - - - - -	52
15.	Mohawk River at Utica, - - - - -	500
16.	West Canada Creek at Middleville, - - - - -	518
17.	East Canada Creek at Dolgeville, - - - - -	256
18.	Mohawk River at Little Falls, - - - - -	1,306
19.	Raquette River at Hannawa Falls, - - - - -	967
20.	Indian River at Indian Lake Dam, - - - - -	146
21.	Schroon River at Warrensburg, - - - - -	563
22.	Hudson River at Fort Edward, - - - - -	2,800
23.	Schoharie Creek at Mill Point, - - - - -	936
24.	Schoharie Creek at Fort Hunter, - - - - -	947
25.	Schoharie Creek at Schoharie Falls, - - - - -	930
26.	Mohawk River at Schenectady, - - - - -	3,320
27.	Mohawk River at Rexford Flats, - - - - -	3,385
28.	Mohawk River at Dunsbach Ferry, - - - - -	3,410
29.	Hudson River at Mechanicville, - - - - -	4,500
30.	Norman's Kill at French's Mill, - - - - -	111
31.	Kinderhook Creek at East Nassau, - - - - -	120
32.	Catskill Creek at South Cairo, - - - - -	-
33.	Esopus Creek at Kingston, - - - - -	312
34.	Rondout River at Honk Falls, - - - - -	88
35.	Rondout Creek at Rosendale, - - - - -	365

\* Not including Hemlock and Canadice lakes, the water supply of the City of Rochester.

NAME OF STATION.		SIZE OF CATCHMENT IN SQUARE MILES.
36.	Walkill River at New Paltz, - - - - -	736
37.	Ten Mile River at Dover Plains, - - - - -	195
38.	Housatonic River at Gaylordsville (Conn.), - - - - -	-
39.	Croton River at Croton Dam (Old), - - - - -	339
40.	Chittenango Creek at Bridgeport, - - - - -	307
41.	Chittenango Creek at Chittenango, - - - - -	77
42.	Oneida Creek at Kenwood, - - - - -	59
43.	Beaver River at Tisse's Bridge, below Croghan, - - - - -	242
44.	Moose River at Moose River, - - - - -	346
45.	Fishkill Creek at Glenham, - - - - -	-
46.	Richelieu River at Fort Montgomery, - - - - -	7,750
47.	Cayadutta Creek at Johnstown, - - - - -	40
48.	West Branch Fish Creek at McConnellsville, - - - - -	187

It is a matter of congratulation to the writer that he has been instrumental in inaugurating so important a work in the State of New York. He refers to this the more willingly, because the Annual Reports of the State Engineer and Surveyor, in which these data are published from year to year, have given him full credit for the work. It is a matter of special gratification in this connection, the writer may say, that he published in 1900, in a paper\* which appears in the Report of the Fish, Game and Forest Commission, for that year, the first catchment area map of the State thus far published. This map has been republished by the Merchants' Association of New York City † and by the State Engineer in his Report for 1901.

While on the historical part of this subject, the writer may further mention that in 1900 he published a paper, read before the American Society of Civil Engineers, On the Flow of Water Over Dams, ‡ which extends the data for computing discharge of weirs far beyond previous results. It is now possible to compute the flow over a dam up to a depth of 9 or 10 feet. Precise measurements were made in some cases to over 5 feet. The experiments also show that at this depth the discharge curve becomes sensibly constant, so that there is no serious difficulty in extending it, when necessary, to 9 or 10 feet, as just stated.

Previous to these experiments work on flow over weirs had been confined to comparatively small quantities. Thus, taking the chief experiments in order of time, Poncellet and Lebros work with a limiting head of 0.68 feet and with a length

\* Natural and Artificial Forest Reservoirs in the State of New York.  
 † An Inquiry into the Conditions Relating to the Water Supply of the City of New York. By The Merchants' Association of New York, 1900.  
 ‡ Trans. Am. Soc. C. E., Vol. XLIV, pp. 220-308.

of crest of experimental weir, of 0.66 feet; Lebos, with limiting head of 0.80 feet and length of crest, 0.66 feet; Francis, limiting head, 1.62 feet and length of crest, 10 feet; Hamilton Smith, limiting head, 1.73 feet and length of crest, 2.59 feet; Fteley and Stearns, limiting head, 1.60 feet and length of crest, 19 feet; Bazin, limiting head, 1.77 feet, length of crest, 6.56 feet; and the Cornell experiments, made by the present writer, limiting head, mostly somewhat over 5 feet\* and length of crest, 6.56 feet. It is thus seen that the quantity of water flowing in the Cornell experiments was much larger than in any of the previous ones. For the higher heads it was about 260 cubic feet per second.

The writer wishes to be understood as not in any way criticising the work of previous experimenters with the weir, but he may properly point out that a very large proportion of the previous work was designed on what may be termed a Lilliputian basis. Very great ingenuity has been displayed in measuring minute differences of head, length of weir, etc., with no other result than in confusing the subject. Indeed, at the present time, engineers, when speaking of weir measurements, apparently measure water with a teacup. As a matter of universal practice this would be perhaps allowable in a country where the streams are nearly all small; but for the great bulk of weir measurements to be made in the United States, where rivers with catchment areas of several thousand square miles are common, water must be rather measured by the bucket-full, and the work, instead of being Lilliputian becomes Titanic. Without pursuing the matter of flow over dams further we may say that as a broad proposition, in the light of present information, where there is a dam on a stream with tolerably uniform crest, the most accurate method of measurement will be by gagings over such dam.†

Gaging by current meter may also be referred to. This method has some advocates who consider it superior to any other. Probably the reason for such an opinion is that tests of a current meter in uniform masonry or concrete channels, where the conditions are the most favorable possible to obtain, have shown fairly accurate results; but in a shallow stream, flowing over a boulder bed, the conditions are so different as to make rational comparison impossible. The current meter is, indeed, only really useful when the following conditions obtain:

1. A smooth, uniform channel for a considerable distance on either side of the point selected.
2. Considerable depth at the point selected and for several hundred feet to either side.

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\* The head varied in different experiments. For detail see paper On the Flow of Water Over Dams.

† On the point, see Water Supply and Irrigation papers of the U. S. Geological Survey, No. 56. Methods of Stream Measurement, p. 14.

3. Smooth bottom of either fine sand, hard earth or very fine gravel.
4. That the current be positive and of some little velocity throughout the whole section.

New York streams as a whole do not, except rarely, answer to these conditions. They are usually shallow, rapid flowing in places, and frequently encumbered with boulders. Current meter observations may be at times from 100% to 200% in error. So far as streams in New York State are concerned, therefore, the current meter should not be used except when there is nothing else to use.

Gaging by floats, rods, etc., may be made when the proper conditions obtain, although usually such methods are only applicable under special and particular conditions. Broadly, we may say that where a good dam exists on a stream the gagings should preferably be first of all made at this point. Or, if there is money available, a special weir may be erected. Failing either of these, the current meter may be used, with due understanding of the limitations indicated in the foregoing.

The great water center of the Adirondack Mountains has streams issuing from it in all directions. The following is a brief resumé of the main water power characteristics of the principal streams.

1. The first important stream is Salmon River, with total catchment area above High Falls of 191 square miles. A reservoir with elevation of water surface of 953 feet was projected on this stream, with capacity of 7,500,000,000 cubic feet, in connection with the water supply for the deep waterways.\* The stream rises in the southwestern corner of Lewis County and flows first southerly and then westerly into Lake Ontario. The extreme head waters are probably at an elevation of 1,400 or 1,500 feet above tide water.

To the north of Salmon River there are a number of streams, but none of them are very extensive. The chief ones which may be mentioned are the West, North and South branches of Sandy Creek, and Deer Creek.

2. The next important stream, proceeding to the north, is Black River, the catchment area of which above its mouth is 1,930 square miles. This stream rises in the western part of Hamilton County and pursues a southwesterly direction, passing across Herkimer County and into Oneida County. It then turns and runs northwest through Lewis County, after which its course is westerly across Jefferson County to Black River Bay, at the eastern extremity of Lake Ontario. Lake Ontario has a mean elevation above tide of about 247 feet. The length of the river, measured along its course from its mouth at Black River Bay to the head waters, is 112 miles.

\*An account of this reservoir, with its principal characteristics, may be found in the Report On Special Water Supply to the Board of Engineers on Deep Waterways, pp. 873-881.

The section drained by the upper river in Herkimer and Hamilton counties is a rugged, mountainous region with numerous lakes, a number of which have been utilized by the State of New York as storage reservoirs to compensate for water taken for the supply of Black River and Erie canals.

The extreme head waters of the main river are Canachagala Lake, North Lake and South Lake. Other lakes on the head waters of the main river are Woodhull, Little Bisby Chain Lakes, Little Woodhull, Chub, Long, White, and a number of others. The chief tributaries of Black River are the Moose and Beaver rivers, both of which rise in Hamilton County and flow across Herkimer into Lewis County. The principal lakes at the head of Moose River are Two Sisters, Pigeon, Big Moose, Second, Cascade, Fulton Chain, Lime Kill, and Little Moose lakes. The principal lakes at the head waters of Beaver River are Lakes Lila and Frances, Josephine Lake, Nehasane, Big Rock, Little Rock, Salmon, Loon, Twitchell lakes, and others.

Other smaller tributaries of Black River are Black Creek, Little Woodhull Creek, Big Woodhull Creek, Crystal Brook, Otter Creek, Independence Creek, Crystal Creek, Swiss Creek, Moose Creek, Sugar and other small streams.

The elevation of the head waters of Black River may be taken at about 1,800 feet above the level of the sea.

A reservoir was also projected for Black River, in connection with the deep waterways surveys. It is proposed to construct a main barrage at the village of Carthage where the water surface will be raised 48.5 feet, and an area flooded at extreme high water of about 78 square miles. The proposed elevation of water surface is 772 feet above tide water, and the total capacity will be about 57,000,000,000 cubic feet.\*

3. The next important stream is Oswegatchie River, which rises in Cranberry Lake and flows northwesterly in an irregular course, finally emptying into the St. Lawrence River at Ogdensburg. This stream lies largely in the Laurentian granite, and the elevation of its source, in Cranberry Lake, is unknown. Cranberry Lake has an area of from 15 to 20 square miles. The chief tributary of Oswegatchie River is Indian River, of which Black Lake is an extension.

4. The next stream is Grass River, which rises in Massawepie Lake, and flows northerly into the St. Lawrence River at the foot of Long Sault Rapids. The elevation of the St. Lawrence River at this point is about 154 feet. The elevation of the source of the stream is unknown, so far as can be learned no measurements ever having been taken.

5. The Raquette River is the next stream to be mentioned. It rises in the

\*For detail of this reservoir see Report to Board of Engineers on Deep Waterways, pp. 864-873

center of the Adirondack region in Blue Mountain Lake, at an elevation above tide of 1,788 feet. It flows northerly into the St. Lawrence River, the elevation of its mouth above tide being 154 feet.

6. The next stream is the St. Regis River, which rises in St. Regis Lake and flows in a northerly direction, emptying into the St. Lawrence River a short distance below the foot of Long Sault Rapids. The elevation of St. Regis Lake is unknown, but Saranac Lake, which is very near, is 1,606 feet above tide water.

7. The next stream is the Salmon River of the North, which rises in Ragged Lake and flows northerly into the St. Lawrence, at Lake St. Francis. The elevation of the source of this river is unknown.

8. Next we have the Chateaugay River, which rises in Chateaugay Lake and flows northerly into the St. Lawrence. The greater portion of this stream is in the Dominion of Canada. The elevation of its source is unknown.

9. Big Chazy River is the next important stream. It rises in the extreme northwestern part of Clinton County and flows easterly into Lake Champlain. The elevation of its source is unknown; but that of Lake Champlain, its mouth, may be taken at about 98 feet above tide water.

10. The Saranac River rises in Saranac Lake, of which the elevation has already been given, and flows northeasterly into Lake Champlain, at Plattsburg.

11. The AuSable River has its source in Upper AuSable Lake, of which the elevation is 1,993 feet, and flows northeasterly into Lake Champlain.

There are several other small streams tributary to Lake Champlain, which are not formerly enumerated, as for instance, the Little Chazy, Salmon River East, Little AuSable and Bouquet rivers.

It may be mentioned that there are three Salmon rivers in the State of New York, which may be designated, for convenience, as Salmon River North, Salmon River West, Salmon River East. The first is tributary to Lake Ontario, the second to the St. Lawrence River, and the third to Lake Champlain.

The Big Chazy River is without lake source. It may be safely predicted, therefore, that it is a much less valuable mill stream than those with lake pondage.

12. Proceeding south, the next considerable stream issuing from the Adirondack water center is the Outlet of Lake George, which empties into Lake Champlain at Ticonderoga. The elevation of Lake George is 323 feet above tide. There is, therefore, about 225 feet fall in the Outlet, which is only a couple of miles in length; but owing to the nearly perfect regulation afforded by the large water area of Lake George, the flow in the Outlet is almost uniform, and we, accordingly, find the water power of this stream fully developed.

13. The next stream is the Hudson River, which reaches the level of tide water at Troy. Its several sources may be considered as in Lake Henderson and Catlin Lake, of which the elevations above tide are, for the former, 1,889 feet, and for the latter about 1,570 feet. Lake Colden, which lies at an elevation of 2,764 feet, is the extreme source of the Hudson River; but as the lake is very small and the stream issuing therefrom is also small, the larger lakes at lower elevations are preferably taken for water power purposes.

Indian Lake, an important tributary of Hudson River, may be mentioned. This lake has a catchment area of 146 square miles and the elevation of water surface is 1,705 feet above the level of the sea. A substantial masonry dam has been constructed at its foot, which raises the water surface 33 feet, impounding thereby, roundly, 5,000,000,000 cubic feet of water, the total length of the enlarged lake being about 15 miles. This reservoir is for the benefit of Champlain Canal and the water power of the Lower Hudson River.

14. Schroon River, a tributary of the Hudson, rises in Elk Lake and flows in a southerly direction into the main Hudson at Thurman. The elevation of its source in Elk Lake is 2,053 feet above tide, while the elevation at its mouth is about 600 feet. A reservoir has been projected on this stream, developing storage up to 18 inches in depth on the tributary catchment area, and giving a total storage of nearly 22,000,000,000 cubic feet. Such a reservoir can be shown to have a capacity of 775 cubic feet per second for every day in the year. The dam to accomplish this would be located at Tumblehead Falls, a short distance below the outlet of Brant Lake. The area of water surface of the full reservoir would be over 26 square miles, and the height of the dam 71 feet. The elevation of the water surface of reservoir is 851 feet above tide water.\* The catchment area of Schroon River, at the dam, is 502 square miles, and at its mouth, 570 square miles.

15. Sacandaga River, another tributary of the Hudson, may be mentioned. This stream has the principal source of its West Branch in Piseco Lake, Sacandaga Lake and Lake Pleasant. It flows first southeasterly to Northampton, and then northeasterly into the Hudson, at Luzerne. The elevation of Lake Pleasant is given at 1,706 feet above tide water. This elevation is substantially the same as Sacandaga Lake. Piseco Lake is not given, but is considered to be somewhat higher. The elevation of the mouth of the river is 550 feet above tide water. The East Branch of the river heads in a number of small lakes, at an elevation of about

\* For details in regard to this reservoir, see Report On a Water Supply from the Adirondack Mountains for the City of New York. By George W. Rafter. In An Inquiry into the Conditions Relating to a Water Supply for the City of New York, made by the Merchants' Association of New York, in 1900.

1,800 to 2,000 feet above tide water. The catchment area of Sacandaga River, at its mouth, is 1,057 square miles.

16. Mohawk River is really a tributary of the Hudson, but for the purposes of this paper we may specially consider the Main Mohawk, making further subdivisions of a number of the principal tributaries.

This stream rises in Central New York, about 25 miles north of Rome, and flows first southerly, then easterly, across the State, emptying into Hudson River at Cohoes. The elevation of its extreme head waters, near Boonville, may be taken at from 1,050 to 1,100 feet above tide water; but at Rome its elevation is only a little over 400 feet above tide. Water power on this stream is substantially confined to the Great Falls at Cohoes, and the Little Falls at Little Falls.

17. Schoharie Creek, the principal tributary of the Mohawk from the south, rises in the Catskill Mountains at a elevation of from 1,600 feet to 1,800 feet above tide, and flows first westerly for 20 miles and then northerly, emptying into the Mohawk River at Fort Hunter. The elevation of its mouth is about 280 feet above sea level. This stream is entirely without lake storage and is subject to very great fluctuations in its flow. Flood flows of from 50,000 to 60,000 cubic feet per second are not at all uncommon, while its minimum flows do not exceed 175 cubic feet per second. The catchment area at its mouth is 947 square miles.

There are a number of other streams entering the Mohawk from the south, but none of them are of any great importance.

18. Of the streams from the north East Canada Creek may be mentioned as one of the principal tributaries. It rises in Morehouse Lake at an elevation of, perhaps, 1,900 feet above tide water. It flows south into the Mohawk River at East Creek, a few miles east of Little Falls, at an elevation of something over 300 feet. The catchment area above its mouth is 283 square miles.

19. West Canada Creek, the chief tributary of the Mohawk River from the north, may be taken as rising in West Canada Lake, in Hamilton County. This lake lies at an elevation of 2,367 feet above tide. The creek flows first westerly to Trenton Falls, and then southerly, emptying into the Mohawk River at Herkimer, at an elevation of something like 380 feet above tide. The catchment area of this stream at its mouth is 569 square miles.

The foregoing are the principal streams issuing from the Adirondack water center. There are a great many smaller ones, but as the object at the present time is not specially to enter into the detail the less important are omitted.

We may now make an estimate of the total fall of each stream, together with the possible water power which may be developed, it being premised that the lakes and valleys of all this region are especially fitted for efficient water storage at low cost.

NAME OF STREAM.	ASSUMED ELEVATION OF SOURCE IN FEET.	ELEVATION OF MOUTH IN FEET.	TOTAL FALL IN FEET.	ESTIMATED NO. OF H. P. WHICH CAN BE DEVELOPED.
1. Salmon River West, - - -	953	247	706	12,000
2. Black, - - - -	772	247	525	150,000
3. Oswegatchie, - - - -	1,000 *	247	753 *	20,000 *
4. Grass, - - - -	1,500 *	154	1,346 *	25,000 *
5. Raquette, - - - -	1,788	154	1,634	70,000
6. St. Regis, - - - -	1,600 *	154	1,446 *	30,000 *
7. Salmon River North, -	1,500 *	154	1,346 *	12,000 *
8. Chateaugay, - - - -	800 *	154	646 *	2,000 *
9. Big Chazy, - - - -	700 *	98	602 *	3,000 *
10. Saranac, - - - -	1,606	98	1,508	80,000
11. AuSable, - - - -	1,993	98	1,885	35,000
12. Outlet of Lake George, -	323	98	225	7,000
13. Main Hudson, - - - -	1,600	00	1,600	150,000
14. Schroon, - - - -	851	600	251	13,000
15. Sacandaga, - - - -	1,706	550	1,156	62,000
16. Main Mohawk, - - - -	1,050	6	1,044	40,000
17. Schoharie Creek, - - -	1,700	280	1,420	14,000
18. E. Canada Creek, - - -	1,900	330	1,570	10,000
19. W. Canada Creek, - - -	2,367	380	1,987	30,000
				765,000
20. On small streams not specifically enumerated, - - - -				35,000
Total power, - - - - -				800,000

In estimating the number of horse power in the foregoing an attempt has been made to give the horse power practical to develop, as distinct from the theoretical horse power. It is obvious that the total theoretical horse power bears very little relation to the horse power which may be practically developed. In estimating the horse power the statement of Charles E. Emery,† that, in the New England States,

\* Approximate.—The writer has not visited several of these streams, and the quantities here given are based upon the best available information.

† Cost of Steam Power. By Charles E. Emery. Trans. Am. Institute of Electrical Engrs. March, 1893.

New York, Pennsylvania, etc., it will not pay to develop 24-horse power when the initial cost much exceeds \$200 per horse power, is taken into consideration. This condition at once cuts out development in the woods, on small streams, long distances from the markets, etc. The figures given, which are necessarily approximate, include the cost of storage reservoirs within practical limits. It also shuts out development where deep foundations or long dams run the cost up to much beyond this figure of \$200 per horse power.

Moreover, the streams issuing from the Adirondack region are, with one or two exceptions, very much less subject to severe floods than other streams of the State. They are, therefore, particularly valuable for mill streams because the expense of repairing frequent damage will be materially less. The reasons for this fortunate condition are two-fold: 1. They mostly issue from lakes, frequently of considerable magnitude; and 2, The area is still largely covered with forests—in some cases with dense primeval forests of pine, spruce, balsam and hemlock.

In order to show the effect of temporary lake storage in reducing flood flows Table No. 124, in the writer's Report to the Board of Engineers on Deep Waterways, may be referred to. This table contains about fifty cases of floods, mostly in the central part of the State, where the work for the Board of Engineers on Deep Waterways was performed. The first case cited is that of Seneca River, with a catchment area of 3,103 square miles. This stream takes the drainage of the following lakes: Canandaigua, Keuka, Seneca, Cayuga, Skaneateles, Onondaga and others, in which, with the water surface of Seneca River, itself, Montezuma Marsh, numerous small ponds and flat valleys, there is a total tributary water surface of about 300 square miles. The severest flood known was in 1865, and amounted to from 22,000 to 26,000 cubic feet per second, or to about 8.5 cubic feet per square mile per second. This river, of course, presents an extreme case because very few streams have as large a tributary water surface as this. It amounts to about 10% of the whole.

As an example of streams without lake storage we may mention Upper Mohawk River, Nine Mile Creek, Oriskany Creek, Cayadutta Creek, Skinner Creek, Beaver Dam Creek and Independence Creek, which have flood flows of from 46 cubic feet per square mile per second to 125 cubic feet per square mile per second. All of these streams are without the regulating effect of lake storage at their head waters.

Hudson River has large temporary lake storage. The heaviest flood recorded on this stream at or near Mechanicville was in the spring of 1869, which it flowed at the rate of 15.5 cubic feet per square mile per second. If Hudson River were to discharge water as rapidly as some of the smaller streams previously mentioned it would sweep out of existence the lower portions of the cities of Troy and Albany. Below the mouth of Mohawk River the floods are much more severe on this stream.

Schoharie Creek is of the opposite character. On this stream, flood flows of from 50 to 60 cubic feet per square mile per second are quite common, while the extreme flow probably rises to 75 cubic feet per square mile per second, or five times the maximum observed on the Hudson River at Mechanicville.

We may now consider the relation of the proposed deep waterways, or other enlarged canals, to the Adirondack region, just described. There are but two possible routes, one from Lake Ontario through Oswego and Mohawk Valleys to tide water in the Hudson River at Albany; and the other, from Lake Ontario through the St. Lawrence River to Lake St. Frances, and thence across the country to Lake Champlain, and from the foot of that lake, at Whitehall, across the dividing ridge to the Hudson River at Fort Miller, and through that river to tide water at Albany. It is seen, therefore, that whichever route is taken for the deep waterways it necessarily skirts the borders of the Adirondack region. If the first, the canal passes along the southern border; if the second, it passes along the northern and eastern borders. In either case, the Adirondack region will necessarily become an important manufacturing center.

In order to define the present status of the deep waterways project the writer will give briefly the steps which have thus far been taken. In March, 1895, President Cleveland appointed James B. Angell, of Michigan, John E. Russell, of Massachusetts, and Lyman E. Cooley, of Illinois, Commissioners to make inquiry and report concerning the feasibility of constructing such canals as would enable vessels engaged in ocean commerce to pass between the Great Lakes and the Atlantic Ocean, together with the most convenient location and probable cost of such canals, etc. This Commission is known as the U. S. Deep Waterways Commission. Owing to a lack of appropriation for this purpose the Commission was unable to make any surveys, but studied the question in its general scope, submitting an able report to Congress, in January, 1897. In October, 1897, the Board of Engineers on Deep Waterways, consisting of Col. Charles W. Raymond, of New York, Alfred Noble, of Chicago, and George Y. Wisner, of Detroit, was appointed to make the detailed surveys and examinations recommended by the Deep Waterways Commission. These surveys and examinations were completed in 1900, and an elaborate report published about December 1, 1901.

It is no part of the present paper to give in detail the work of this Board of Engineers any further than to call attention to the fact that whatever route may be adopted the Adirondack region is certain to be benefited. Even though it be the southern route, the northern and eastern boundaries will still have the benefit of water communication by way of Lake Champlain and the St. Lawrence River.

The estimated cost of the deep waterways for a 21-foot channel, which the

Board considered preferable, may, without going into the details of estimates of various alternative routes, be taken at \$200,000,000.

While the deep waterways surveys were in progress the State of New York has also moved in the direction of an improvement of Erie Canal. This improvement involves a deepening to a depth of 12 feet, with material change of route. It is technically known as the Barge Canal, because it is proposed to enlarge its capacity enough to carry a barge of 1,000 tons. The boats now navigating Erie Canal carry 240 tons.

In March, 1899, Governor Roosevelt requested Gen. Francis V. Greene, Major Thomas W. Symons, John N. Scatcherd, George E. Green and Frank S. Witherbee together with the Superintendent of Public Works and the State Engineer and Surveyor, to act as a Committee on Canals. In his letter of appointment Governor Roosevelt stated that he desired the opinion of a number of experts who should include in their number not merely high class engineers but men of business, and especially men who had made a study of the problems of transportation, who knew the relative advantages and disadvantages of ship canals, barge canals and ordinary shallow canals, who were acquainted with the history of canal transportation as affected by the competition of railways, and who had the knowledge which will enable us to profit by the experience of other countries in these matters. This Committee examined into the whole subject and under date of January 15, 1900, submitted a report of several hundred pages, recommending that a barge canal 12 feet in depth would best answer the present requirements of commerce. The estimated cost of the project, including certain work on Oswego Canal, was about \$62,000,000. The writer was consulting engineer to this committee.

Chapter 411, of the Laws of 1900, authorized a complete survey of the Barge Canal route to be made. This project was reported upon by the State Engineer and Surveyor under date of February 12, 1901, since which time it has remained *in statu quo*. The estimated cost by this survey was from \$54,000,000 to \$80,000,000.

While all this canal agitation has been going on in the United States our Canadian neighbors have not been idle. They have, in the last few years, reconstructed the St. Lawrence River Canals, enlarging and deepening them to 14 feet. But probably their most interesting development is for a ship canal, via Ottawa River, Lake Nipissing and Georgian Bay, with a total length of 430 miles. Such a canal would avoid the long detour via St. Lawrence River, Lake Ontario, Lake Erie and Lake Huron. By it, the course is nearly direct from either Sault Ste. Marie or the Straits of Mackinac to Montreal. If constructed it would take the commerce of Lakes Superior, Michigan and Huron, amounting to easily 8,000,000 tons per year, to Montreal. Under date of March 7, 1902, George Y. Wisner, Consulting

Engineer, estimates a total cost for this canal of \$80,000,000 as against \$200,000,000, the cost of the canal through New York State. Even were such a canal constructed the Adirondack region may still realize by water navigation through the St. Lawrence River and Lake Champlain the principal benefits which will accrue to it from either Deep Waterways or Barge Canal.

In order to show the relative advantages of these two canals the following statements of distances are given: From Sault Ste. Marie to Montreal, the distance, by way of the Montreal, Ottawa and Georgian Bay Canal, is 605 miles, and from Sault Ste. Marie to Liverpool, 3,398 miles. The distance from Sault Ste. Marie to New York, by way of Lakes Huron, Erie and Ontario and the Oswego-Mohawk-Hudson route, is 1,081 miles; or, by way of the St. Lawrence-Champlain-Hudson route, 1,289 miles. The distance to Liverpool from Sault Ste. Marie by the shorter of these two routes is 4,186 miles, and by the longer route, 4,394 miles. These figures show a balance of 788 miles from Sault Ste. Marie to Liverpool in favor of the Montreal, Ottawa and Georgian Bay Canal, as against the shortest distance via Ottawa-Mohawk-Hudson route to New York.

It is no part of the present paper to point out the significance of these figures any further than they apply to the Adirondack region especially under consideration. As regards the whole State their significance is equally clear.

As stated in the beginning of this paper the area of the Adirondack region may be taken as substantially equal to that of the State of Massachusetts, or to a little more than 8,000 square miles. According to Census Bulletin No. 125, issued January 14, 1902, the total value of farm property in Massachusetts was \$182,646,704, and the total number of acres in farms was 3,147,064, of which 1,292,132 acres were improved and 1,854,932 unimproved. The total land area of Massachusetts is 8,040 square miles, of which 4,917 square miles, or 61.2% are included in farms.

Census Bulletin No. 179, issued June 3, 1902, gives similar statistics for the State of New York in 1900. The total value of farm property was \$1,069,723,895. The total number of acres in farms was 22,648,109, of which 15,599,986 acres were improved and 7,048,123 were unimproved. The total land area of New York is 47,620 square miles, or 30,476,800 acres, of which 22,648,109 acres, or 74.3% are included in farms.

We may also consider the relative manufacturing of the two States as given in Census Bulletin No. 158, issued April 7, 1902. The total capital employed in manufacturing in Massachusetts in 1900 was \$823,264,287. The assessed valuation of the real estate was \$2,247,094,547. The value of the annual product was \$1,035,198,989.

According to Census Bulletin No. 189, issued April 25, 1902, the same figures for New York State in 1900 were: Total capital invested, \$1,651,210,220; assessed valuation of real estate, \$5,093,025,771; and the value of the annual product, \$2,175,726,900.

Comparing the two States by unit areas it is found that the area of New York is nearly six times as great as that of Massachusetts. Hence, for equivalent areas, the value of the annual product in Massachusetts would be over \$6,000,000,000, or, roundly, three times as great as that of New York.

As to why this is so Census Bulletin No. 158 furnishes a decisive answer in the following language:

"The principal advantage which the State of Massachusetts possesses is its water power. \* \* \* The power of the Connecticut River at Holyoke, and at Turners Falls, in the town of Montague, utilized by means of immense dams of the most permanent construction, and by a system of canals, affords in each place a succession of mill sites along the entire water frontage. The Deerfield, Millers, Chicopee and Westfield rivers, tributaries of the Connecticut, are all noteworthy power-producing streams. At Lowell and Lawrence, upon the Merrimac, the possession of similar advantages led to the selection of these places for the installation of the factory system in the manufacture of textiles. At Fall River, the power furnished from Watuppa Pond has been an essential element in the development of that cotton manufacturing center; while upon the Blackstone River and many lesser streams throughout the State the existence of sites naturally adapted to the erection of mills was influential in the expansion of the woolen and cotton industries in the early part of the century, thus laying the foundation of numerous thriving industrial communities."

In Massachusetts a liberal policy towards manufacturing has always been exercised by the commonwealth. Mill acts have been enacted giving manufacturers an opportunity to develop water power on every stream. The result is that even relatively small brooks are, in many cases, fully utilized and are the source of considerable wealth to the citizens.

In New York State, on the contrary, none of these things have been done. We have been so tied up to the single interest of canal navigation that the streams of the greater portion of the State have been reserved for the canals, and the laws, generally, discourage any such development as has taken place in Massachusetts. We need, therefore, a constitutional amendment with the enactment of a mill act, broad enough to permit the development of any stream to its full capacity without any further powers than those granted by the act. It is possible, moreover, that we need by statutory enactment a modification of a long series of court decisions which have grown up on the theory that the State has absolute control of the streams, and may dispose of them without regard to the wants and wishes of the riparian proprietors.





WORK OF BARK BORERS, BATH-ON-HUDSON.  
*Tomicus calligraphus* Germ. was by far the most abundant and injurious.

# Insects Affecting Forest Trees.

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THE following brief account of various insects injurious to certain forest trees is based upon work of the writer extending over three seasons. Considerable of the collecting was done in the Adirondacks, in the vicinity of Saranac Inn and much more at Karner, N. Y., which is approximately half way between Albany and Schenectady. The white pines at Bath-on-the-Hudson, just across the river from Albany, were also closely watched, and a number of outbreaks in various portions of the Hudson river valley were investigated. The last three years appear to have been exceptionally favorable for certain bark and wood borers (see plates 1 and 2) and consequently a considerable proportion of the observations relate to these insects. More detailed notices of these injurious species, together with many others, have been prepared for publication and will be issued as a separate work. The illustrations are nearly all original and most of the process figures are reproductions of photographs taken by the writer. Due acknowledgment should be made to Dr. A. D. Hopkins, now connected with the United States Department of Agriculture, who kindly determined the bark and wood borers or Scolytids noticed in this paper.

## Insects Affecting the Pine.

The pine is one of our most valuable forest trees, and is unfortunately becoming altogether too scarce in many sections of the State. Much of this is undoubtedly due to many drafts made upon it for commercial purposes, but a considerable number of trees are ruined by various insect enemies. This has been specially true in the last three or four years, when several species of bark borers have been exceptionally abundant and have undoubtedly killed a great many pines in the Hudson and Mohawk river valleys, and probably in other sections of the State. It is proposed at this time to give our observations, together with brief accounts, of some of the more injurious species affecting these trees and their methods of work.

**INSECTS AFFECTING THE TRUNK.** The trunk of the pine forms a congenial home for a great many species, some of which attack it while the tree is still vigorous, while others prefer a diseased, dead or even decaying condition. Each species has well-defined food habits, and as a rule it thrives only under certain conditions. Beginning at the base of a living trunk, we will work up and then study the species following the primary invaders.

**Bark Borers.** This group includes a number of species which operate largely in diseased or nearly dead tissues. Some forms attack healthy trees and most of them can complete their transformations in dead tissues.

### TURPENTINE BARK BEETLE.

*Dendroctonus terebrans* Oliv.

This insect is exceedingly common throughout New York State, and may be found working in small numbers at the base of pine trees in almost every locality. The most characteristic signs of this beetle's presence are the masses of pitch occurring at the base of larger trees. These exudations are very irregular and may sometimes be nearly concealed by pine needles and other debris on the ground. This insect makes a gallery about  $\frac{3}{16}$  to  $\frac{1}{4}$  of an inch in diameter, and by preference attacks living tissues, thus causing a flow of pitch from the wounded parts.



FIG. 1. *DENDROCTONUS TERE-  
BRANS.*  
ORIGINAL.

This beetle has been met with by the writer in hard pine on Long Island, on both hard and white pine in the vicinity of Albany, and on white pine in various places in the State. In no instance has it caused very serious injury, although its pitch masses were sometimes quite abundant.

*Description.* The adult is a rather stout brownish beetle from about  $\frac{3}{16}$  to  $\frac{1}{4}$  of an inch long. The jaws are black, the eyes are finely granulated and the head and thorax thickly and somewhat coarsely punctured. The wings or elytra are striated and somewhat coarsely punctured. The general form of the beetle and certain structural details are shown in the figure.

The pupa is white, quite stout and about  $\frac{1}{4}$  of an inch long. The lateral edges of the abdominal segments are each provided with a rather



FIG. 2. ANAL PLATE OF  
LARVA OF *DENDROCTO-  
NUS TEREBRANS.*  
ORIGINAL.



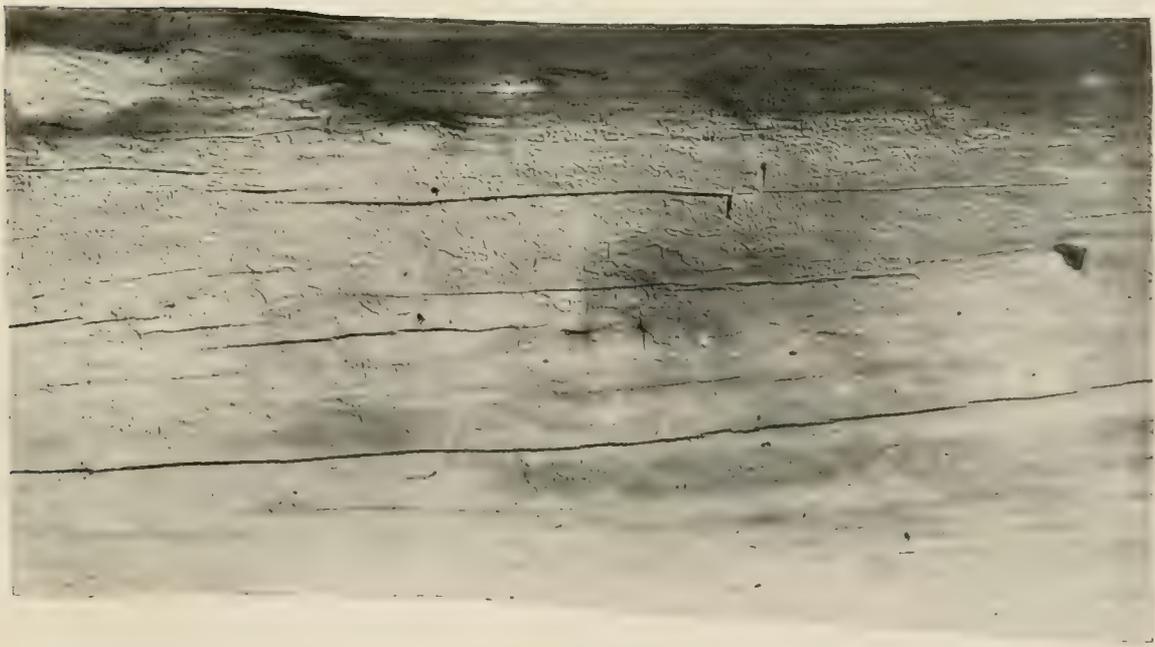
PHOTO, SEPT. 28, 1901.



PHOTO, APRIL, 1902.

WORK OF BARK BORERS, BATH-ON-HUDSON.  
Compare the two views of these trees. *Tomicus calligraphus* Germ. and *T. pin*i Say were responsible for most of the injury.





1

1. Bare wood grooved by galleries.



2

2. Entrance or central chamber under pitch tubes, adults and larval galleries.



4

4. Pitch tube in profile.



3

WORK OF COARSE WRITING BARK BEETLE (*TOMICUS CALLIGRAPHUS* GERM.) IN WHITE PINE.



stout fleshy spine tipped with a dark chitinous point. A pair of similar spines are found on the last segment and smaller, scattering ones on the dorsal surface of the abdomen. Three segments project beyond the tips of the wing pads.

The grub is a stout, brown-headed, white larva about  $\frac{3}{8}$  of an inch long. The tips of the mouth parts and adjacent sutures are dark brown or black. The most prominent characteristic of this grub is the group of seven dark, chitinous spines on the horny anal plate. They are arranged as follows: An anterior transverse row of three, two wider apart behind and between these two others, one in front of the other, figure 2.

*Life History.* The life history of this insect has been studied closely by Dr. A. D. Hopkins, who states that the hibernating adults commence to fly in the latitude of West Virginia as early as April 20th, and that all have emerged by the 10th of May. The species rarely breeds in the bark of logs, but prefers to attack living tissues. The primary or entrance gallery is usually extended longitudinally both above and below the main entrance and seldom laterally, though the secondary or drainage galleries may do so. The female deposits from 20 to 30 eggs in a mass along the sides of the main or secondary gallery, and when the grubs emerge they proceed to feed in a body on the bark before them. Plate 8, figure 4, illustrates a gallery of this species and shows how its walls have been preserved by pitch. The first egg-depositing period, according to Dr.

Hopkins, extends through the month of May, and larvæ are found from the first of June to the beginning of winter. Pupæ commence to appear early in July, and may be found from then till winter. The beetles of the first brood develop about the middle of July, emerge in August and possibly late in July, and young larvæ may be again found by August 10th. Later in the fall all stages may be met with in the bark of infested trees, some occurring as low as 6 inches below the surface of the ground. Our own observations agree with those of Dr. Hopkins as recorded above.

*Natural Enemies.* Dr. Hopkins has observed *Thanasimus dubius* Fabr. attacking and killing this large bark beetle and records finding numbers of the insects in the stomachs of brook trout.



FIG. 3. PUPA OF *DENDROCTONUS TEREBRANS*.

ORIGINAL.

## COARSE WRITING BARK BEETLE.

*Tomicus calligraphus* Germ.

The preceding species is confined to the very base of the trunk while this form is found almost solely in the thicker bark of the trunk and larger limbs of both white and hard pine. The adult beetle is cylindrical, about  $\frac{1}{4}$  of an inch in length and may be recognized by its more or less longitudinal burrows in the thicker bark. This is one of the largest and commonest species of this genus found in the State and its operations have been observed by us in many localities in and about Albany in the Adirondacks, and on Long Island.

*Description.* The beetle is about  $\frac{1}{4}$  of an inch in length and varies in color from light brown to nearly black. It is rather stout, cylindrical, and the conspicuous excavation or declivity at the posterior end of the wing covers is bordered on each side by a row of six teeth or chitinized processes. (Figure 5.) The teeth are arranged on each wing cover as follows: A minute tooth a little to one side of the median line, a dorsal sub-equal pair, and three teeth of nearly uniform height on the lateral and ventral margin of the declivity. The prothorax is thickly and rather finely granulated while the wing covers are marked with rows of closely set, rather large punctures. The general form of the beetle and the sculpturing of the dorsal surface and certain structural details of the antennæ are shown in figure 4.



FIG. 4. *TOMICUS CALLIGRAPHUS*.  
ORIGINAL.

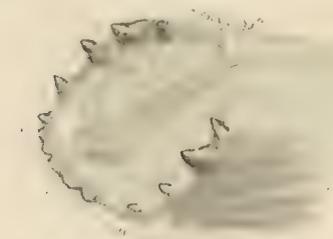


FIG. 5. DECLIVITY OF *TOMICUS CALLIGRAPHUS*.  
ORIGINAL.

The white pupæ occur in oval cells in the bark. They are not quite so large as the beetle, having a smaller transverse diameter and tapering very much to the posterior extremity. Two or three of the abdominal segments project beyond the tip of the wing covers. As the pupæ advance in age, the white becomes yellowish and the mandibles become dark brown.

The full grown larva is a brown headed grub about  $\frac{3}{16}$  of an inch long when normally extended. Its body is rather stout, usually slightly curled, and there is frequently a considerable thickening of the thoracic segments. Portions of the mandibles and the borders of adjacent sutures are dark brown.



PHOTO, OCT, 1902.

WHITE PINE KILLED BY BARK BORERS IN 1900, LANSINGBURGH, N. Y.



PHOTO, OCT, 1902.

HARD PINE DEFORMED BY WORK OF WHITE PINE WEEVIL, SALEM, N. Y.



The galleries of this insect are very characteristic, and frequently afford one of the readiest means of recognizing the species. The exterior signs of its presence may be limited to numerous circular holes about  $\frac{1}{8}$  of an inch in diameter or very few of these may be found. This frequently occurs in cases where beetles have entered the bark in large numbers but have not emerged. The entrance is usually effected under a projecting scale of bark and is therefore not conspicuous, while many of the exit holes (plate 6, figure 1) occur on the prominent ridges and are therefore very easily detected. This species under certain conditions, attacks living tissues and in that event its presence is indicated by brownish or whitish pitch tubes which may be nearly  $\frac{1}{2}$  an inch in diameter and almost that in height. One of these structures is represented in profile at plate 3, figure 4, and a close examination would show that it was built up with particles of pitch brought out from the burrows by the beetles. Plate 3, figure 2, shows a portion of a pine trunk with a number of pitch tubes, indicating that the tree was alive when attacked. The pitch tubes are located, as a rule, over the central chamber, from which the females make their galleries, usually following the grain of the bark. Plate 3, figure 3, represents the inner side of a piece of bark and shows one of the central chambers with five galleries extending therefrom. The small larval burrows may also be detected in the lower portion, and it will be seen that they are placed at somewhat regular intervals, originating in small notches gnawed at these points by the female. Occasionally eggs are deposited very largely on one side of the gallery, and in many instances on both sides. The larval mines dilate gradually with the growth of the young and usually have a somewhat serpentine course, terminating in the oval pupal cell. In badly infested trees, they may form masses of interlacing galleries, and it frequently happens that the beetles are so abundant as to eat away and destroy most of the inner bark, as represented at plate 5, figures 1, 2, 3. The pitiful condition of a badly infested tree, a few years after being attacked, is shown at plate 4, figure 1. It will be seen that most of the bark has dropped from the trunk and plate 3, figure 1, shows the many shallow grooves in the exposed wood. The work of this insect is so inconspicuous that at times few exterior indications may be seen. Plate 6, figure 2, shows the base of a tree, the inner bark of which has been riddled by this borer, as represented at figure 3 of the same plate. It will be observed that the interior is nothing but a decaying mass of borings, and the few exit holes occurring in such a piece of bark are represented at plate 6, figure 1. The galleries of this species are sometimes preserved for an indefinite time by the infiltration of pitch, plate 5, figures 2 and 4, and this is incontrovertible evidence of living tissues having been attacked.

The work of this species on two trees in association with others is shown at plate

2, figures 1 and 2. These two pines were photographed September 28, 1901, and it will be seen that the top of one has very little foliage, and, as a matter of fact, it was entirely dead at that time. The thrifty lower limbs were somewhat infested at the time the photograph was taken. The other tree bore rather abundant foliage and gave little indication of weakness. It was attacked to some extent by the borer. The same trees are represented at plate 2, figure 2, as they stood the following April. It will be observed that the partly dead tree has been entirely killed, and that very few needles are to be seen on the one which showed little injury the preceding fall. Both have been killed by borers, and are remarkable instances of the rapidity with which insects may destroy trees. Plate 1 shows how seriously this insect and its associates may affect strips of pine in the vicinity of Albany.

*Life History.* The development of this insect requires about ten weeks. August 5, 1901, a slender pine was observed in which this species was entering in large numbers. The needles were somewhat thin at that time, pitch tubes were rather abundant and many small masses of pitch were to be found upon the foliage of surrounding shrubs. The beetles were then making their primary galleries, the bark of the tree was living along practically its entire length, and many eggs were being laid. About eight weeks later, or September 26th, two-thirds of the needles were brown and the remainder were changing rapidly. October 16th practically all the needles were brown and dead, the bark had been killed and its inner layers consisted of little else but borings. Practically all of the living Tomicids had forsaken this tree, though some were found in those nearby. During this short time the entire life cycle was completed, and the inner bark had been entirely destroyed by the work of beetles and grubs.

*Habits.* It is not intended by the above account to give the impression that this insect normally attacks living trees, but the evidence submitted above proves conclusively that, under certain conditions, it may and does cause serious injury. It is undoubtedly true, as stated by other writers, that this species, like some of its allies, attacks by preference diseased or dying trees and that only when it becomes exceptionally abundant is there danger of its injuring healthy pines. The writer has observed this insect in the vicinity of Albany, where it has caused more injury to white pines than to the equally abundant, though smaller, hard or pitch pine.

*Natural Enemies.* The two Clerids, *Thanasimus dubius* Fabr. and *Clerus quadriguttatus* Oliv. were met with by the writer in greater or less numbers in the galleries of this bark borer. The former species was especially abundant and is undoubtedly one of the most efficient natural checks upon the undue increase of this borer and its allies. *Hister lecontei* Mars. and a species of *Hypophloeus* was met



4



3



2



1

WORK OF COARSE WRITING BARK BEETLE (*TOMICUS CALLIGRAPHUS* GERM.) IN WHITE PINE.

1 and 3. Very badly eaten bark.

2 and 4. Adult galleries preserved by infiltrated pitch.



with in considerable numbers in the deserted galleries of this insect at Karner and at Manor, N. Y. *Plegaderus transversus* Say was present in numbers in the galleries of this insect at Karner, and the same was true of *Trogosita virescens* Fabr. A species of *Aulonium* was also met with in the galleries of this insect.

### SOUTHERN TOMICUS.

#### *Tomicus cacographus* Lec.

This little bark borer is frequently associated with the preceding, and confines its operations largely to the thinner bark of small pines and that of the limbs of larger trees. It was found by the writer in August and September, 1900, in considerable numbers at Slingerlands and Karner. At the latter place it was working in recently cut hard pines, and in the former was breeding in white pine limbs. The species was common at Manor, Long Island, in the same year and was taken from under the bark of the middle portion of the trunk of a pitch pine which had been attacked by *Dendroctonus terebrans* Oliv., and in one instance at least, it appeared to be the primary offender, boring in large numbers in limbs on which green needles were still to be found. It was observed working in living tissues at the base of another dying hard pine, and was also operating in other trees. The workings of this species have been characterized by Dr. Packard as much like those of *T. calligraphus* Germ., except that the main gallery is narrower to correspond with the smaller size of the insect. Our own observations show that the burrows made by the beetles during the breeding period are more regular and are apt to run with the grain of the bark, the eggs being deposited on either side and the young making more or less oblique, serpentine galleries in the adjacent tissues. Later the bark may become a mass of interlacing burrows, nearly filled with particles of decaying bark.

*Description.* This is one of the medium sized species of *Tomicus*. The beetle is a trifle over  $\frac{1}{8}$  of an inch long, cylindrical, rather slender in form and, like other species of this genus, varies in color from light to dark brown. The posterior excavation or declivity of the wing covers is bordered by a series of five teeth. The one near the dorsal median line is very minute, the second and third are much larger and connected or nearly so at the base, and the fourth and fifth are smaller and distinct from each other. (Figure 6.) The prothorax is rather coarsely granulated and the wing covers are marked with longitudinal rows of rather deep punctures.



FIG. 6. DECLIVITY OF *TOMICUS CACOGRAPHUS*.

ORIGINAL.

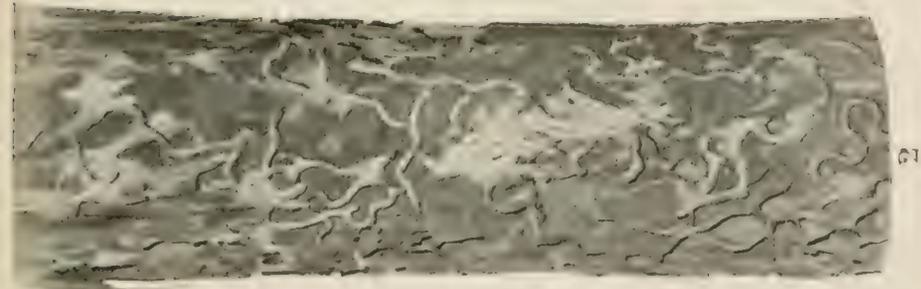
The soft white pupæ may be found in their oval cells in the bark. They are normally creamy white, about as long as the beetle and with a tapering abdomen with one or two segments usually extending beyond the tips of the wing covers.

The full grown larva or grub is creamy white, about  $\frac{3}{16}$  of an inch long and with the body slightly curved. The head is light brown with the tips of the mouth parts and adjacent sutures much darker.

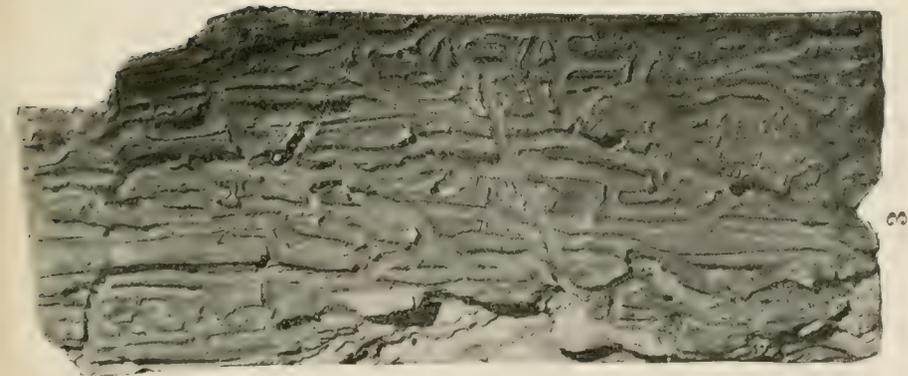
*Life History.* Adults of this species were entering the limbs of a hard pine in large numbers at Manor, L. I., October 3, 1900. The galleries being made at that time were evidently both for hibernation and food. They were a little over  $\frac{1}{16}$  of an inch in diameter, exceedingly tortuous and apparently with no definite plan. In one portion the beetles had just begun their operations and the curious manner in which they work in living bark is shown on plate 7, figure 1. A more advanced stage is illustrated at plate 7, figure 2, and shows how completely a limb may be girdled within a short time. The specimen from which this illustration was made was taken from a limb about 10 feet long which bore many green needles. The foliage dropped readily, but, as the tree had apparently been vigorous till within a short time, the injury was attributed to this insect. A central or entrance chamber will be seen in both of these illustrations, though most of the galleries are very irregular and apparently follow no plan. The tendency of the adults to work largely with the grain of the bark is shown in plate 7, figure 3, which illustrates a very badly bored piece of hard pine bark. There was very little or no exterior evidence of the operations of the larva in this instance.

*Natural Enemies.* Several insects prey upon this bark borer, one of the most important being *Thanasimus dubius* Fabr., which attacks this species as stated by Dr. Hopkins. The writer has also met with *Hister lecontei* Mars. and *Plegaderus transversus* Say in the galleries of this insect, where it was associated with the larger *Tomicus calligraphus* Germ. Dr. Hopkins records meeting with *Hister parallelus* Say in the burrows of this species.

Dr. A. D. Hopkins has reared several parasites from this species. *Spathius canadensis* (?) Ashm. was bred by him from cocoons found in the mines of this insect in white pine; and *S. pallidus* Ashm. was reared by him from cocoons found in the larval galleries under the bark of scrub pine.



1



2



3



4

WORK OF PINE BARK BORERS.

1. Early operations of *Tomioides cacographus* Lec. in hard pine. 2. Same in a more advanced stage. 3. Bark badly eaten by this species. 4. Work of *Tomioides cacographus* Germ. and *Rhagium lineatum* Oliv. in white pine.



## PINE BARK BEETLE.

*Tomicus pini* Say.

This is a small form like the preceding, and measures only about  $\frac{5}{32}$  of an inch in length. It is confined almost entirely to the thinner bark near the middle portion of the trunk and to that of the larger limbs. This species is associated with larger forms, specially *Tomicus calligraphus* Germ., and appears to confine its attacks largely to the white pine, though it has been recorded in spruce and larch. This borer was breeding in large numbers August 18, 1901, at Saranac Inn, in a small dying white pine about 18 inches in diameter. The tree was abundantly infested about midway of its height, and a few beetles were found at the top and near the base. This species was also met with by the writer in considerable numbers under the bark of the larger limbs of a large dying white pine at Lansingburgh, which was abundantly infested with *Tomicus calligraphus* Germ. The same conditions were found to obtain at Bath-on-the-Hudson, except that the attack was more advanced. The destructive work of this species was also observed by the writer at Round Lake, N. Y., and it was brought to his attention by a correspondent residing at Catskill, where 50 pines 25 to 30 years old had died during the summer of 1901, and in this latter instance it is very probable that this species was the primary cause of the injury.

*Description.* The beetle is slightly larger than *Tomicus cacographus* Lec., being about  $\frac{5}{32}$  of an inch long and usually a little stouter. It varies in color, like the preceding, from light to very dark brown. One of the most prominent characteristics of this beetle is the presence of but four teeth on each side of the conspicuous elytral declivity or excavation. They are arranged as follows: The dorsal one near the median line is minute and sometimes wanting in the female; the second and third are larger, specially the latter, and touch at the base; the fourth is much smaller and independent, figure 7. The prothorax is rather coarsely granulated and the elytra or wing covers are ornamented with longitudinal rows of rather small punctures.



FIG. 7. DECLIVITY OF *TOMICUS PINI*.  
ORIGINAL.

The typical form of the burrows of this insect is well shown in plate 8, figure 3, which represents the central or entrance chamber and a long adult gallery, which is about  $\frac{1}{16}$  of an inch in diameter, from which may be seen the somewhat tortuous expanding larval mines, which are rarely more than  $\frac{1}{2}$  an inch in length. The speci-

men of bark photographed shows also the work of what is probably a young *Monohammus* larva. It will be seen by an examination of this figure that, in this case at least, two females continued their work from the central chamber, one going up and the other down and approximately parallel with the bark fibers. A more advanced stage of this insect's work is shown at plate 8, figures 1 and 2, which represent portions of adult galleries together with a great many very irregular larval mines, several pupal cells and a few exit holes. This insect and its relatives may cause considerable injury to the inner bark without any very perceptible exterior signs.

The work of this species in the thinner bark of the middle portion of a young pine is well shown on plate 9. The view of the inner aspect of the bark (figure 2) shows the galleries of the *Tomicus* and also the broader shallow workings of young *Monohammus* larvæ. A great number of exit holes are represented in figure 1 by the light spots. Both of these illustrations were taken with a light background and consequently the exit holes appear as white spots.

Dr. Fitch has noticed this insect and he states that the adult burrows have some resemblance to the fingers of a hand spread apart, or to the track of a bird, in that they diverge from a common center and run up and down the tree. He states that this insect may be found under the bark of old white pines.

Prof. A. D. Hopkins records this species as exceedingly common in the bark of white pine in West Virginia and observes that it attacks all other kinds of pine in that State. He has also found it in both the larch and black spruce, but not so frequently as in the pine. In May and June, 1897, he found it quite commonly excavating egg galleries in the living bark of black spruce, and his observations led him to conclude that under favorable conditions it might prove a very destructive enemy of this tree.

*Natural Enemies.* Comparatively little has been recorded concerning the natural enemies of this species. *Clerus quadrisignatus* Say was found by the writer in the burrows of this insect where it was associated with *Tomicus calligraphus* Germ. The very efficient *Thanasimus ?dubius* Fabr. was also found by the writer under similar conditions.

#### *Tomicus caclatus* Eich.

This little species is frequently found in association with the larger *T. calligraphus* Germ., and like other small forms of this genus, prefers the thinner bark of small trees or the upper portion of the trunk of larger ones. Dr. Fitch has characterized it as one of the most pernicious of all the insects infesting white pine forests and the yellow pine in the Southern States. He believed that this species frequently attacked trees in full health and vigor.



4



1



3



2

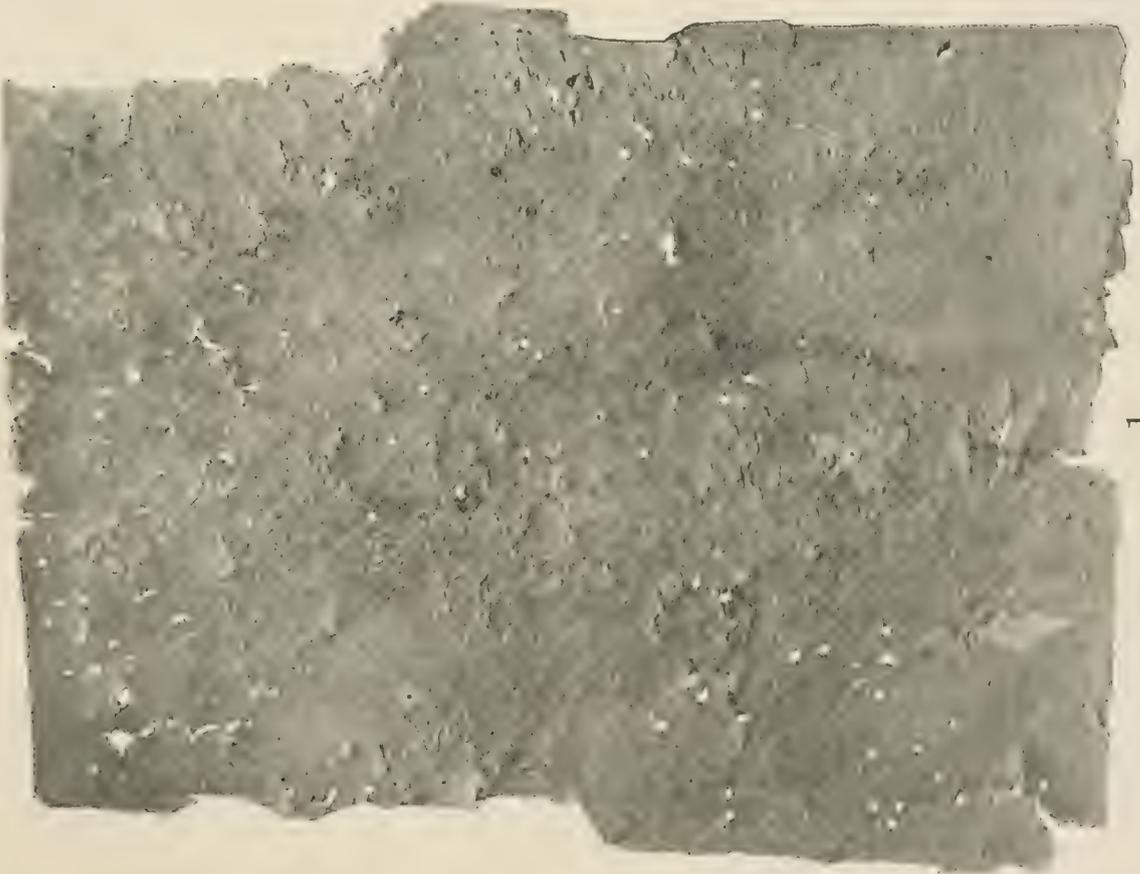
WORK OF BARK BORERS IN WHITE PINE.

1 and 2. Advanced stage of work of *Tomictus pini* Say.

3. Portion of typical mine of *Tomictus pini* Say; also work of young *Monochamus* larva.

4. Borings of *Dendroctonus terebrans* Oliv.





1



2

WORK OF PINE BARK BORER (*TOMICUS PINI* SAY) IN WHITE PINE.

1. Surface of bark, showing exit holes and small pitch tubes. 2. Interior of bark, showing galleries of *Tomiscus* and young *Monohammus*, and exit holes. The light background in both views causes the latter to appear white



This beetle was found by the writer at work in balsam in company with *Tomicus balsameus* Lec., in hard pine with *T. calligraphus* Germ. and *T. cacographus* Lec., in white pine with *T. calligraphus* Germ. and *T. pini* Say, and in spruce with *Polygraphus rufipennis* Kirby.

*Description.* This is another medium sized *Tomicus*, being about  $\frac{1}{8}$  of an inch in length, cylindrical, and varying in color from light to very dark brown. It is a little shorter and more slender than *Tomicus cacographus* Lec.; the posterior, dorsal portion of the wing covers is more hairy and the declivity is not so well marked. There are three principal tubercles or chitinous teeth, a small dorsal one near the median line and two larger, widely separated teeth on the flattened area of the declivity. Between the larger tubercles and farther from the median line there are several minute chitinous points marking the real margin of the declivity. There is considerable variation in the teeth on the declivity in this species, particularly of those marking the border or edge and the illustration represents a specimen in which the latter are unusually well developed (Figure 8.). The prothorax is rather finely granulated and the wing covers are marked with longitudinal rows of rather fine punctures.

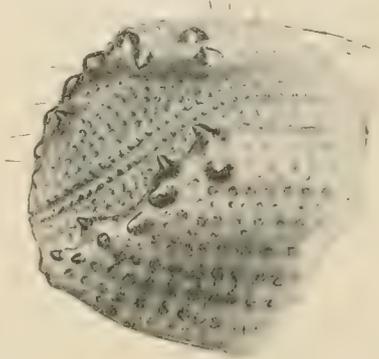


FIG. 8. DECLIVITY OF *TOMICUS CAELATUS*.  
ORIGINAL.

The pupa has been described by Dr. Fitch as resembling the perfect insect in size and shape. It is white at first and as maturity approaches it may darken in color. The larva is a soft white grub resembling those of allied species. Its polished head is white at least during the early periods of its life. The mandibles are chestnut brown and there are no indications of eyes or feet.

The galleries of this species, judging from the few specimens collected, are more irregular than those of some other members of the genus. The central or entrance chamber is well marked and from this three or more females may make their way in rather tortuous courses, sometimes parallel with and sometimes nearly across the bark fibers.

The eggs are deposited on both sides of the burrows and the grubs or larvæ excavate very irregular galleries for a distance of about an inch and end their labors in a rather deep oval cell in the sap wood in which the grub transforms to the beetle.

Dr. Fitch noticed this insect in his 4th Report under the name of *Tomicus xylographus* Say and he comments as follows on the boring habits of this species.

He states that a long slender cylindrical gallery is formed, which is excavated about equally in the outer surface of the wood and in the inner layers of the bark. In some cases two, three or even six galleries may originate from one point, running in opposite directions, but always lengthwise with the tree or limb. Little notches are excavated at intervals in the adult galleries while the work is in progress, one to four eggs being placed in each notch. The gnawings of the beetles are left strewn in the bark behind them and as they travel backward and forward in the burrow from time to time, the little stiff hairs with which their bodies are provided serve as a brush to sweep this dust into the egg notches, as stated by Dr. Fitch. Thus the mouths of the egg notches are filled and the eggs therein covered and concealed. The female forms a burrow from four to eight inches or more in length.

*Life History.* Dr. Fitch states that the eggs probably hatch in 10 to 20 days according to the temperature. The young grub is found lying with its back towards the sawdust with which the cavity in which the egg is laid was filled, its head thus being close to the soft innermost layer of bark at the extremity of the notch. This cavity is continued by the larva to a distance of from 1 to 3 inches at approximately right angles to the main boring. The galleries increase in size with the development of the grubs and those not overtaken by disaster excavate oval cells in which the transformations to the adult take place.

*Natural Enemies.* This species is subject to attack by a number of natural enemies. The writer has taken *Thanasimus dubius* Fabr. in the burrows of this bark borer, where it was associated with *Tomicus calligraphus* Germ. This predacious beetle is undoubtedly one of the most efficient natural checks on bark borers. Another small beetle, *Hister parallelus* Say, was also found by the writer in the galleries of this bark borer.

#### *Pityogenes* Species.

This is a very small species, only  $\frac{1}{32}$  of an inch in length, and was met with by the writer August 5, 1900, at Slingerlands, N. Y., where it had been working in recently cut pine limbs. Larvæ and pupæ were present and the beetles had evidently commenced operations recently. This species was associated with *Tomicus cacographus* Lec., and a species of *Hypophloeus* was found in its galleries. This bark borer was also met with by the writer in limbs of a dying white pine at Saranac Inn, August 19, 1900, where all stages were present, and though the tree was not badly infested, this borer may have had a hand in its death, as its operations extended over the entire length of the tree. In this instance it was associated with



1



2



3



4



5

BORERS AND INSECT GALLS.

1. *Monohammus confusus* Kirby, much reduced.

2. Oak Fig Gall, *Biorhiza forticornis* Walsh, on chestnut leaved oak.

3. Typical gallery of *Phlaosinus dentatus* Say, in arbor vitae.

4. Work of *Pityogenes* species in white pine.

5. Work of *Pityophthorus* species and a Buprestid in hard pine.



*Tomicus balsameus* Lec., another species of *Pityogenes*, *Hypophloeus* species, and a Chalcid; the latter two were not determined. This insect was also met with in September of the same year at Bath-on-the-Hudson, where it was boring dead limbs of white pine in which were to be found larvæ, pupæ and adults. This latter tree had also been attacked by *Tomicus calligraphus* Germ. The borings of this insect are quite irregular. There is a rather large irregular central chamber, with three to four or five primary or egg galleries diverging sometimes at right angles and sometimes obliquely to the wood fibers. In one case noticed, several larval galleries originated from the central chamber, showing that the eggs, in at least one instance, were deposited in little notches in its wall. The primary or egg galleries are from about 1 to 1½ inches in length, and from them arise the slender, somewhat tortuous



FIG. 9. WORK OF PITYOPHTHORUS SPECIES IN WHITE PINE.

ORIGINAL.

larval galleries, which may attain a length of about 1½ inches. Pupation occurs at the tip of the mine in a slightly enlarged cell, which is sometimes excavated in the sap wood.

#### *Pityogenes* Species.

Another species of this genus, stated to be a new form by Dr. Hopkins, was met with by us at Saranac Inn, in August, 1900. It was operating in a nearly dead young pine and its galleries were quite different from the preceding. Its central chamber is not so large, the notches for the reception of the eggs are placed a little further apart, and the larval galleries do not cut the wood so deeply as a rule. The pupal cells are excavated to a much greater depth in the sap wood. The work of this species is illustrated in plate 10 figure 4. Apparently the same species was met with in another white pine where it was associated with *Tomicus caelatus* Eich., and also in dying balsam, where it occurred in company with the last named species and with *Tomicus balsameus* Lec.

*Pityophthorus* Species.

A small species belonging to this genus was met with by the writer September 8, 1900, at Karner, working under the bark of a dead hard pine limb. Recently transformed adults and a few pupæ were observed in the galleries. The twig was also bored by a Buprestid larva. The adult galleries of this insect are remarkable for their delicacy. They are represented much reduced in plate 10 figure 5. It will be seen that the general design has been much marred by the work of the Buprestid above mentioned, and the tortuous larval galleries may be seen branching from the primary ones at irregular and somewhat considerable distances. The larva, as it attains maturity, appears to make a very irregular excavation, which sometimes doubles back upon itself or is simply a very broad excavation.

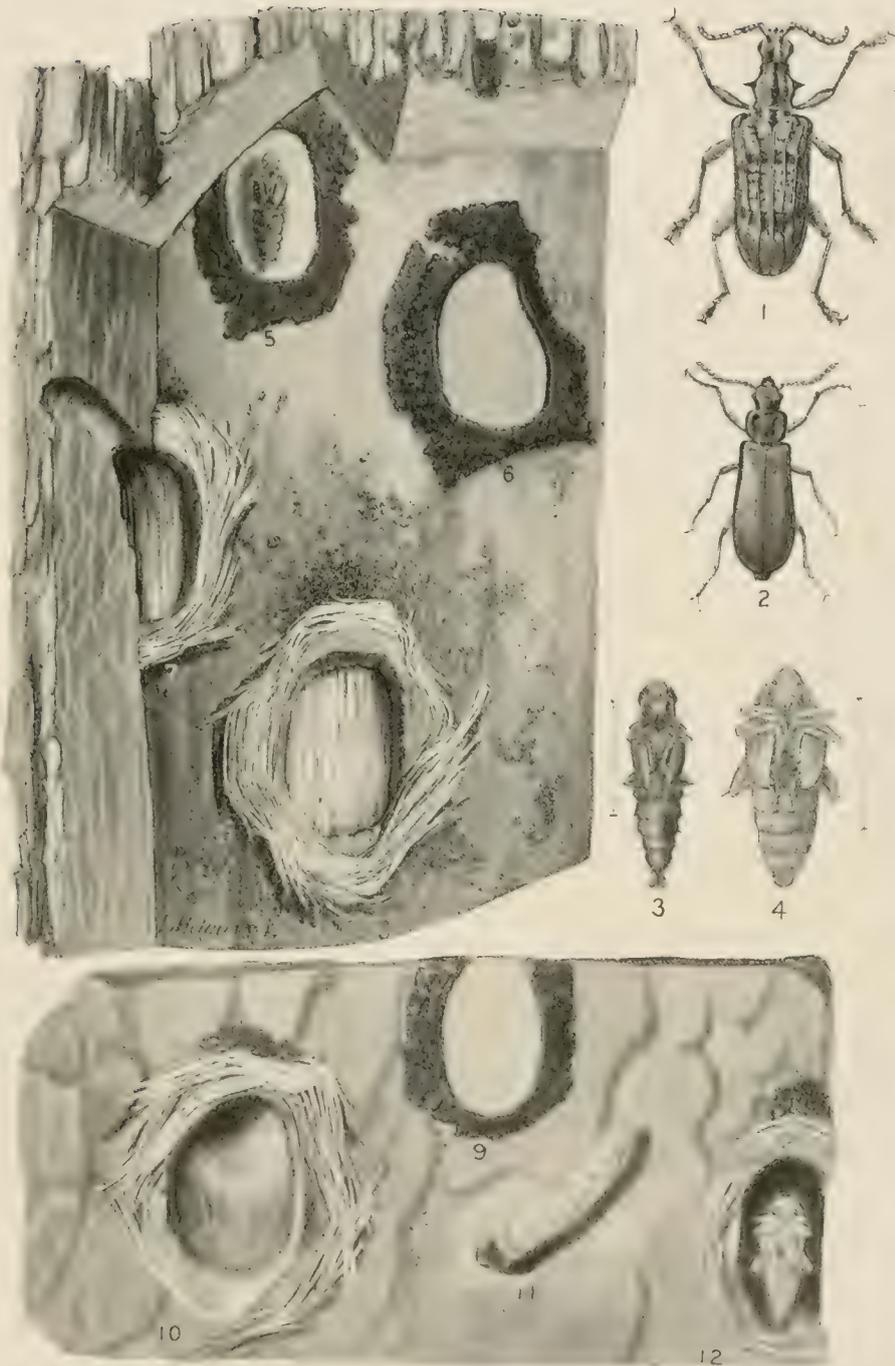
*Pityophthorus* Species.

Another insect belonging to this genus was met by the writer August 22, 1900, at Axton, where it was working in small numbers under the bark of a young dying white pine. The central chamber of this species is somewhat circular and in the specimen figured has four primary galleries with a short fifth. The primary or egg galleries run longitudinally or obliquely to the wood fibers and cut into the wood a considerable proportion of their depth. The larval galleries are somewhat tortuous, expand very gradually, and cut the sap wood for about one-half their depth, and toward the extremities a greater proportion lies in the wood (Figure 9).

**Borers of dead, frequently nearly rotten, bark.** The forms noted above are all bark borers and a student of their habits will observe that each species has characteristic methods of work and is limited by certain conditions. The insects noticed below appear to prefer diseased or dying tissues and thrive only to a limited extent in dead or decaying bark.

**RIBBED RHAGIUM.***Rhagium lineatum* Oliv.

A white, broad-headed, flattened grub may frequently be found in considerable numbers under the bark of dead white pine previously bored by various bark beetles, such as those mentioned above. This species is exceedingly common and has been met with by the writer in the vicinity of Albany in large numbers. This beetle was so abundant in 1901 that about 50 adults and numerous pupæ and larvæ were obtained in a few minutes from under the bark of one tree at Lansingburgh. This species is never injurious to living trees, so far as our experi-



*RHAGIUM AND PYTHO.*

Ribbed Rhagium, *Rhagium lineatum* Oliv. 1. Beetle. 4. Pupa. 7, 8, 10. Pupal cells. 11. Larva or grub  
12. Pupa in cell.

*Pytho americanus* Kirby. 2. Beetle. 3. Pupa. 5. Pupa in cell. 6, 9. Pupal cells.

DRAWN UNDER THE AUTHOR'S DIRECTION BY L. H. JOUTEL.



ence goes, since it is one of the forms which revel in partly rotten tissues. The operations of this grub and certain associated insects soon loosen the bark so that it drops off in large sheets. The work of this species is shown at plate 7, figure 4.

*Description.* This beetle is a grayish insect, mottled with black and about  $\frac{5}{8}$  of an inch long. Its general form and markings are well shown in plate 11, figure 1. The prothoracic spines and the two prominent ridges on each wing cover are the most characteristic features of this beetle.

The pupa is white, rather stout, and varies in length from about  $\frac{1}{2}$  to nearly  $\frac{3}{4}$  of an inch. The dorsum of the head, pro- and metathorax and each abdominal segment bear minute hairs or setæ somewhat grouped on each side of the dorsal line. The brown abdominal spiracles are conspicuous. Plate 11, figure 4.

The pupal cell is constructed just under the bark. It is oval, about  $\frac{1}{2}$  by  $\frac{3}{4}$  inches in diameter and is partly lined with somewhat decayed wood particles. The most characteristic feature is the mass of fibers torn from the wood at the side of the cell and incorporated in its walls (Plate 11, figures 7, 8, 10 and 12). The excavation in the wood is probably necessary in order to give requisite depth for the thicker pupa and beetle. This is in marked contrast to the pupal cells of *Pytho americanus* Kirby, a species frequently associated with *Rhagiium* and which is noticed on the following page.

The white flattened grub or larva ranges in length from  $\frac{3}{4}$  to  $1\frac{1}{4}$  inches and is remarkable for its broad head, which is amber-colored and is fully as wide as the thoracic segments. The powerful jaws are tipped with black. The corneous prothoracic shield is yellowish, and the six true legs are poorly developed (Plate 11, figure 11).

*Life History.* Some pupæ and many beetles were found under the bark of one tree September 21st. The remaining pupæ were nearly ready to assume the adult form and the beetles were to be found mostly within the pupal cells. Many of them had begun to burrow in an oblique direction up and out through the bark. Some had just started the work, but in many cases the beetles had nearly penetrated the thick bark, though none had escaped, so far as was observed.

The grubs of this species evidently become full grown during the latter part of the summer, construct their pupal cells, and transform to beetles before the approach of cold weather. The adults winter very largely in the pupal cells or in the characteristic upward, curving exit burrows which they begin soon after assuming the adult condition.

*Pytho americanus* Kirby.

This species is frequently associated with the preceding form and appears to prefer bark tissues in a more advanced stage of decay. It was met with by the writer rather commonly in various localities associated with the Ribbed Rhagium.

*Description.* The beetle is much flattened and is about  $\frac{1}{2}$  an inch long, with the head and thorax black, and the striated wing covers dark bluish green. The powerful jaws are rufous, tipped with black, and the antennæ, legs and abdomen are similarly colored. The form of the insect is represented on plate 11, figure 2.

The pupa is whitish, more slender than that of *Rhagium*, and may readily be recognized by its occurring in cells with walls composed entirely of nearly rotten particles of bark. Plate 11, figure 3.

The pupal cell is nearly circular, about  $\frac{3}{4}$  of an inch in diameter, and is constructed between the bark and the wood. There is no excavation in the wood and the walls are composed only of partly rotten borings, plate 11, figures 5, 6, 9. The difference between the cells of *Rhagium* and *Pytho* is well brought out in the illustration.

*Life History.* The larva evidently becomes full grown the latter part of the season and transforms to the pupa and then to the beetle before the approach of cold weather. This species probably hibernates very largely in the pupal cells or else under the bark.

## PINE SAWYER.

*Monohammus confusor* Kirby.

The grub of this large beetle is frequently associated with the preceding species in the work of reducing the inner bark to characterless dust. The galleries of this giant grub are larger than the preceding forms and not infrequently score the sap wood, leaving large white splinters which are very characteristic of its work. This borer not only operates in the inner bark and sap wood of dying trees but under certain conditions it appears to attack healthy tissues. It also bores into the heart wood of trees and forms very irregular galleries in the timber, thus reducing its value materially for most commercial purposes. The coarse white chips made by this grub may frequently be met with in small piles under logs lying in mill yards and the operations of the borer itself may be heard in the stillness of the night.

The parent insect, plate 10, figure 1, is a magnificent beetle, about  $\frac{1}{2}$  of an inch long and with tremendous antennæ which may measure as much as 3 inches in length.

**Ambrosia Beetles or Wood Borers.** The preceding forms all confine their operations very largely to the inner bark and sap wood and either assist in destroying the living tree or hasten the removal of its bark. The species next to be considered operate in the wood and prefer to enter such tissues when exposed and are therefore followers of the preceding forms.

*Xyloterus bivittatus* Kirby.

Small, round, black holes may occasionally be observed in the exposed wood of various coniferous trees and on examining them more closely it will be seen that they have a uniform diameter and that their walls are black, a discoloration produced by the fungus upon which the beetles feed. The work of this insect was met with by the writer in various trees in the Adirondack region. The galleries are characterized by a main burrow entering the wood vertically for a short distance and then giving off branches on either side which run parallel to the lines of growth and each of these galleries lead into a series of vertical brood chambers in which the young are reared.

The adult is a stout, brownish-black beetle measuring a little over  $\frac{1}{8}$  of an inch in length. The form of the antennæ, the sculpturing of the prothorax and the markings of the wing covers are shown at figure 10.

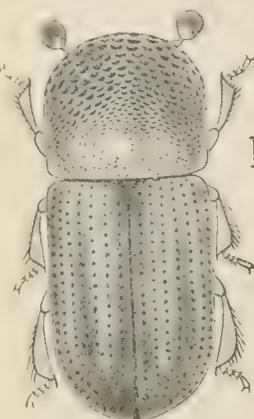


FIG. 10. *XYLOTERUS BIVITTATUS*.

AFTER HUBBARD, U. S. DEPT. AGR., DIV. ENT. BUL. 7, N. S. '97.

*Gnathotrichus materiarius* Fitch.

This is another of the wood boring beetles which is also known as an ambrosia beetle because of its living upon a cultivated fungus termed Ambrosia. This insect was taken by the writer in August, 1900, in the stump of a white pine which had been cut between September and December of the previous year. The bark had fallen from the stump and the wood had evidently weathered for some time, as its surface was discolored and black. It was very probably dead when cut. This form was also found in considerable numbers in a dead pitch pine at Manor, in October of the same year.

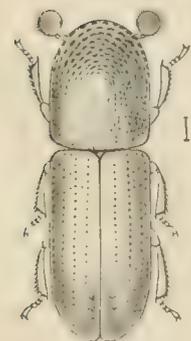


FIG. 11. *GNA-THOTRICHUS MATERIARIUS*.

AFTER HUBBARD, U. S. DEPT. AGR., DIV. ENT. BUL. 7, N. S. '97.

The beetle is a rather slender, cylindrical, brownish-black insect, about  $\frac{1}{8}$  of an inch in length and with yellowish legs. The globular antennæ, the sculpturing of the thorax and the linear dottings of the wing covers are well shown in figure 11.

The burrows of this insect extend into the wood vertically for a distance of  $\frac{1}{2}$  an inch and from this main gallery several branches arise at different depths which extend in a direction approximately parallel with the lines of growth, each leading into a series of vertical brood chambers, figure 12.

**Woodborers.** There are many forms, beside the preceding, which might be included under this heading. The larvæ of many insects bore very largely in the wood of white pine but in this brief paper only the following will be noticed in this connection.

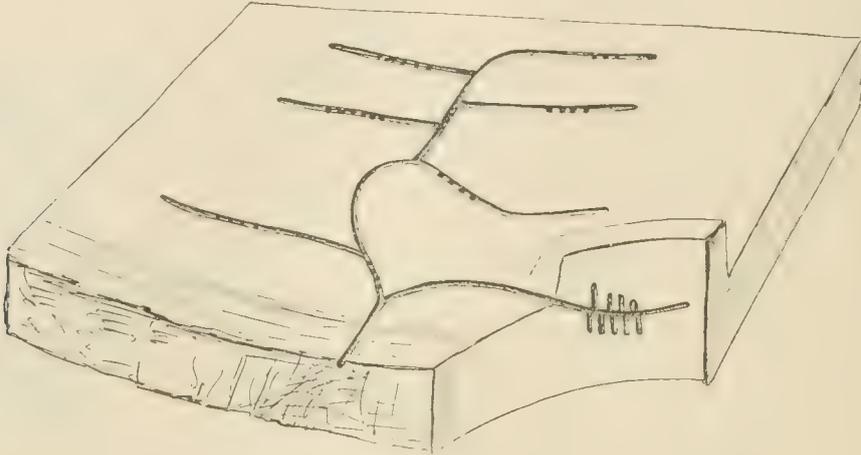


FIG. 12. GALLERY OF *GNATHOTRICHUS MATERIARIUS* IN PINE.

AFTER HUBBARD AND HOPKINS, U. S. DEPT. AGR., DIV. ENT., BUL. 7, N. S. '97.

## WHITE ANTS.

*Termes flavipes* Kollar.

The common wood borers are also aided in the work of destruction by white ants which, in some localities, are very abundant. This was especially true on Long Island where many of the hard pine stumps had been extensively tunneled by these industrious insects. One small tree met with at Karner near Albany had been infested to such an extent that ant galleries were observed over four feet from the ground. The tree was a small one and in the course of a few years would become so weakened as to fall in a severe storm.

**INSECTS ATTACKING THE SMALLER LIMBS.** There are certain forms which confine their operations almost entirely to the smaller limbs of our various pines and for convenience sake they are grouped together. Some of the most important of these are the following:

## WHITE PINE WEEVIL.

*Pissodes strobi* Peck.

This is an exceedingly common insect on hard and white pines in certain years and its operations may be observed to a greater or less extent in almost any group of pines in New York State. The greatest injury caused by this weevil is due to its operations in the terminal shoots of the pines. The beetles may be found in large numbers on the young growth where they apparently feed and deposit eggs in the crevices of the bark. The young grubs work in the inner bark and attack the outer sap wood so that badly infested twigs have these vital tissues entirely destroyed. The insect appears to begin operations in the rough bark just beneath the uppermost whorl and from this point the destruction is continued down the leader to the next whorl and even below it. The larvæ make longitudinal, slightly tortuous mines in the inner bark. Their progress is plainly shown by the shrunken, discolored bark over the affected portion, plate 13, figure 5. The killing of the central shoot is a serious matter in the case of the pine because the tree is compelled to branch and this renders impossible the growth of the long, straight trunks which produce the most valuable timber. This species was collected by the writer in large numbers at Karner, N. Y., and adults were captured in greater or less abundance throughout the season, the beetles being most numerous between the 13th and 26th of June, and from the 9th to the latter part of August. Earlier writers have stated that the weevils are most abundant the latter part of April or May but our own observations indicate that this species breeds more or less throughout the entire year, and that not infrequently large numbers may complete their transformations in midsummer or the latter part of August. The life history of this species has not been closely followed, and the extended breeding season renders it somewhat difficult to make precise statements. Dr. Fitch was of the opinion that the species completes its life cycle within a year, and it seems very probable that such is the case, and possibly it may be completed in a shorter period. The insect is probably able to pass the winter in the larval, pupal and adult stages, the final transformations taking place in small oval cells, about  $\frac{1}{4}$  of an inch in length, in the wood or bark, plate 13, figures 3, 6. The insect also breeds under the bark of pine logs and stumps. The work of this species in such locations is much less serious than that in the twigs, and has attracted very little attention in the past.

*Description.* The adult insect is a reddish-brown beetle about  $\frac{1}{4}$  of an inch in length, and with a whitish spot near the posterior third of each wing cover. The weevil is somewhat mottled on the sides and legs. The snout is rather long and

## Explanation of Plate 12.\*

FIG.

1. Pitch mass of pitch twig moth *Retinia comstockiana* Fern., with pupal shell protruding therefrom in one case; the other shows old and recent pitch.
2. Pitch mass of pitch inhabiting midge, *Diplosis resinicola* Osten Sacken.
3. Shoot infested with Nantucket pine moth larva, *Retinia frustrana* Scudd., showing the abortive growth.
4. Pitch pine needle gall fly, *Diplosis pini-rigidæ* Pack., showing needles deformed by this insect.
- 4a. Work on needles of the previous year.
5. Needles affected by the pine leaf miner, *Gelechia pinifoliella* Chamb., note the brown tips of the affected needles.
6. A pine sawfly larvæ, *Lophyrus abietis* Harris in natural position on the needles; below are stubs of eaten needles.
- 6a. Cocoon of same at base of pine needles.
7. Pine Chrysomela, *Glyptoscelis pubescens* Fabr., much enlarged.
8. Pales weevil, *Hylobius pales* Herbst., much enlarged.
9. *Chrysobothris pusilla* Bap. & Gory, much enlarged.
10. *Chrysobothris floricola* Gory, enlarged.
11. *Chrysobothris dentipes* Germ., much enlarged.
- 12, 13 and 14. Varieties of the light loving grapevine beetle, *Anomala lucicola* Fabr., a species which is very abundant on hard pines.
15. *Pilophorus crassipes* Uhl., much enlarged.
16. *Magdalis alutacea* Lec., much enlarged.
17. *Magdalis perforata* Horn, much enlarged.
18. Lace winged fly, *Chrysopa* species.
- 18a. Cocoons of same on needles.

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\* Executed from nature, under the author's direction, by L. H. Joutel.





FIG.

18b. Stalked eggs of lace winged fly.

19. Pitch tip moth, *Pinipestris zimmermani* Grote.

20. Work of pitch tip moth, *Pinipestris zimmermani* Grote, in a shoot, showing its abortive character and the peculiar small pitch mass near its base.

21. Pitch twig moth, *Retinia comstockiana* Fern.

22. Spittle insect, *Aphrophora parallela* Say.

23. Adult of pine leaf miner, *Gelechia pinifoliella* Chamb.

stout and the legs somewhat so, as represented at plate 13, figure 7. The pupæ are creamy white, about the same size as the beetle, and in recently transformed individuals nearly uniform in color, except for the dark brown eyes and brownish tips of the mandibles.

*Natural Enemies.* This weevil is subject to attack by several natural enemies. Certain birds frequently explore the infested tips and devour the contained larvæ or pupæ. Several Ichneumon or Chalcid flies have been observed in the burrows of this insect, and Messrs. Riley and Howard have recorded the rearing of *Bracon pissodis* Ashm., from specimens of this insect received from Wellesly, Mass., and Dr. A. D. Hopkins records rearing *Spathius brachyurus* Ashm., from this insect in West Virginia.

### PALES WEEVIL.

*Hylobius pales* Herbst.

This large, dark chestnut-colored weevil, about  $\frac{3}{8}$  of an inch in length (plate 12, figure 8), is more or less common in May and June on pine trees and in mill yards. This species was met with by the writer somewhat commonly on hard pines at Karner from the middle of June till the latter part of September, in 1901. This insect is stated by Dr. Packard to work under the bark of white pines, making irregular burrows which extend over the surface of the sap wood, and later sink into the wood where the pupal cell, which is nearly  $\frac{1}{4}$  of an inch long, is constructed in the autumn.

*Magdalis perforata* Horn.

This small jet black beetle (plate 12, figure 17), ranging in length from  $\frac{3}{16}$  to  $\frac{1}{4}$  of an inch, was met with by the writer on hard pines at Karner from early June till the latter part of July, 1901. It was associated with the white pine weevil, *Pissodes strobi* Peck, and probably has similar habits, though it is a rarer insect.

*Magdalis alutacca* Lec.

This is a small black weevil (plate 12, figure 16), about  $\frac{3}{16}$  of an inch in length, which was also associated with the white pine weevil, *Pissodes strobi* Peck, on the tips of hard pines in midsummer. It apparently breeds within the tips, and probably has habits somewhat similar to its larger associates.

### PITCH TIP MOTH.

*Pinipestris zimmermani* Grote.

The tips of hard pines at Karner not infrequently begin to wilt, gradually turn brown and break off and investigation reveals burrows in the center of the tips. At the right season of the year, a reddish-brown and a somewhat livid green caterpillar, about  $\frac{3}{4}$  of an inch long, armed with linear series of dark brown chitinous spots on its body segments, may be discovered in the burrows.

The work of this species is very characteristic and may be recognized by the small pellets of pitch which are thrust out from the hole a few inches from the tip (plate 12, figure 20). The pretty slate gray moth (plate 12, figure 19), with a wing spread of about  $\frac{3}{4}$  of an inch, appears in midsummer. This insect has been recorded as attacking a number of pines, the most important of which are the white, pitch, red and austrian pines. Dr. D. S. Kellicott has observed the work of this borer and states that it sometimes completely girdles the stem of a tree with its burrows. The operations as observed by him are very different from those met with by us at Karner and it is possible that two insects have been confused under the same name.

### NANTUCKET PINE MOTH.

*Retinia frustrana* Scudd.

There is a small insect which operates in the tips of hard pine twigs and causes the death and subsequent drying of the terminal leaves, plate 12, figure 3. The small web at the base of the terminal bud is frequently the only indication of insect presence, but if the injury is investigated at the proper time, a small yellowish caterpillar may be found within its burrow.

The work of this insect was met with by the writer on hard pine at Karner in 1901. It is a species which was first brought to notice on account of its extensive depredations upon the hard pines of Nantucket Island in 1883. Many trees were very seriously injured at that time. The insect was closely studied then by Prof. Scudder, and in later years attracted the attention of Prof. Comstock.

*Life History and Habits.* The following condensed account of the life history and habits of this insect is that given by Prof. Comstock: "About the middle of May, 1879, the scrub-pines (*Pinus inops*) in Virginia, near Washington, were found to be greatly injured by small Lepidopterous larvæ. On many trees there was scarcely a new shoot to be found which was not infested at its tip by from one to four yellowish, black-headed caterpillars. They were so completely concealed while at

work that their presence would scarcely be noticed, and the effect of their work was hardly visible until the twig was almost completely destroyed. Upon close examination a delicate web was seen inclosing the base of the bud and the surrounding new leaflets, resembling much the nest of a small spider. When this web was removed, one or several little yellow caterpillars were seen either retreating into a mine in the bud or into the bases of the leaves, which were also mined, or, not infrequently, they dropped from the twig, suspending themselves by a silken thread. The bud was often so hollowed that it dropped to pieces almost at a touch.

"At the time when they were first noticed larvæ of almost all sizes were to be found. Some were apparently almost full grown, while others had evidently not been long hatched. The nearly full-grown specimens measured 8 mm (.31 inch) in length. The first pupæ were obtained early in June. Most of the larvæ transformed within the burrows which they had made, first spinning more or less of a silken envelope about themselves. Others, however, issued from their mines, and spun rather tough grayish cocoons between the leaves. The pupæ were short, stout, and brown in color, with each segment furnished dorsally with two serrated lines, one consisting of large and the other fine teeth.

"The first moths issued June 13, the pupæ having previously worked their way, by means of the spines just mentioned, into such positions that they could give forth the moths without injury to the latter, and a few weeks later almost every shoot had one or more of the empty pupal skins protruding from it.

"In the latter part of August, individuals of the second brood were very abundant in the scrub-pine in the vicinity of Washington. As before, they were found in almost every stage of growth, and the difference was even more marked. In one instance five larvæ of greatly differing sizes were found in one shoot. The smaller ones were boring into the bases of the leaves, and the larger ones into the twig proper. The largest of the five had made quite a long channel from the tip of the bud down into the heart of the twig. Pupæ were also found at this time, which did not give forth the moth until late in the winter.

"The usual mode of hibernation is in the pupa state. A thorough search in January in the field showed only pupæ. The pupæ collected in August and September did not begin to give forth the moths in the breeding cages before early January, though this was continued at intervals through January, February and March and was greatly hastened without doubt by the heat of the room. On February 15, however, a few twigs were collected, from one of which, on February 28, a full-grown larva had emerged and was found crawling about the cage. This would seem to indicate occasional larval hibernation."

*Parasites.* Mr. Scudder records the breeding of three hymenopterous parasites from this insect, one a species of *Bracon*, another a minute *Perilampus*, both of these Mr. Scudder states to be undescribed. He adds that the latter is by far the more important.

### PITCH PINE RETINIA.

*Retinia rigidana* Fern.

A form closely allied to the preceding also infests the pitch pine and works in a similar manner. The larva is brownish and slightly larger than the preceding, and the moth is stated to possess characters intermediate between those of *R. frustrana* Scudd. and *R. comstockiana* Fern.

### PITCH TWIG MOTH.

*Retinia comstockiana* Fern.

The pitch masses of this insect may frequently be met with on the upper side of smaller limbs and twigs on hard pines, and fresh masses of pitch laying upon an older accumulation is nearly conclusive evidence that the larva is still at work, and on cutting open such a mass, it will be seen to cover the entrance of a small gallery which runs longitudinally and which may extend a distance of 1 to 2 or more inches, sometimes in one and in other cases in both directions, plate 12, figure 1.

This species was very abundant on the hard pines at Karner in 1901. The life history of the insect may be summarized as follows: The winter is passed in the larval or caterpillar stage, the operations in the spring beginning about the 15th of April. The spring addition is frequently nearly equal to the original size of the pitch mass and the demarcation between the old and the new is very evident. Empty pupal cases were observed in the field June 12th, though no adults were obtained in breeding cages till the 20th. Prof. Comstock expresses the opinion that this insect passes through two generations in a season, but our own observations hardly bear out this conclusion.

*Description.* The moth is a delicate, grayish-brown, yellow insect, having a wing spread of about  $\frac{3}{4}$  of an inch, plate 12, figure 21. The pupa is brownish, about  $\frac{1}{2}$  of an inch in length, and the abdominal segments are each provided with two transverse rows of stout teeth. These prove of great assistance to the pupa in wriggling out of its burrow.

The larva is about  $\frac{1}{2}$  of an inch long when full grown, the head and thoracic

## Explanation of Plate 13.\*

FIG.

1. Nearly full grown larva of imperial moth, *Basilona imperialis* Drury.
2. Masses of the pine bark louse, *Chermes pinicorticis* Fitch.
3. Pupal cells of white pine weevil, *Pissodes strobi* Peck under bark of pine log
4. Burrows of larvæ of same in bark.
5. Portion of dead shoot killed by the insect, showing the circular exit holes, the borings of the insect in upper part and the shrunken area extending down on the affected portion of the twig.
6. Pupal cells of white pine weevil within the wood, showing method of exit and also a few exit holes in the shrunken affected bark.
7. Adult weevil, *Pissodes strobi* Peck, enlarged.
8. Leconte's sawfly larvæ, *Lophyrus lecontei* Fitch in resting position, showing below the stubs of devoured foliage.
9. Pine leaf scale insect, *Chionaspis furfura* Fitch.

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\* Executed from nature, under the author's direction, by L. H. Joutel.





shield are light brown, and the body yellowish-white. The labrum and tip of the mandibles are dark brown, the tubercles are good sized, well chitinized and bear one or two setæ. The spiracles or breathing pores are enclosed by dark brown rings of chitin, and the anal shield is somewhat chitinized and ornamented with rather long setæ. This larva may be readily distinguished from the larger, dark colored one of the pitch tip moth, *Pinipestris zimmermani* Grote, by its not possessing linear series of dark brown blackish chitinized spots.

The egg has been characterized as lemon-yellow, elliptic-oval in form when deposited on the glass of a breeding jar, and nearly  $\frac{1}{25}$  of an inch long.

*Parasites.* It might be thought that a caterpillar having the entrance to its burrow protected by a pitch mass would be safe from the attacks of parasitic insects. Such, however, is not the case, and this species is the host of at least two parasites which were bred by Prof. Comstock; one is known as *Ephialtes comstockii* Cress., and the other is a species of *Agathis*. An Ichneumon, *Cremastus retinæ* Cress., was reared from this insect by Messrs. Riley and Howard. The writer also succeeded in breeding from this borer an exceedingly small, four-winged fly which was determined by Dr. Ashmead as a species of *Stenomesus*.

### PITCH INHABITING MIDGE.

*Diplosis resinicola* Osten-Sacken.

The work of this insect is somewhat similar to that of the preceding in that it produces masses of pitch along the smaller limbs of hard pines. These masses however, are usually largely on the under side of the limbs and are all much clearer, the pitch being semi-transparent or nearly whitish in color (plate 12, figure 2), and in warm weather drops may occasionally fall. An examination of these pitch masses will frequently reveal within them orange-red, footless maggots, about  $\frac{1}{4}$  of an inch in length, which develop into small, dark colored winged midges about  $\frac{1}{3}$  of an inch long.

### PINE BARK CHERMES.

*Chermes pinicorticis* Fitch.

Patches of flocculent downy matter may be observed on the underside of the limbs and on the smooth bark of white pines, and are very characteristic of this pest, plate 13, figure 2. This insect appears to be a somewhat common one on pines growing in parks and under somewhat artificial conditions in New York State. The writer has observed the work of this species for a number of years

in Washington Park, Albany, where it has frequently been so abundant as to literally cover the smooth bark of a considerable proportion of the trunks and limbs of certain young white pines. The presence of large numbers of this insect reduces the vitality of a tree and apparently leads to a sickly condition, which, in a few cases, appears to have eventually resulted in death. It is impossible to say that this plant louse is the primary cause of the injury, but our own observations tend to sustain this view.

*Life History.* The life history has not been worked out in detail. The eggs commence to hatch early in April in favorable seasons, and the young larvæ emerge from the ball of woolly matter which protects the eggs and travel actively over the bark for a time. They are so small as to be nearly invisible to the naked eye, and in the early part of May they are more abundant than at any other time. Traveling soon ceases, and they attach themselves to the tender bark of the young twigs. They increase rapidly in size and assume a dark reddish-brown color approaching black, and the woolly secretion of the body appears and soon hides them from view. Maturity is probably reached during the last of May, and the wingless females deposit eggs for another brood. Winged females are produced about the first of June. There are several broods during the summer, and the winter appears to be passed in some seasons, at least, by wingless females which commence feeding toward the latter part of March and begin to deposit eggs in early April. These hatch about the 15th and young begin to attach themselves the 26th. The wingless females disappear about May 1st, hatching ceases by the 7th, and winged adults appear about the 9th; by the 17th all the young are attached, and by the 23d the winged adults disappear. These latter records are based on observations made by Mr. Storment in Illinois. He further states that this species may have an alternative food plant which at present is unknown.

*Description.* The eggs occur in downy balls as recorded by Prof. Osborn, and vary in number from 5 to 60 or more in each; usually there are only a few. They are yellowish, slightly ovate, about  $\frac{1}{75}$  of an inch long, and with a transverse dimension of one-half that.

The young of the winged form, as described by Prof. Osborn, are oval in shape, flattened, yellowish or light brown. The antennæ are 3-jointed, the first joint is short and thick, the second slightly longer and not so thick and the third is three times as long as the first, half as thick, and set with a few stiff hairs at the apex. As the young develop, they become darker in color, assuming a deep red or brown, and finally an almost black appearance. The woolly substance develops thickly on the abdominal segments and also on the meso- and metathorax, hiding the insect

and changing its appearance to that of a ball of white down. The winged form has been described by Prof. Osborn as light reddish in color with very white wings, which expand rapidly and become transparent, while the body becomes darker until almost black. The antennæ are 5-jointed and short. The tarsi are 1-jointed, with a rudimentary first joint and two claws. The forewings are folded roof-like over the body, the anterior pair having a strong subcostal vein which is branched at the basal third, the lower branch running parallel for a distance and then turning obliquely toward the posterior margin, to which, from the same branch, two oblique discoidal veins also run. The stigma is indistinct. The wingless female is inclosed in a wooly mass which adheres to the bark. The legs and antennæ are persistent, small, the latter being 3-jointed and the tarsi 1-jointed and terminated by a pair of claws. The body is elongated, pyriform during egg laying and contracts to a globular or flattened shape afterwards or in the winter.

*Natural Enemies.* This species is subject to attack by a number of natural enemies; among the more important may be mentioned several species of lady bugs, particularly the 15-spotted lady bug, *Anatis ocellata* Linn., and the 2-spotted lady bug, *Adalia bipunctata* Linn., both species which have been observed by the writer in considerable numbers around infested pines in Washington Park. The twiced stabbed lady bug, *Chilocorus bivulnerus* Muls., and the spotted lady bug, *Megilla maculata* DeG., have also been reported as preying upon this insect. Syrphid larvæ and ant lions, *Chrysopa* and *Hemerobius*, are recorded by Mr. Storment as being very destructive to this insect.

*Remedial Measures.* This insect is easily reached by sprays, and Dr. E. B. Southwick observes that stiff sprays are quite efficient in combating this pest. Mr. Storment states that thorough spraying with kerosene emulsion in May proved very efficient. The standard emulsion was probably diluted with 9 parts of water. In case it is undesirable to use kerosene emulsion, it is probable that the insect would be equally susceptible to a whale oil soap solution, 1 pound to 4 gallons of water, or even a forcible spray of cold water would wash off large numbers of the pests. This latter could be used very well where a nearby hydrant afforded sufficient head.

### SPITTLE INSECTS.

The twigs of pine are not only bored by various injurious insects but their fluids are sucked from them by peculiar little hoppers which are known as Spittle Insects, on account of a frothy spittle-like mass with which the young cover themselves. Several species were met with by the writer on hard pines at Karner in 1901. The

spittle masses were observed in the early part of the summer, and the adult insects were captured from the latter part of June through September.

*Aphrophora saratogensis* Fitch was the most abundant form and was captured in small numbers from the last of June till after the middle of September. It may be recognized by its uniform brown color, variegated with very light brown or yellow. It is a slender species about  $\frac{3}{8}$  of an inch in length.

*Aphrophora parallela* Say was taken in smaller numbers during July. The adult is nearly  $\frac{1}{2}$  of an inch in length, dark brown mottled with black, and may be easily recognized by the whitish spot near the center of each wing cover. (Plate 12, figure 22.)

*Aphrophora quadrangularis* Say is a smaller species than either of the two preceding and measures about  $\frac{1}{4}$  of an inch in length. It is a rather pretty, oblique-banded form which was met with in small numbers on hard pine during August and September.

**INSECTS AFFECTING THE FOLIAGE.** The foliage of the pine is attractive to a considerable number of insects and a few of the more important are noticed in this connection.

#### LE CONTE'S SAW-FLY.

*Lophyrus lecontei* Fitch.

Dirty yellowish, black spotted caterpillars may be met with in clusters on the upper branches of pines in July and in September and October. These insects feed upon the old leaves and therefore cause less injury than those that attack the recently developed ones. They live in companies and frequently strip one or more branches. Dr. Fitch states that these worms, when nearly mature, are so large that two often unite, standing face to face and holding together the five leaves which form a bundle, commence at the tip and gradually eat it down to the base. The larvæ and their work are represented on plate 13, figure 8. There are several other species which possess similar habits.

#### LIGHT LOVING GRAPEVINE BEETLE.

*Anomala lucicola* Fabr.

This short, stout, little beetle, measuring from  $\frac{1}{3}$  to nearly  $\frac{1}{2}$  of an inch in length, was very abundant the latter part of June and throughout July, 1901, on hard pines at Karner. It may be easily recognized by the illustration at plate 12, figures 12, 13, 14, and is universally known as the grapevine beetle. It undoubtedly

feeds upon this vine whenever convenient, and its presence in such large numbers upon hard pine is very good evidence that it eats the foliage of this tree to some extent.

### PINE CHRYSOMELA.

*Glyptoscelis pubescens* Fabr.

A thick, brilliant, brassy, cylindrical beetle, tinged with copper color, may be found feeding on the leaves of hard pine in May and June, as stated by Dr. Fitch.

This insect is a rather stout form, and ranges from a little over  $\frac{1}{4}$  to about  $\frac{1}{3}$  of an inch in length, plate 12, figure 7. It was met with rather commonly by the writer in June, 1901, when it was feeding at the base of hard pine needles at Karner.

### IMPERIAL MOTH.

*Basilona imperialis* Drury.

The larva or caterpillar of this magnificent moth attains a length of three to four inches and may be recognized by its pale orange colored head and legs and the six thorny yellow knobs behind the head. The caterpillar may be found on the leaves of the white pine late in August and during September. It is represented on plate 13, figure 1. The moth is a rare species and the larva seldom causes material injury. It has been recorded as living upon 52 food plants, representing 15 natural orders. The white pine is its favorite in the north and a number of species of oak in the south. It is stated that in recent years this insect has displayed a decided preference for red maples in the vicinity of Germantown, Pa.

### PINE LEAF MINER.

*Gelechia pinifoliella* Chamb.

The caterpillar of this pretty little moth lives entirely within the pine needles and usually enters them about midway of their length, devouring the softer inner portion toward the tip, and then reversing its position and working toward the base. Its presence is indicated by the brown tips of the needles, plate 12, figure 5. This little insect was met with by the writer in considerable numbers on hard pines at Karner in 1901, and its operations were also observed that same year at Round Lake. Prof. Comstock states that there are certainly two, probably three, and possibly more generations yearly. The writer has bred this moth the latter part of June in considerable numbers. The egg has been described by Prof. Comstock as of a variable

reddish brown, with the surface marked with numerous delicate carinæ, which meet at the end. The larva is a small, cylindrical, yellowish-brown creature, about  $\frac{1}{6}$  of an inch in length, and the moth is a very small, brownish, irregularly gray banded insect with a wing spread of about  $\frac{3}{8}$  of an inch, plate 12, figure 23.

This minute insect, although it lives within such a snug retreat, is subject to attack by several minute parasitic forms.

### PITCH-PINE NEEDLE GALL FLY.

*Diplosis pini-rigidæ* Pack.

The work of this interesting little gall fly may be recognized by the shortened, deformed needles (plate 12, figure 4) on pitch pine, which may be observed at various times during the summer. An examination at the right season will reveal thick, orange colored larvæ in the basal enlargements.

This insect was met with at Karner during several years, though it was at no time excessively abundant. The attack was in most cases confined to one or two tips on the tree and a considerable proportion of the needles would be affected, indicating that the female probably remains on one branch and deposits a large proportion of the eggs at the base of adjacent needles. The work of this species was observed by its describer, Dr. Packard, at Brunswick, Maine, in 1862 or 1863. He found the larva in September of that year and states that when it is fully developed, it forsakes the gall, ascends to the terminal buds and pupates on one side of them exposed to the air. He adds that there are sometimes two larvæ, one on each side of the leaf. The cocoons are described by him as pale, oval and covered with pitch which exudes from the buds of the tree. They were found May 20th. At maturity, the pupa wriggles partly out of the cocoon and through the adhering pitch, and the fly emerges from the projecting case.

*Life History.* The life history of the species has been summarized by Dr. Packard as follows: The eggs are probably laid at the base of the needles early in May and possibly the preceding autumn or the larva may winter in this gall, though this does not appear probable. They pupate within silken cocoons about the middle or the third week of May and the fly probably appears about the early part or the middle of June and deposits eggs which give rise to the brood that we have found in September. Dr. Packard finds that a large percentage of the insects are destroyed by a chalcid parasite. Very small larvæ were met with by us July 27, 1901, in affected needles. On the 20th of the following June a few deformed needles were found among the old foliage and young larvæ were to be seen and

flies were bred July 23d. These latter, however, were probably adults of *Diplosis resinicola* Osten-Sacken.

The work of this insect was again observed July 15th of the same year, at which time the malformation was well developed in new grown needles. It will be seen that our observations substantiate in a general way the life history as outlined by Dr. Packard.

### PINE LEAF SCALE INSECT.

*Chionaspis pinifoliae* Fitch.

This is an elongated white scale insect which sometimes occurs in immense numbers on pines grown in parks. The female scale is somewhat oval, elongated, and with a yellowish pellicle at its anterior extremity. The male scale is linear, ridged, snowy white, and with a yellowish pellicle at one end. The life history of this insect is substantially as follows: Prof. R. A. Cooley has observed the eggs hatch at Amherst, Mass., May 25th, and Dr. Le Baron observed them hatching in Illinois from the 10th to the 25th. The young crawl over the leaves for two or three days, then settle and begin feeding. The male is said to require about ten days for the development of its scale and the female three weeks, the former being mature at the time the latter is passing through its second molt. The second generation is developed later in the season, and Mr. Cooley has found it impossible to separate the two, as the hatching period is such an extended one that all stages of development can be found at any time during the summer. The life cycle is complete in so short a period as to lead Mr. Cooley to think that possibly there may be three broods in the latitude of Amherst, Mass. The winter is passed in the egg stage as in the case of allied species.

*Natural Enemies.* This insect is preyed upon by several insects. Two minute parasites, *Perrisopterus pulchellus* How. and *Aphelinus mytilaspidis* Le Baron, have been reared from this scale insect. The somewhat common twice stabbed lady bug, *Chilocorus bivulvurus* Muls., has been repeatedly recorded as feeding upon this insect and several other species are known to prey upon it.

The following insects were taken in more or less numbers among pine needles, but it is rather doubtful if any of them feed on the foliage, which is certainly not true of the flower cricket.

*Chrysobothris floricola* Gory.

This is a modestly colored, small, flattened insect, which measures about  $\frac{3}{8}$  of an inch in length, plate 12, figure 10. It occurred in considerable numbers among the needles of hard pine from the 13th of June till the latter part of August.

*Chrysobothris pusilla* Bap. & Gory.

This is the smallest species of the genus met with on hard pine at Karner, and its blue abdomen, uncovered when the insect was in flight, glistened brightly in the sunshine. It is only about  $\frac{1}{4}$  of an inch in length and was taken in considerable numbers from early in June till the latter part of September. See plate 12, figure 9.

*Chrysobothris dentipes* Germ.

This is an oblong, oval, flattened, bronze-colored and brownish beetle, copper colored beneath (plate 12, figure 11), which was met with by the writer on hard pine at Karner between the end of May and the first of July, 1901. It is a rather large form, measuring  $\frac{1}{2}$  of an inch or more in length, and occurred in relatively small numbers.

## PINE FLOWER CRICKET.

*Oecanthus pini* Beut.

This flower cricket was taken by the writer on hard pine at Karner in 1901 as follows: Four on July 27th; four August 21st; and one September 6th. Immature specimens of what probably belong to the same species were taken, one on July 8th and two on the 19th.

This insect was described by Mr. Beutenmuller as follows: "Head and antennæ testaceous, the latter becoming darker towards the tip; first two joints with four black marks; the inner mark on the first joint long and straight, the outer oblique; those on the second joint parallel; eyes black; thorax testaceous with a longitudinal line on each side above; anterior pairs of legs testaceous; posterior femora green, tibiæ testaceous; body beneath black with the sides yellowish green; body above blackish with a green stripe along the back; elytra transparent, with grass-green veins; hind wings slightly protruding beyond the elytra; veins also green.

"The female is somewhat paler than the male, and the wings extend a little more beyond the elytra; ovipositor dark testaceous, tip black. Average length from head to tip of wing covers, 14 mm.; body, 12 mm.; width, 4.5 mm."

He states that it may be easily distinguished from *Æ. nigricornis* Walk., by the grass-green color of the wings, the testaceous head and thorax, and the marks on the basal joints of the antennæ. He adds that it lives only on pine trees and usually on the high branches.

## Insects Affecting the Spruce.

The spruce is one of the valuable timber trees of the Adirondack region, and like the pine is subject to attacks by a number of insects. A few of the more important are noticed briefly here.

**INSECTS ATTACKING THE TRUNK.** The trunk of this tree is the home of several species of economic importance.

**Bark Borers.** At least one of the members of this group must be considered as a serious enemy of this valuable tree.

### DESTRUCTIVE SPRUCE BARK BORER.

*Polygraphus rufipennis* Kirby.

The adult insect is a light brown or black, rather stout beetle, about  $\frac{3}{32}$  of an inch in length. It may be commonly found running somewhat irregular transverse galleries in the inner bark of the spruce. Eggs are deposited along the sides of the primary galleries and the young grubs extend their mines at approximately right angles and nearly parallel with the bark fibers. This is a very common species in the Adirondacks and must be regarded as a dangerous enemy of the spruce, since it is always present in small numbers in cut logs and trimmings. This of itself is not harmful, but when the insect becomes unusually abundant, it may turn its attention from the dead and dying and attack living trees. This borer was observed by the writer associated with species of *Dryocoetes* in spruce and with *Tomicus balsameus* Lec., in balsam.

*Life History.* The life history of this borer, as recorded by Dr. Hopkins in West Virginia, is as follows: The adults emerge in May or June and are attracted to stumps, trunks and tops of recently fallen trees and to those weakened by the attacks of insects. The beetles commence to excavate an entrance through the bark and their presence is indicated by the fine brownish borings in the crevices. The entrance is extended to the upper surface of the soft inner bark where the central chamber is excavated. The female, which appears to do most of the work, is now joined by a male which stations himself in the outer gallery to keep out enemies and objectionable visitors, and renders assistance in expelling the borings. The female excavates the gallery from the inner bark to the wood and then in the inner layer of the bark and at right angles to the bark fibers for a distance of 1 or 2 inches. Eggs are



FIG. 13. *POLYGRAPHUS RUFIPENNIS.*

EARLY GALLERIES AND EGG NOTCHES.  
ORIGINAL.

deposited in small notches along the sides of the brood chambers and from one to two other females are admitted to this central chamber, and they start galleries in other directions. The eggs begin to hatch before the galleries are completed and the grubs burrow in the inner bark on which they feed. This is soon filled with grubs of various sizes and by the time all the eggs are hatched, the inner bark within, for a radius of from 2 to 4 inches, is completely riddled by galleries. The grubs on attaining full growth enlarge the ends of their burrows and form cells in which the final transformations take place. The beetles may either emerge from the bark shortly and start a second brood or remain in this retreat till the following spring. Dr. Hopkins states that two or three broods may occur in one season

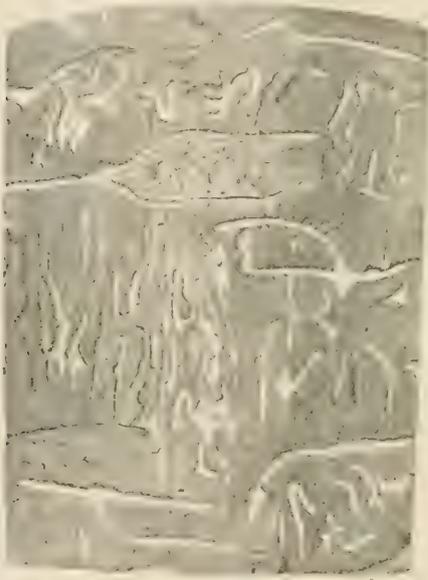


FIG. 14. SPRUCE BARK RATHER BADLY EATEN BY *POLYGRAPHUS RUFIPENNIS*.  
ORIGINAL.



FIG. 15. SPRUCE BARK BADLY EATEN BY *POLYGRAPHUS RUFIPENNIS*.  
ORIGINAL.

and his observations lead him to believe that owing to the shortness of the season and the high elevations occupied by the spruce in West Virginia, there is generally but one generation annually.

*Description.* The beetle varies from light brown to black. It is quite small, being about  $\frac{3}{32}$  of an inch long and rather stout. The head is thickly and finely punctured and nearly concealed by the overhanging prothorax. The mouth parts are tipped with black and the concolorous, coarsely granulated eyes are divided, the two portions being connected by a smooth strip of chitin. The prothorax is much narrowed in front, is thickly and finely punctured and the wing covers or elytra are

rough, finely punctured and almost striated. It may be distinguished from all other spruce bark beetles by the divided eyes.

The white pupa is about the same size as the beetle, rather stout and with a tapering abdomen which is terminated by a pair of fleshy, spine-like processes.

The brown-headed, white grubs or larvæ are about  $\frac{1}{4}$  of an inch long when full grown. The mouth parts and adjacent sutures are dark brown and the body is usually somewhat curved.

The galleries of this insect are very characteristic and may be distinguished from those of *Tomicus balsameus* Lec., which works in balsam, and may therefore be met with in the same forest, by the fact that the wood is rarely scored by the spruce infesting species, while the balsam borer frequently cuts nearly half of the diameter of the primary gallery from the sap wood. The general character of the adult galleries is well shown in the accompanying illustration, figure 13, which represents the central chamber, the transverse primary or egg galleries diverging therefrom, and the minute egg notches. Figures 14 and 15 illustrate the above mentioned features and a number of small dilating mines of the young. It will be observed that the larval mines begin as very slender borings which widen gradually and end in a somewhat broader pupal cell which is sometimes excavated partly in the sap wood. Several of the egg chambers may also be seen.

*Associated Insects.* Dr. Hopkins records having found the following species associated with this insect in spruce: *Homalota* species, *Baptolinus longiceps* Fauv., *Paromalus bistratus* Er., *P. difficilis* Horn, *Epuraca truncatella* Mann., *Hypophylus parallelus* Melsh., and *H. thoracicus* Melsh., and a Tenebrionid larva. He also obtained a Dipterous larva from the galleries of this borer.

*Natural Enemies.* The following predaceous insects were observed by Dr. Hopkins, either in association with this borer or preying upon it: *Thanasimus trifasciatus* Say, *T. dubius* Fabr., *Phyllobænnus dislocatus* Say, and a Clerid larva.

The following parasites were reared by Dr. Hopkins from this species or collected by him from infested logs or trees: *Spathius claripennis* Ashm., *Cenophanes pityophthori* Ashm., *Cosmophorus hopkinsii* Ashm., a common parasite of the adult, a species of *Eurytoma*, a species of *Lochites*, *Cccidostiba polygraphi* Ashm., *C. dendroctoni* Ashm., *Decatomidca polygraphi* Ashm. The value of these insects in controlling this borer is shown by the fact that Dr. Hopkins believes them to be the principal natural agents in checking the injuries to spruce in West Virginia between the years 1882 and 1889.

*Cryphalus striatulus* Mann.

This bark borer was met with in spruce by the writer in August, 1900, at Saranac Inn, where it was working in company with *Tomicus balsameus* Lec. The affected tree was situated near the water, and its red foliage attracted attention. The trunk exhibited no signs of injury, but as this borer was found working almost entirely at the base of the limbs, it was apparently the primary cause of the trouble. This insect was also met with at Floodwood in hemlock, and at Axton in a small balsam tree.

The adult beetle is about  $\frac{3}{32}$  of an inch long, and ranges in color from light yellowish-brown to almost black. The prothorax bears a number of prominent chitinous tubercles, and the wing covers are faintly striated with rows of fine punctures.

The operations of this insect, as previously mentioned, appear to be confined very largely to the base of the limbs, particularly on the upper side. The burrows are very irregular and seem to have little plan, consisting as they do, of a series of interlacing galleries, which often unite to form large excavations around the base of the twig.

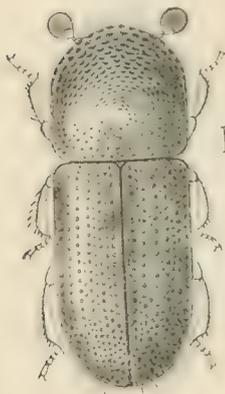
*Dryocates* Species.

FIG. 16. *XYLOTERUS*  
*POLITUS*.

AFTER HUBBARD, U. S.  
DEPT. AGR., DIV. ENT.  
BUL. 7, N. S. '97.

A species belonging to this genus was met with by the writer August 14, 1900, at Saranac Inn, where it was breeding under spruce bark in company with *Polygraphus rufipennis* Kirby. The beetle is about  $\frac{3}{32}$  of an inch long, and in the case of the specimen obtained, a yellowish-brown color. More mature individuals are doubtless much darker. The galleries are larger than those of *Polygraphus*.

**Wood Borers or Ambrosia Beetles.** Several species belonging to this most interesting group may be found working in trees previously injured by some earlier mentioned forms.

*Xyloterus politus* Say.

This species is recorded as a common enemy of deciduous as well as coniferous trees. It was met with by the writer in a fallen beech tree at Floodwood August 21, 1900. It was also found by him in the stump of a recently fallen soft maple at Axton, and has been recorded by other writers from a number of trees.

Its black-walled galleries with series of brood chambers are quite characteristic, and when present in numbers reduce the value of timber materially.

*Description.* This beetle is more slender and a little smaller than *Xyloterus*

*bivittatus* Kirby. It varies in color from light brown to almost black, is cylindrical in shape and about  $\frac{1}{8}$  of an inch long. The shape of the antennal club, and the sculpturing of the dorsal surface are shown in figure 16. This species and the following have divided eyes, the two divisions being some distance apart and connected only by a narrow dark strip, which is best seen in recently transformed, light colored individuals. The galleries of this insect may extend to some depth in the wood, lateral burrows being given off at intervals and the brood chambers occurring very close together, almost like the cells of a honey bee. The walls of the galleries and brood chambers are deep black, as in the case of allied species.

*Natural Enemies.* A predaceous beetle, *Colydium lincola* Say, has been recorded by Dr. Hopkins as occurring in the burrows of this species. Another small beetle, *Ips sanguinolentus* Oliv., was also found by him in association with this species, feeding on the sap wood of sugar maple.

#### *Monarthrum mali* Fitch.

This is a minute, reddish-brown cylindrical beetle, about  $\frac{3}{32}$  of an inch in length, which may be found in cylindrical, black-walled galleries in dead beech, spruce and other trees. It was taken by the writer August 21, 1900, at Floodwood, in a fallen beech which had begun to decay, and was also found by him in a spruce stump at Axton. It has been recorded by various writers as breeding in a number of hard and soft wood trees.

*Life History.* Mr. H. G. Hubbard has recorded some interesting observations on the life history of members of this genus. He states that the males assist the females in forming new colonies, and that the young are raised in separate pits or cradles which they do not leave until maturity is attained. The galleries constructed by the female beetles extend deeply into the wood, with their branches mostly in a horizontal plane, figure 18. The mother beetle deposits her eggs in circular pits which she excavates from the galleries in two opposite series parallel with the grain of the wood. An egg is deposited in each and the cavity packed with chips taken from the fungus bed and upon which ambrosia has begun to grow. The young grubs as soon as they hatch eat the fungus and eject the refuse from their cradles. At first they lie curled up in the pit made by the mother, but as they grow larger, they deepen the cradle with their own jaws until when full grown they slightly exceed the length of the fully extended grub. The young swallow the wood which they excavate but do not digest it. It passes through the body unchanged in texture and is excreted in pellets and stained a yellowish color. A

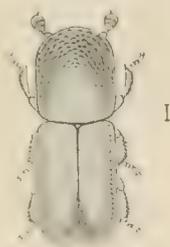


FIG. 17. *MONARTH-  
TRUM MALI.*  
AFTER HUBBARD,  
U. S. DEPT. AGR.,  
DIV. ENT. BUL. 7,  
N. S. 97.

portion of the excrement is evidently utilized to form the fungus or food bed. The mother beetle is constantly in attendance upon the young during their developmental period and guards them with jealous care. The mouth of each cradle is closed with a plug of the food fungus, which, as fast as it is consumed, is renewed with fresh material. The grubs perforate this plug from time to time and clean out

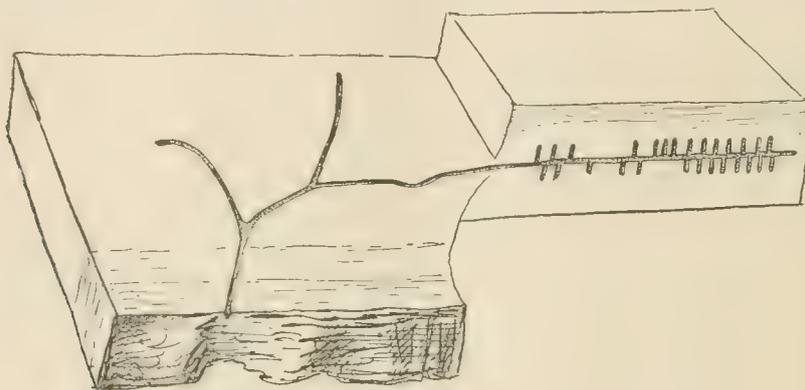


FIG. 18. GALLERIES OF *MONARTHUM MALI* IN MAPLE.

AFTER HUBBARD, U. S. DEPT. AGR., DIV. ENT. BUL. 7, N. S. '97.

their retreats by pushing the pellets through the opening, where they are removed by the mother, who seals it again with ambrosia. The transformations to the adult occur in these lateral pits or cradles.

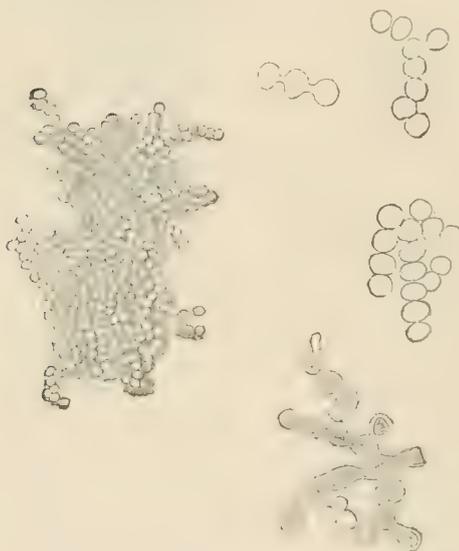


FIG. 19. AMBROSIA OF *MONARTHUM MALI*, GREATLY ENLARGED.

AFTER HUBBARD, U. S. DEPT. AGR., DIV. ENT. BUL. 7, N. S. '97.

*Description.* The parent beetle is a minute, reddish-brown, cylindrical insect, about  $\frac{3}{32}$  of an inch long. The shape of the antennal club, the puncturing of the prothorax and the linear dotting of the elytra are well shown in figure 17. The elytral declivity is slightly excavated and marked by two rather inconspicuous teeth on each side.

This insect enters the dying or dead tree vertically for a distance of about  $1\frac{1}{4}$  inches and from that point inward branches may diverge at oblique angles. The brood chambers are nearly  $\frac{3}{8}$  of an inch long and extend vertically above and below the main branches, figure 18.

*Natural Enemies.* Only one natural enemy, so far as known to the writer, has been recorded. Dr. A. D. Hopkins states that he found the predaceous beetle, *Colydium lincola* Say, with this species in jack oak.

## Insects Affecting the Balsam.

The fir or balsam is one of the prettiest and most characteristic trees of the Adirondack region, and though its wood may not have a high commercial value the insects infesting it are worthy of brief notice.

### INSECTS ATTACKING THE TRUNK.

#### BALSAM BARK BORER.

*Tomicus balsameus* Lec.

A small brown or nearly black beetle, about  $\frac{3}{32}$  of an inch in length, may be found working in large numbers in the inner bark of this tree. The reddish tops of the affected tree is a rather characteristic sign of the insect's presence. Our own observations lead us to conclude that this beetle is generally distributed throughout the Adirondacks, where it exhibits a decided preference for the balsam, though it does not hesitate to attack spruce and white pine. It has been found in the Adirondacks in both of the latter trees several times, once in arbor vitæ, and has been obtained from hemlock. There is little doubt but that this insect can and does kill healthy trees. A balsam ten inches in diameter just beginning to die, as was shown by its reddening top, was cut down August 14, 1900. This insect was found in all stages and in large numbers from the base of the tree almost to its tip, some 50 feet high. The bark along much of this distance appeared to be healthy and the lower limbs had not begun to show any signs of weakness. No other insect had affected the vitality of this tree, so far as could be determined. Such balsams were to be met with here and there in the woods and it was stated that many of these trees had been affected in this way a few years earlier. Numerous dead balsams here and there attested to the truth of this assertion.

This insect was associated with *Tomicus pini* Say and species of *Pityogenes*, in white pine. It was obtained with *Cryphalus striatulus* Mann. and also with *Polygraphus rufipennis* Kirby from spruce. *Tomicus caelatus* Eich. was found with it in balsam.

*Description.* This is our smallest species of *Tomicus*, the adult beetle being only about  $\frac{3}{32}$  of an inch long. It is rather slender in form and varies from light brown to almost black in color. The rather coarse, light brown hairs are quite conspicuous near the posterior end of the elytra and the possession of these hairs enables one to separate it from the preceding species. The excavation of the declivity is comparatively slight and bears on each side three small independent,

nearly equidistant tubercles, the lower two being larger and farther apart. The dorsal tubercle of the three is small and near the median line. There is also a very minute tubercle a little above and outside of the lowest tubercle, but ordinarily it is not seen. The prothorax is coarsely granulated and the wing covers are marked with longitudinal rows of rather small punctures. The structural details of the declivity are shown in figure 20.



FIG. 20. DECLIVITY OF  
*TOMICUS BALSAMEUS*.  
ORIGINAL.

The white pupa of this species is about the same size as the beetle. It tapers somewhat at the posterior extremity, which latter bears a pair of slender, pointed processes.

The partly curled grub or larva is almost  $\frac{1}{8}$  of an inch long and has a brownish-yellow head with dark mouth parts.

The operations of this species are best seen in a tree where the beetles have just begun to enter. There will usually be found three to five branched



FIG. 21. CENTRAL CHAMBER AND EGG  
GALLERIES OF *TOMICUS BALSAMEUS*.  
ORIGINAL.



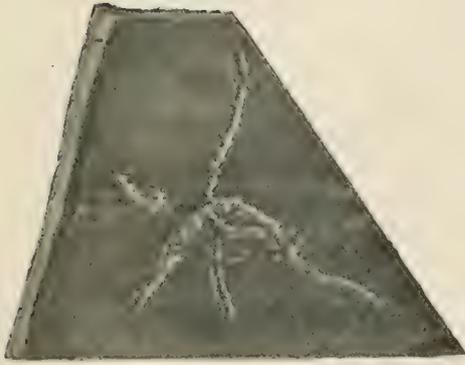
FIG. 22. GALLERIES OF *TOMICUS BALSAMEUS*  
SHOWING CONDITION UNDER RIDDLED BARK. ORIGINAL.

burrows here and there under the bark. A very small one is represented at figure 21. It will be seen that there are five radiating adult galleries and also that each one contains a number of minute notches, which are egg chambers. Each branch represents the work of a female and all have origin in a central chamber, near the entrance of which the male stands guard.

A more advanced stage of this insect's work is shown at plate 14, figure 3, which represents the work of three females diverging from a common chamber. It will be seen that a number of the eggs have hatched and that the larvæ have worked



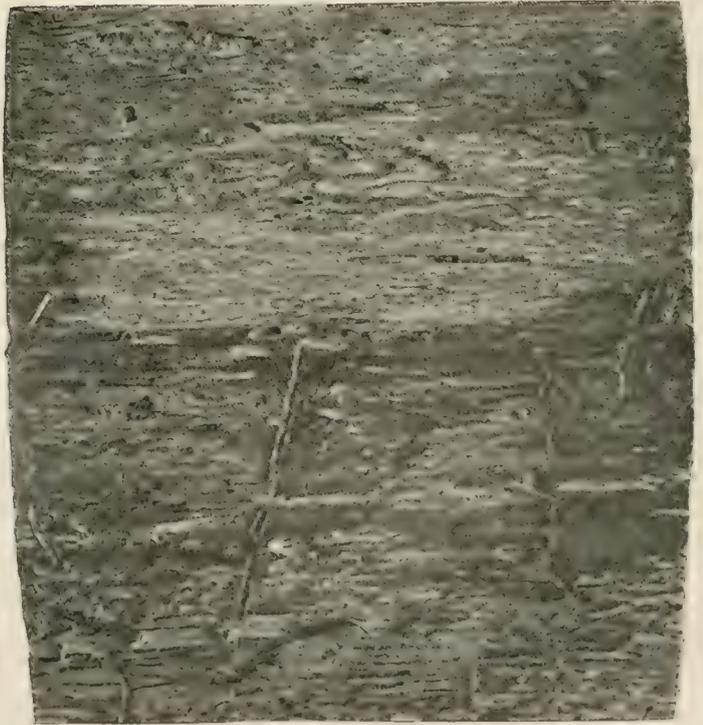
1



2



3



4



5



to a considerable distance in a direction nearly parallel with the wood fibers. The egg notches are also seen. This same gallery, eaten in the bark, is represented at plate 14, figure 1. It will be seen that in this instance at least the larvæ bored in the sap wood rather more than in the bark.

A still more advanced stage is shown at plate 14, figure 5, which represents a portion of a trunk which had been injured by a large number of the beetles. The adult galleries, egg notches and the work of larvæ or grubs can all be seen.

Plate 14, figure 4, represents a portion of a very badly infested trunk after the attack has practically ended. It will be observed that the inner bark is a mass of partially decayed tissues filled with numerous larval and adult galleries. Figures 22, 23



FIG. 23. GALLERIES OF *TOMICUS BALSAMEUS*.  
SHOWING FITCH CHAMBER, PUPAL CELL IN SAP  
WOOD AND WORK OF YOUNG *Mono-*  
*lamus* LARVA. ORIGINAL.

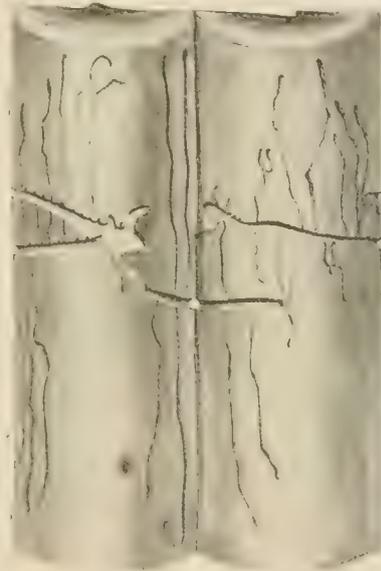


FIG. 24. SPLIT TWIG.  
SHOWING GIRDLING BY ADULT GALLERIES OF  
*Tomicus balsameus*. ORIGINAL.

represent the condition after the decayed tissues have been removed. The adult galleries may be readily recognized where they score the surface of the wood and here and there are peculiar chambers a little to one side of an adult gallery. These are not central or entrance chambers but are evidently little cavities hollowed out by the beetles for the reception of balsam and show conclusively that the tree must have been alive at the time of the initial attack. Hard, dried balsam can easily be found in such cavities.

Figure 24 illustrates very nicely how thoroughly this insect may girdle twigs. It

represents a small twig less than  $\frac{1}{2}$  an inch in diameter and shows the adult galleries of two females passing from a central chamber around the twig in opposite directions and overlapping each other on the farther side by about  $\frac{1}{2}$  an inch.

The larvæ or grubs pursue a rather tortuous course at approximately right angles to the parental galleries and end their operations in slightly enlarged elliptical cells where the final transformations to beetles occur.

### LARGE BLACK CARPENTER ANT.

*Camponotus herculeanus* Linn.

This large ant was met with a number of times in the Adirondacks where it had begun to excavate galleries in the balsam, and in some instances its work had progressed to such an extent that the tree was unable to stand a severe storm and had been blown down.

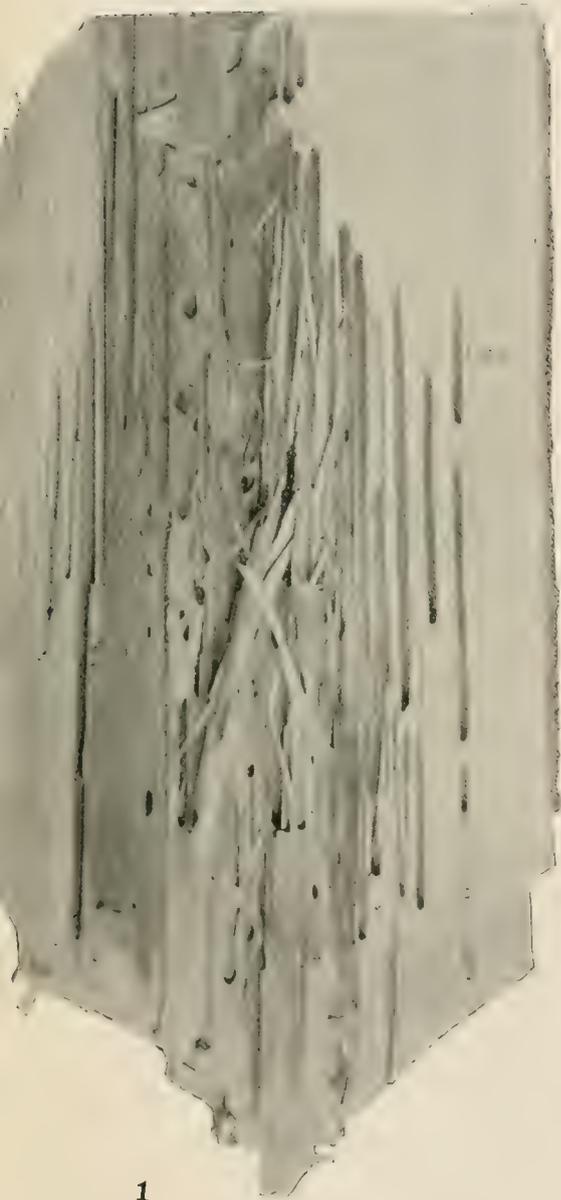
These insects are unable to enter sound trees, but wherever the wood is exposed they are very apt to effect an entrance. The peculiar method in which these insects work in balsam is well shown at plate 15, figure 1. It will be seen that the wood has been eaten away along well-defined lines, leaving large laminæ which are connected by irregular oval holes and with the lower ends eaten away entirely. This method of work contrasts very strongly with the operations of the same species in elm, shown in plate 15, figure 2. The reason for the difference probably lies in the fact that the balsam toward the end of the growing season deposits a layer of harder wood, which makes it easier to work along certain lines, while the interlacing fibers of the elm present no such difference, all of the year's growth being nearly of the same hardness, and therefore in the latter instance, the ants work in any direction which fancy indicates and follow no definite plan.

### Insects Affecting Arbor Vitæ.

This tree is somewhat common in the Adirondacks and as its wood, frequently used in rustic work, is often artistically carved by a little borer, a brief account of the species is given in this connection.

*Phæosinus dentatus* Say.

A very interesting beetle, about  $\frac{1}{10}$  of an inch long, may be met with in the Adirondacks working in the inner bark of dying and dead arbor vitæ. This insect is remarkable for its beautiful galleries and can not be considered an injurious species, since it is rarely abundant.



1



2

OPERATIONS OF LARGE BLACK CARPENTER ANT (*CAMPONOTUS HERCULANEUS* LINN.).

1. Work in balsam.

2. Work in elm



*Description.* The beetle varies in color from a light brown to black, is a very little over  $\frac{1}{16}$  of an inch long and relatively stout. The mouth parts are tipped with black. The eyes are black, coarsely granulated, transversely elongated and partly divided near their middle. The prothorax is rather coarsely and thickly punctured and tapers very much anteriorly. The wing covers or elytra are margined anteriorly, deeply striate and thickly clothed with short, yellowish hairs.

A pupa nearly ready to assume the adult form is yellowish white, about the length of the beetle and stouter. The eyes are a brown and the mouth parts almost black. Four of the abdominal segments project beyond the wing pads.

The typical burrow, figures 25, 26, and plate 10, figure 3, has a very characteristic form. From the three lobed primary or entrance chamber a broad burrow about  $\frac{3}{4}$  of an inch long runs nearly parallel with the wood fibers. Eggs are laid in minute notches on both sides of the primary channel and the young work for a short distance at nearly right angles and then they are apt to take an oblique direction.

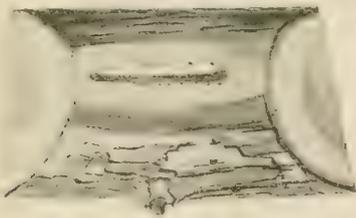


FIG. 25. *PHLAEOSINUS DENTATUS*  
ADULT GALLERY AND EGG NOTCHES. ORIGINAL.



FIG. 26. *PHLAEOSINUS DENTATUS*  
SMALL GALLERY AND LARVAL MINES. ORIGINAL.

The larval burrows score the sap wood lightly at first but as the grubs increase in size the wood is entered more deeply, till nearly half the burrow may be in the wood.

*Natural Enemies.* This little insect appears to be kept well in check by natural enemies, of which a number have been recorded. Dr. Hopkins states that the predaceous *Cymatodera bicolor* Say, and *Clerus quadrisignatus* Say, var. *nigripes* Say, have been observed under red cedar bark with this insect. Several small parasites also prey upon this species. *Spathius canadensis* Ashm., a species of *Pteromalus* and a species of *Eurytoma* have been observed by Dr. Hopkins preying upon this borer. The writer has reared another small parasite from this insect, which has been kindly determined by Mr. Ashmead as *Caudonia pityophthori* Ashm. MS.

## Insects Injurious to Oaks.

The different varieties of oaks growing within our State afford sustenance to large numbers of insects. It is impossible in the present article to even mention all the species which might be met with, and only a very few of the more important or the more interesting, which have come under the writer's observation in recent years, are treated of briefly.

### SPECIES AFFECTING THE LEAVES.

#### YELLOW STRIPED OAK CATERPILLAR.

*Anisota senatoria* Abb. & Sm.

A black spiny caterpillar with four orange-yellow stripes on the back and two on each side, is frequently very abundant on the scrub oaks at Karner, where it annually defoliates many of these trees. It happens that the species of oak involved in this attack are not of much importance, but this insect also depredates on others which have a high commercial value. There are several records of this caterpillar being so numerous as to migrate in swarms on railroad tracks and stop trains. The economic importance of this species may be judged by the opinion of Dr. Packard, who states that this insect and the forest tent caterpillar "as a rule do more harm to oak forests than perhaps all other species combined."

*Life History.* The life history of this insect is substantially as follows: The moths appear in the latitude of New York about the second week in June and their eggs are placed in large irregular clusters on the under side of the leaf. Dr. Lintner has found as many as 500 in a single cluster, though in our own collecting from 200 to 300 were commonly met with, plate 16, figure 1. The eggs vary in color from clear white to dull coral red, the deeper color being the sign of the approaching disclosure of the caterpillar. They hatch in about ten days, and the yellowish caterpillars with their prominent black spines behind the head feed side by side in masses. Their presence at this time can easily be detected by the partly stripped branches and also by the fine brownish excrement on the leaves below. July 19, 1901, this pest was so abundant at Karner that it was not at all difficult to find one or more of the leaves nearly covered with young caterpillars. The portion of the leaf upon which the eggs are laid is usually untouched, though everything else and the adjacent foliage may have been eaten, plate 16, figure 2. The smaller caterpillars are about  $\frac{1}{4}$  of an inch long at this time, and larger, darker ones may attain a length

of  $\frac{1}{2}$  an inch. July 23d a molt occurred, and the caterpillars were then coal black with bright red longitudinal stripes, and the thoracic horns were considerably longer than in the preceding stage. Four days later larvæ were observed in at least three different stages and clumps of oaks were easily found at Karner where the entire shoot had been defoliated. The younger caterpillars were frequently clustered on the under surface of the leaves, plate 16, figure 5, and the larger ones at this time measured about 1 inch in length. September 6th practically all of the larvæ had disappeared and the pupal stage was assumed.

*Description.* The moth is a bright yellowish-red insect, its front wings specked with black dots and with a rather large white spot near the middle. The female has a wing spread of about  $2\frac{1}{3}$  inches, and the male about  $1\frac{1}{2}$ . The latter is darker in color and has its antennæ broadly pectinate for more than one-half their length, plate 16, figures 6, 7.

*Natural Enemies.* This species is the prey of a number of natural enemies. Its spines probably serve to protect it to some extent from insectivorous birds, but Prof. A. J. Cook has recorded the robin and blue jay as feeding upon it. One Hymenopterus parasite, *Limneria fugitiva* Say, has been bred from this insect. Dr. Lintner records the rearing of another parasite from this insect, but unfortunately has not given its name.

### BUCK OR MAIA MOTH.

#### *Hemileuca maia* Drury.

This very pretty moth is relatively rare and its small black spiny caterpillar may sometimes be met with in early summer feeding in company upon the leaves of various oaks, particularly on those in swampy places. This insect occurs in similar locations to those preferred by the yellow striped caterpillar, *Anisota senatoria* Abb. & Sm., and has been rarely met with by the writer.

*Life History.* The moths begin to issue from the ground late in September or early in October, deposit their eggs in small belts encircling twigs, where they remain during the winter. The young hatch about the latter part of May and attain maturity about the middle of July when they enter the ground, pupate and appear as stated above. This species feeds upon a number of different oaks and has also been recorded on scrub willow, hazel and wild black cherry.

*Description.* The moth is a beautiful blackish insect with wings so lightly covered with scales that they appear semi-transparent. They are ornamented with creamy white bands which are broadest on the hind wings, plate 16, figure 9. The eggs are deposited in belts from  $\frac{1}{4}$  to a little over  $\frac{1}{2}$  of an inch in length, containing

## Explanation of Plate 16.\*

1. Egg mass of *Anisota senatoria* Abb. & Sm. on underside of oak leaf.
2. Egg shells of same on partly eaten leaf.
3. Shrunken larvæ of same infested by parasite on leaf stalks showing the characteristic feeding of the insect.
4. Nearly full grown larvæ of same.
5. Recently hatched larvæ feeding side by side and showing the skeletonizing in the earlier stages.
6. Male, natural size.
7. Female depositing eggs.
8. Full grown larva of Buck moth, *Hemilcuca maia* Drury.
9. Male of *Hemilcuca maia* Drury.
10. Egg mass of same.
11. *Cacoccia fervidana* Clem., enlarged.
12. Nest of same, composed of partly eaten, curled leaves.
13. *Serica trocifformis* Burm. on leaf, natural size.
14. Same enlarged.
15. Two spotted tree hopper, *Enchenopa biotata* Say.
16. Another peculiar tree hopper, *Archasia galcata* Fabr.
17. Another tree hopper, *Thelia acuminata* Fabr.
18. Dog day cicada or Harvest fly, *Cicada tibicen* Linn. in its resting position.
19. Acorn weevil, *Balaninus nasicus* Say, natural size.
20. Same enlarged.

\* Executed from nature, under the author's direction, by L. H. Joutel.





from 70 to 170 eggs, plate 16, figure 10. The individual egg is about  $\frac{1}{20}$  of an inch long, obovate, compressed on the sides and the apex reddish-brown, while below it is yellowish-white. The full grown larva is a beautiful creature with its round head and short brown hairs and fascicular spines. It is represented at plate 16, figure 8.

*Natural Enemies.* This species suffers from the attack of several natural enemies. Dr. Lintner observed that 8 out of the 30 individuals he reared were parasitized by a small fly which proved to be *Limmeria fugitiva* Say. This little parasite spins a cocoon on the outside of its victim's body. It was found under the elevated central portion of the caterpillar which was clasping a stem. Another small parasite was also reared from this insect by Dr. Lintner.

*Cacoccia fervidana* Clem.

This little caterpillar was common at Karner in June and July, 1901, and its web nests were observed in numbers here and there on the scrub oaks. It was much rarer in 1902, and apparently fluctuates considerably in numbers from year to year.

*Life History.* The web nests of this species began to appear June 13, 1901, and were more common on the 26th and later. Inhabited webs were also taken July 27th, and others August 9th. It appears probable that the period of flight may be an extended one, and that the insect breeds more or less during the summer months. The web is rather small, irregular, and measures about 3 or 4 inches in length and  $2\frac{1}{2}$  to 3 inches in its greatest diameter. It is filled with a mass of excrement, as in the case of allied species, plate 16, figure 12. A number of small dark colored caterpillars, about  $\frac{2}{5}$  of an inch long, were observed in the nests after most of the moths had appeared. They looked very much like the full grown larvæ of this species, and may have been retarded individuals. Unfortunately none of the latter were brought to maturity. Pupation occurs in the nest, and adults were bred July 23, 26, and August 16, 1901.

*Description.* The larvæ collected June 26th were nearly an inch long, with the head and thoracic shield jet black, and the body varying in color from yellowish-green to olive-green. The dark brown tubercles are not very conspicuous. Scanty cocoons were spun by the larvæ in their nests, and the meshes entangle a mass of excreta. The pupa is about  $\frac{3}{8}$  of an inch long, dark brown, ringed with lighter brown, and each segment bears a conspicuous row of stout spines, and behind it another row of smaller ones.

The moth is represented on plate 16, figure 11, and has been described by

Prof. Robinson as follows: "Palpi reddish-brown, short, the third joint extending beyond the head. Head and thorax reddish-brown above.

"Anterior wings reddish-brown, much clouded with fuscous beyond the middle. A dark brown patch on the costa and a smaller one on the disk below it indicate the central fascia.

"A large dark-brown sub-apical patch is continued as a broad fuscous shade to internal angle. Fringes pale.

"Posterior wings very dark fuscous above; pale testaceous beneath, tinged with fuscous internally. Fringes pale testaceous. Abdomen fuscous above, pale testaceous beneath.

"Under surface of anterior wings entirely clouded with fuscous, giving in some lights a purple reflection. Expanse, male, 20 mil., female, 23 mil."

*Parasites.* Several small parasites have been reared from this insect. Messrs. Riley and Howard record the breeding of a species of *Meteorus* from specimens on oak received from St. Louis, Mo., October 24, 1873. *Microcentrus delicatus* Cress. was reared from other specimens on oak from St. Louis, July 7 to 17, 1873, and *M. solidaginis* Cress., MS. was obtained July 6, 1873, from specimens taken on oak at St. Louis, Mo. The writer also bred parasites July 15th and 26th from this insect and the young of a plant bug, probably *Podisus placidus* Uhl. was taken in association with this species and presumably preys upon it.

#### *Scrica trociformis* Burm.

A small brown beetle a trifle less than  $\frac{1}{4}$  of an inch in length, may be met with in considerable numbers on scrub oaks in June. It may be recognized by its black head, very dark thorax and brick red, rather deeply grooved wing covers and by its stout, somewhat rotund shape, plate 16, figures 13, 14. The beetles fly about from bush to bush and eat small irregular holes in the foliage. A large robber fly was observed by the writer preying upon this species.

#### INSECTS OCCURRING ON TWIGGS.

Oak twigs afford sustenance to many species, and only a very few of those coming under personal observation in recent years can be noticed at this time. The following species of leaf hoppers represent some of the grotesque forms among insects.

*Stictocephala inermis* Fabr.

This is a greenish-brown, inconspicuous tree hopper, about  $\frac{5}{16}$  of an inch in length, shaped somewhat like a beechnut, and it is not marked by any excessively developed processes. This little species was present in small numbers on hard pine at Karner in 1901. Two specimens were taken July 19th, and it was probably present, though not captured, on other dates. Dr. Fitch records this species as occurring on oak.

*Thelia acuminata* Fabr.

This is one of our most grotesquely shaped tree hoppers and is characterized by the enormous development of the prothoracic horn, which extends nearly vertically to the height of  $\frac{1}{8}$  of an inch, plate 16, figure 17. It is a rare species and a single specimen was taken on scrub oak at Karner July 24, 1901.

*Thelia monticola* Fabr.

This grotesque little leaf hopper measures about  $\frac{3}{8}$  of an inch in length, and may be recognized by its yellowish-brown color and the peculiar elevation on the immensely developed prothorax. It is a very common species on the Virginia Creeper or *Ampelopsis*, and was taken by the writer in small numbers on scrub oak at Karner in July, 1901. Dr. Fitch, in his catalogue of the Homoptera of the State of New York, published in 1851, described this form as *T. querci*, and states that it occurs on scrub oak.

*Telamona godingi* Van Duz.

This species resembles the preceding in color and general shape, except that the prothoracic elevation is much narrower and is almost horn-like in character. A single specimen was taken on scrub oak at Karner, July 27, 1901.

*Archasia galeata* Fabr.

This apple green species has the thorax enormously developed into an arching shield, which covers most of the body. It is represented at plate 16, figure 16, and was taken in small numbers on scrub oak at Karner in 1901.

**TWO MARKED TREE HOPPER.***Enchenopa binotata* Say.

This peculiar brownish black leaf hopper with its enormous horn-like projection over its head may be met with in the fall on a number of plants. This peculiar development of the prothorax is undoubtedly protective since it gives the resting insect some resemblance to a thorn.

**DOG DAY CICADA.***Cicada tibicen* Linn.

This is our common harvest fly and may be easily recognized with the aid of the illustration on plate 16, figure 18. It occurs on a number of trees and may be met with somewhat commonly in July and August.

**OAK FIG GALL.***Biorhiza forticornis* Walsh.

The irregular reddish tinted, greenish galls of this insect may be met with in dense clusters along the midrib or on the stems of white and scrub oaks in midsummer. This species was observed rather commonly at Karner on the dwarf chestnut oak. The galls on the under surface of the leaves are very pretty about the middle of August. They are then irregular in shape, greenish-yellow and tinted with red. The mass of forming galls and a badly infested shoot are represented on plate 10, figure 2. The galls are found along the midrib on both the upper and under surface of the leaf and when on a twig constitute a very irregular mass and look not unlike figs closely packed around a central stem. Dr. Fitch observed this species and states that the female inserts a number of eggs a short distance from each other, apparently sinking them into the wood beneath the bark, causing a little discoloration. He describes the formation of the gall substantially as follows: A spongy spot runs inward from the gall to the pith of the limb. The wounds on the bark heal over soon and later are marked only by a smooth round swelling or elevation which soon commences to form. It increases in size till at length the bark bursts and a small round granule, the size of a pin head, protrudes from the opening. The small galls resemble a cluster of grapes and when about  $\frac{1}{2}$  their normal size begin to press upon each other. The larva lives in the midst of its gall and the mature insect escapes through a round hole.

## SPECIES AFFECTING THE FRUIT.

## ACORN WEEVIL.

*Balaninus nasicus* Say.

This is a small beetle with a remarkably long, slender snout which was observed in small numbers at Karner during June, 1901. It was bred the following season from acorns of the bear or chestnut scrub oaks. This species is one of the most common nut weevils and has been bred from hickory and hazel nuts and chestnuts as well as acorns.

*Life History.* Dr. Harris records finding this species paired upon hazel nut bushes in July, at which time the eggs are probably laid. He states that others appear in September and October, and must pass the winter concealed in some place of security. Mr. Glover records two broods, the last one probably hibernating in the earth, and adds that Mr. Akhurst of Brooklyn has observed that these insects sometimes remain in the larval condition over one season. Mr. W. H. Patton states that the following species of *Balaninus* have been reared from acorns: *B. caryae*, *B. uniformis*, *B. nasicus*, *B. rectus*, *B. quercus* and *B. coccinea*.

*Description.* This species has been described by Dr. Harris as follows: "Its form is oval, its ground color dark brown; it is clothed with very short rust yellow flattened hairs, which more or less conceal its original color, and are disposed in spots on its wing covers. The snout is brown and polished, longer than the whole body, as slender as a bristle, of equal thickness from one end to another, and slightly curved; it bears the long elbowed antennae, which are as fine as a hair, just behind the middle. This beetle measures nearly  $\frac{3}{10}$  of an inch in length, exclusive of the snout." The beetle is represented on plate 16, figures 19, 20. The larva or grub of this species has been described by Dr. Riley as yellow, with reddish-brown head and dark brown mandibles.

*Natural Enemies.* This species is apparently exempt from the attacks of natural enemies. Messrs. Riley and Howard, however, record the rearing of *Trichacis rufipes* Ashm. MS., from cocoons infested with this insect, and *Blastobasis glandulella* Riley from St. Louis, Mo., and states that this is probably from a Cecidomyiid inquiline. It thus appears that no undoubted parasitic enemy has yet been obtained.

## Preventive Measures.

The conditions obtaining in most of our American forests are such that we must depend very largely upon natural agents of one kind or another to keep injurious insects in check. The leaf feeding species noticed in the preceding pages are subject to attack by a number of insect enemies and certain birds prey upon them. This is true to a certain extent of the forms working in bark and wood, except that the birds which can get at them are limited to fewer groups. Parasitic enemies are valuable allies and occasionally it may pay to attempt the introduction into localities where it does not occur of a form of well-known economic value, but ordinarily very little can be done in the way of protecting insect enemies.

Our native birds are exceedingly important checks upon the increase of various insects, and perhaps as much can be done toward reducing insect ravages by encouraging the presence of birds and preventing a decrease in their numbers as in any other way. Dr. W. T. Hornaday, of the New York Zoological Society, estimated a few years ago that there had been a decrease of about 48% in the number of our birds during the past 15 years. This decrease is very significant when taken in connection with the enormous number of insects which birds devour.

The Forest Tent Caterpillar, *Clisiocampa disstria* Hübn., has been causing very serious injury in different sections of the State in the past 4 or 5 years and one cannot help feeling that there may be some connection between this large decrease in bird life and the abnormal abundance of this pest, especially when it is remembered that 25 species of birds feed more or less upon this caterpillar. It would seem wise to at least protect these forms so far as practicable and this may be done by stopping the promiscuous gunning, prohibiting bird egging by boys and by keeping hawks, crows and jays within bounds.

The severe outbreaks of several bark borers in the last 2 or 3 years calls attention to their work and raises the question as to the possibility of controlling them more thoroughly. Comparatively little will be done along this line in the case of large tracts of forests, but in small areas, such as we find in the vicinity of Albany or in other sections of the State not heavily forested, something may be accomplished by carefully cutting and then removing the infested trees or peeling the bark from them and allowing the trunks to lie in the woods. It would seem as though the value of the wood and timber would amply pay for the extra labor necessary to remove these dying and dead trees. It is easy to detect them in winter, and as nothing can be gained by allowing them to remain, they could be cut and disposed of to the best possible advantage. These recommendations would apply not only

to pine attacked by bark borers but also to hickory infested by the dangerous species which has proven so injurious in New York in recent years. The thing to be remembered in this connection is that cutting should be done at a time when the insects are mostly within the tree and will therefore be more likely to perish. This is true of all these species in the winter and also of some at certain periods in the summer. The sudden dying of a tree in midsummer in the midst of other valued pines should receive immediate attention, and if the bark beneath is inhabited by large numbers of grubs, the infested tree should be cut and either destroyed or the bark removed at once so as to prevent the developing of the insects and a later generation entering other trees. The writer has seen several instances in the vicinity of Albany where such measures could have been adopted to advantage and in all probability might have resulted in saving adjacent trees. Dr. A. D. Hopkins, now of the U. S. Department of Agriculture, has made an extensive study of these insects in various sections of the country, and he recommends for certain bark borers that the winter cutting be regulated to include as many of the infested, dying and dead trees as possible, and that the logs of the same be placed in water before June 1st. Secondly, that the summer cutting be so regulated that as many recently attacked trees as possible may be cut and the bark removed from their trunks and stumps, and, thirdly, that a large number of trees not infested be girdled where logging operations will be carried on the following summer and winter. The girdled trees may then be felled and the logs containing the young grubs peeled or placed in water before the first of the succeeding June.

These recommendations of Dr. Hopkins were prepared with special reference to the spruce-destroying species, *Dendroctonus piceaperda* Hopk., which has been causing severe injury in Maine, and to which he attributes serious damages to spruce forests in earlier years. It does not follow that this is the best time to girdle trees for other species, but the presumption is that the most effective results can be secured by operations conducted about that time. The precise season for different borers must be determined by repeated tests. We know that some are attracted to dying trees, and if we were to produce this condition at about the time when most of them are looking for favorable conditions and then destroy the tree and its contained hosts, much would be accomplished. The checking of the destructive bark borers renders it unnecessary to safeguard against species which follow, because they will not attack living trees as a general rule.

Most of these measures, except protecting birds, have not the slightest effect upon weevils and other insects which work in the tips of our pine trees. It is

impracticable to do anything else toward preventing their ravages in native forests, and in the case of valued trees on lawns or large estates, something can be accomplished by cutting away the infested tips and burning them while they still contain insects. The White Pine Weevil, *Pissodes strobi* Peck., is usually well controlled by parasites. Occasionally it is present in enormous numbers and then the destruction of small twigs literally mined with its burrows, and almost filled with its grubs and pupæ, cannot but result in good, even though it may involve the destruction of a few parasites.



THE END OF THE DAY.





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