# XI.—REPORT OF PROGRESS OF AN INVESTIGATION OF THE CHEMICAL COMPOSITION AND ECONOMIC VALUES OF FISH AND INVERTEBRATES USED FOR FOOD.

## UNDERTAKEN FOR THE UNITED STATES FISH COMMISSION.

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SIR: Herewith I have the honor to transmit a report of progress of the investigation of the chemical composition and economic values of fish and marine invertebrates used for food, which has been in process for some time past in this laboratory, under the auspices of the Smithsonian Institution and the United States Fish Commission.

This report includes analyses of fifty-one samples of fish and twenty-five of oysters, lobsters, and other invertebrates. It is divided into three parts.

Part I gives account of analyses of fish, including description of samples, tabular statements of results, and methods of analyses.

Part II gives similar data regarding invertebrates. The investigation it describes was undertaken at my suggestion by my assistants, Messrs. Woods and Beamer, who have also shared in the investigations of fish, and who report those upon invertebrates.

Part III summarizes the more immediately practical results of the work, especially in its relations to the nutritive values of the samples analyzed, the detailed account of the more abstract investigations being reserved for another occasion.

Permit me to say that I regard this as only the beginning of a much needed research. Work in this line, rightly conducted, may, unquestionably grow into an inquiry of the greatest value.

To obtain the best results the investigation should, it seems to me, be pushed in two directions, namely, toward the study of—

1. The chemical constitution of the tissues and fluids of the bodies of the animals.

2. Their economic values, especially for food.

The more abstract study of the chemical composition of the substances is of less immediate interest to any except the chemist and physiologist; but, if successfully carried out, its results will have most important bearings upon the more practical questions referred to. We must know more of the chemical constitution of the compounds that occur in our foods and of their functions in nutrition before we can, with satisfactory accuracy, estimate their values and proper uses for food. At the same time, an approximate estimate of the nutritive values, and one commensurate with our present knowledge of the ingredients of foods and their functions, can be based upon analyses somewhat less detailed, even, than most of those here given. The analyses already made, though insufficient to permit as reliable generalizations as are to be desired, do, nevertheless, help toward an estimate of the composition and values of a number of our more common species of edible fish and invertebrates.

Some of the results herewith reported are striking and unexpected. Among the different sorts of fish which the New York and Middletown markets furnished for my table, a sample of flounder contained only 5 per cent. of dry edible solids, actual nutrients, the rest being water and refuse; while one of salmon yielded 33 per cent. of nutritive substance. The proportion of nutrients in salmon was nearly one-third larger than it would be in an ordinary slice of beef-steak; that in flounder not one-fourth as large.

Taking the fish at retail prices in Middletown markets, the total nutrients in striped bass came to about $2.30 per pound; while in Connecticut River shad, whose price, thanks to our fish commissions, was very low, we bought the same nutrients at 44 cents per pound. In good beef they were costing about $1 per pound.

It makes very little difference to the man with five thousand dollars a year whether he pays fifty cents or five dollars a pound for the albuminoids in his food; but it does make a difference to the man who must pay his rent and support his family on five hundred dollars a year. The economical housewife who hesitates in the dry-goods store before taking a piece of calico at eleven cents a yard when she can get another that may do as good service for ten, goes to the market and unknowingly pays, perhaps, a dollar for a given amount of food, when she might have got the same materials in forms equally nutritious and wholesome, for fifty cents.

The large amount of attention devoted to this kind of investigation in Europe has brought results capable of being successfully popularized. In Germany, tables giving the chemical composition and nutritive valuations of foods are becoming current among even the common people. An attempt toward a similar application of the results of the present work is given in tabular form in Part III.

The details of the analytical work herewith reported have been performed for the most part by my friends and assistants, Messrs. W. H. Jordan, B. S., G. P. Merrill, B. S., C. D. Woods, B. S., and M. Beamer, C. E., for whose skillful aid I desire to express my thanks.

I wish also to acknowledge the generous contribution by Mr. A. R. Crittenden, of the firm of Wilcox, Crittenden & Co., of this city, of $100 towards the expenses of the analysis of fish.

Further and especial thanks are due to Mr. E. G. Blackford, Fish Commissioner of the State of New York, for a gift of the same amount ($100) towards defraying the expenses of the investigation of the invertebrates, as well as for the furnishing of samples and valuable information.

In conclusion, permit me to express my appreciation of the pecuniary and other aid which has been courteously afforded by yourself, and which has rendered the investigation possible.

Very respectfully, your obedient servant,

W. O. ATWATER,

*Chemical Laboratory, Wesleyan University,*
*Middletown, Conn., July* 1, 1881.

Prof. SPENCER F. BAIRD,
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# PART I.

## ANALYSES OF FISH.

### DESCRIPTION OF SAMPLES OF FISH ANALYZED.

Nos. I, XIII, XV, and XVI were purchased at fish markets in Middletown, in the months of March, April, May, and June, 1879; the other samples were procured as stated below.

No. I. Halibut (*Hippoglossus americanus*).

The sample was from the posterior half of the body. The price was 15 cents per pound. The proportions of flesh, edible portion, refuse, and loss in cleaning (see "Methods of Analysis") were as given in Table I.

No. II. Flounder (*Pleuronectes americanus*).

The entrails of the fish had been removed. Price 10 cents per pound. The following figures show the proportions of edible portion, waste, &c., in each sample and in both together. The figures for the two together are also given in Table I.

| | A. | B. | Both. |
|---|---|---|---|
| | *Grams.* | *Grams.* | *Grams.* |
| Weight of edible portion, flesh | 239 | 715 | 954 |
| Weight of refuse, head, bones, skin, &c | 355 | 961 | 1,316 |
| Loss in preparing for analysis | 19 | 19 | 38 |
| Total weight of sample in grams | 613 | 1,695 | 2,308 |
| Total weight of sample in pounds and ounces | 1 lb. 5.6 oz. | 3 lbs. 11.8 oz. | 5 lbs. 1.4 oz. |

No. III. Cod (*Gadus morrhua*).

The head and entrails of the fish had been removed. Price 10 cents per pound. Proportions of flesh, refuse, &c., as per Table I. Total weight of one dressed fish, 2,780 grams=6 pounds 2.1 ounces.

No. IV. Eels (salt water) (*Anguilla rostrata*).

Dressed, *i. e.* skin, head, and entrails removed. Price 15 cents per pound. The proportions of flesh, refuse, &c., in Table I are those of eleven fish, which were not weighed separately. The total weight was 1,368 grams=3 pounds 0.3 ounces.

No. V. Alewives (*Pomolobus vernalis*).

Caught in the Connecticut River. Price 12 cents per dozen. Twelve whole fish weighed 2,566 grams=5 pounds 1.5 ounces. The cost per pound was thus 2⅓ cents. The proportions of flesh and refuse in four of the fish were as per figures in Table I, in which table are given corresponding data for samples which follow.

No. VI. Shad (*Alosa sapidissima*).

From the Hudson River. Price 20 cents per pound. Two whole fish weighed 1,925 grams=4 pounds 3.9 ounces.

No. VII. Striped Bass (*Roccus lineatus*).

From Connecticut River. Price 20 cents per pound. One whole fish weighed 2,055 grams=4 pounds 8.5 ounces.

No. VIII. Mackerel (*Scomber scombrus*).

Price 15 cents each. Four whole fish weighed 1,280 grams=2 pounds 13.1 ounces, which would make the price about 20 cents per pound.

No. IX. Halibut (*Hippoglossus americanus*).

Section of fatter portion of body. Price 15 cents per pound.

No. X. Shad (*Alosa sapidissima*).

From Connecticut River. Price 8 cents per pound. One whole fish weighed 1,595 grams=3 pounds 8.3 ounces.

No. XI. Cod (*Gadus morrhua*).

Price, 8 cents per pound. One fish, dressed, *i. e.*, with head and entrails removed, weighed 2,532 grams=5 pounds 9.3 ounces.

No. XII. Blue Fish (*Pomatomus saltatrix*).

Price 10 cents per pound. One fish, entrails removed, weighed 1,400 grams=3 pounds 1.3 ounces.

No. XIII. Mackerel (*Scomber scombrus*).

Price 18 cents per pound. Two whole fish weighed 8,982 grams=19 pounds 12.1 ounces.

No. XIV. Salmon (*Salmo salar*).

Sample furnished by Mr. E. G. Blackford, 74, 75, 76, and 80 Fulton Market, 134 Beekman street, and 223 Front street, New York City. From Maine. One fish, entrails removed, weighed 4,764.3 grams=10 pounds 8 ounces.

No. XV. Porgy (*Stenotomus argyrops*).

Four whole fish weighed 1,290.5 grams=2 pounds 13.5 ounces.

No. XVI. Haddock (*Melanogrammus aeglefinus*).

Price 8 cents per pound. One fish, with entrails removed, weighed 1,900 grams=4 pounds 3 ounces.

No. XVII. Salmon Trout, called also "Mackinaw Trout" (*Salvelinus namaycush*).

Received November 7, 1879, from Mr. Blackford, Fulton Market, New York. In letter of November 6, Mr. Blackford describes the samples as follows: "Salmon trout (*Christivomer namaycush*) weighs 8 pounds 3 ounces. Caught in Lake Ontario November 5. This is very plenty in market at this season of the year. You will probably find spawn in it." The sample, a whole fish, weighed on receipt 3,630.4 grams=8 pounds, and had evidently shrunk slightly by loss of water and otherwise in coming. It contained considerable spawn, which, as in other cases, was rejected, with entrails, bone, skin, &c., in preparing for analysis.

No. XVIII. White Fish (*Coregonus clupeiformis*).

Received November 7, 1879, from Mr. Blackford, who says in accompanying letter: "White fish (*Coregonus clupeiformis*) weighs 2 pounds 15 ounces, caught at Alburgh Springs, Vt., from Lake Champlain. Is the great food fish of the lakes, and is in its finest condition at the present season." Total weight of one whole fish as received, 1,313 grams =2 pounds 14.3 ounces, showing, as usual, slight shrinkage in transport and handling.

No. XIX. Striped Bass (*Roccus lineatus*).

Received November 7, 1879, from Mr. Blackford, who described it as "Striped bass; weighs 2 pounds 9 ounces; caught at Bridgehampton, Long Island, November 5. They are very plenty at this season and in their best condition." Total weight of one whole fish, 1,098.5 grams=2 pounds 6.7 ounces.

No. XX. Red Snapper (*Lutjanus Blackfordii*).

Sample received from Mr. Blackford November 28, 1879, "caught in Fernandina, Fla." Total weight of one whole fish, 3,507.5 grams=7 pounds 15 ounces.

No. XXI. Haddock (*Melanogrammus æglefinus*).

Sample received from Mr. Blackford November 28, 1879, "caught off Rockaway, Long Island." Total weight of one fish from which entrails had been removed, 2,402 grams=5 pounds 4.7 ounces.

No. XXII. Flounder (*Paralichthys dentatus.*)

Sample received from Mr. Blackford March 9, 1880. "The fish was caught at Amagansett, Long Island." The sample was rather old, and the flesh very soft. It emitted some odor and assumed a pasty appearance in drying. It is worthy of note in this connection that the percentage of "gelatin" in this sample is large. Total weight of one whole fish, 1,257.5 grams=2 pounds 12 ounces.

No. XXIII. Smelt (*Osmerus mordax*).

Received March 9, 1880, from Mr. Blackford, from Hackensack River, New Jersey. Seventy-three whole fish weighed 1,023 grams. = 2 pounds 4 ounces.

No. XXIV. Spotted Brook Trout (*Salvelinus fontinalis*).

Sample received from Mr. Blackford, March 16, 1880, "Cultivated Trout." Six whole fish weighed 1,295 grams = 2 pounds 13.7 ounces.

No. XXV. Boned Codfish.

Per label on box, "Packed and warranted by Henry Meigs & Co., Boston, Mass.," "Snow flake" brand. Purchased April 8, 1880, in Middletown, in 5 pound packages; price 50 cents each, or 10 cents per pound. The following statements were printed on the box: "This package contains pure codfish, and that the best that could be cured. Great care is taken in the selection, curing, and packing, and the fish is recommended to the consumer for its economy, convenience, cleanliness, and quality. In the fall of 1876 we introduced boned codfish in small boxes. We have been experimenting with paper, and we have now to offer a paper box that is in every way water and air tight. The package is thus always neat, the contents clean, and there no longer escapes the fish odor, that to many is so offensive."

No. XXVI. Red Snapper (*Lutjanus Blackfordii*).

From the eastern coast of Florida. Sample received from Mr. Blackford April 20, 1880. Entrails removed. Weight of sample, 5,499 grams = 12 pounds 1.9 ounces.

No. XXVII. California Salmon (*Oncorhynchcus chouicha*).

From Sacramento River, California. Received from Mr. Blackford, April 20, 1880. Edible portion of the anterior part of body. The fish was evidently not very fresh. It emitted some odor, and in drying swelled a great deal, and became pasty.

No. XXVIII. Smoked Halibut.

Purchased in Middletown, Conn., April 29, 1880. Part of one side of fish, including skin and a few small bones. Total weight of sample, 1,616 grams. = 3 pounds 9 ounces.

No. XXIX. Canned Salmon (*Oncorhynchcus chouicha*, probably).

Put up by G. W. Hume & Co., San Francisco, Cal. One can, said to contain 2 pounds, cost 45 cents. Weight of entire sample, 8,700 grams = 1 pound 14.7 ounces, which would make actual cost of the contents of can about 20 cents per pound. The sample had a good deal of oil. Solids and oil were crushed together in a mortar; the oil was readily absorbed, so that the sample was easily worked.

No. XXX. Fresh Mackerel (*Scomber scombrus*).

Caught off Cape May, N. J. Received from Mr. Blackford, May 11, 1880. Total weight of four whole fish, 2,594 grams = 5 pounds 11.5 ounces.

No. XXXI. Porgies (*Stenotomus argyrops*).

From Rhode Island. Received from Mr. Blackford, May 11, 1880. The fish were whole. Total weight, 2,847 grams = 6 pounds 4.4 ounces.

No. XXXII. Shad (*Alosa sapidissima*).

From Connecticut River. Purchased May 19, in Middletown, Conn. Price 10 cents per pound. Total weight of one whole fish, 1,750 grams = 3 pounds 14 ounces.

No. XXXIII. Smoked Herring (*Clupea harengus*).

Purchased May 19, 1880, in Middletown, Conn. Total weight of six whole fish, 4,547 grams = 10 pounds 0.4 ounces.

No. XXXIV. Salt Codfish.

Sample purchased in Middletown, Conn., November 16, 1880, of Mr. S. T. Camp, who states that the fish is the kind known to the trade as "channel fish," and were caught in the deep water near George's Banks. The fish as commonly sold (head and entrails removed, salted and dried) cost 7 cents per pound. One fish weighed 4,156 grams = 9 pounds 2.2 ounces.

Nos. XXXV *a* and XXXV *b*. Spent or foul salmon (*Salmo salar*), males.

Nos. XXXVI *a* and XXXVI *b*. Spent or foul salmon (*Salmo salar*), females.

Received November 18, 1880, from Government salmon breeding establishment, through the courtesy of Mr. Charles G. Atkins, Bucksport, Me. In accompanying letter Mr. Atkins suggests that though "spent" salmon [the eggs having been removed by stripping] they were in better condition than those that have spawned naturally. From measurements made by Mr. H. L. Osborn, assistant in natural history in Wesleyan University, I select the following as of interest in comparing the dimensions and weights of these with salmon in good condition:

| | XXXV *a* | XXXV *b* | XXXVI *a* | XXXVI *b* |
|---|---|---|---|---|
| Greatest height of body.......millimeters.. | 156 | 154 | 163 | 166 |
| Least height of body.......do ..... | 60 | 58 | 63 | 64 |
| Greatest width of body.......do ..... | 58 | 57 | 66 | 67 |
| Girth at tip of pectoral fin.......do...... | 360 | 355 | 380 | 400 |
| Girth at anterior end of dorsal.......do...... | 380 | 365 | 390 | 395 |
| Girth over anus.......do...... | 290 | 285 | 340 | 315 |
| Girth at posterior end of adipose fin.....do...... | 200 | 190 | 200 | 210 |
| Length to tip of middle caudal ray......do...... | 826 | 830 | 915 | 896 |
| Length to base of middle caudal ray.....do ..... | 750 | 750 | 835 | 813 |

The proportions of flesh, refuse, &c., were:

| | XXXV *a*. | XXXV *b*. | XXXVI *a*. | XXXVI *b*. |
|---|---|---|---|---|
| Edible portion.......grams.. | 2, 345. 7 | 2, 381. 1 | 2, 693. 0 | 3, 040. 2 |
| Waste, entrails, skin, bone, &c.......do.... | 1, 998. 4 | 1, 715. 0 | 2, 487. 5 | 1, 955. 9 |
| Loss in cleaning.......do.... | 28. 3 | 14. 2 | 7. 0 | 21. 3 |
| Total weight.......do.... | 4, 372. 4 | 4, 110. 3 | 5, 187. 5 | 5, 017. 4 |
| Total weight in pounds and ounces........ | 9 lbs. 10. 2 oz. | 9 lbs. 1 oz. | 11 lbs. 7 oz. | 11 lbs. 1 oz. |

Portions of Nos. XXXV *a* and XXXV *b* were sampled together and analyzed as No. XXXV. The same was done with Nos. XXXVI *a* and *b*, which were analyzed as No. XXXVI.

No. XXXVII. Salt Codfish.

Sample purchased of Mr. S. T. Camp, Middletown, Conn., November 29, 1880, who states that the fish is of the kind known to the trade as "boat fish," and was caught near the shore, in the vicinity of Nantucket. Total weight of two whole fish, 2.813 grams = 6 pounds 3.2 ounces.

No. XXXVIII. Black Fish (*Tautoga onitis*).

From Stonington, Conn., received December 1, 1880, from Mr. Blackford. Weights of two whole fish as follows:

| | *a.* | *b.* |
|---|---|---|
| Edible portion ........ grams.. | 546.5 | 322.0 |
| Waste ........ do... | 716.8 | 441.9 |
| Loss in cleaning ........ do... | 23.7 | 11.1 |
| Whole fish ........ do... | 1,287.0 | 775.0 |
| Whole fish in pounds and ounces ........ | 2 lbs. 13.4 oz. | 1 lb. 11.4 oz. |

No. XXXIX. Mackerel (*Scomber scombrus*).

From Cape Cod, Mass., sample received from Mr. Blackford, Dec. 1, 1880. One whole fish weighed 337 grams = 11.9 ounces.

Nos. XL *a* and XL *b*. Land-locked Salmon (*Salmo salar*), var. *sebago*, males.

Nos. XLI *a* and XLI *b*. Land-locked Salmon (*Salmo salar*), var. *sebago*, females.

From Schoodic salmon-breeding establishment, Grand Lake Stream, Maine. Sample received December 1, 1880, from Charles G. Atkins, who says, in letter dated Grand Lake Stream, Maine, November 27, 1880, "I send * * * * four male land-locked salmon and four females, whose eggs have been taken from them by the artificial process. They are as near spent fish as we can get, but I think they are in better condition than those that have spawned naturally." The following measurements and weights indicate the size of the fish and proportions of flesh and refuse:

| | XL *a.* | XL *b.* | XL *c.* | XL *d.* |
|---|---|---|---|---|
| Greatest length ........ millimeters.. | 520 | 500 | 510 | 500 |
| Girth at tip of pectoral fin ........ do ...... | 285 | 250 | 265 | 260 |
| Girth at anterior base of dorsal fin ...... do ...... | 292 | 255 | 278 | 270 |
| Girth at anus ........ do ...... | 216 | 175 | 220 | 195 |
| Edible portion ........ grams.. | 745.1 | 623.8 | 754.3 | 761.8 |
| Waste, entrails, &c ........ do... | 767.5 | 594.8 | 741.9 | 648.8 |
| Loss in cleaning ........ do... | 17.4 | 11.6 | 10.4 | 8.9 |
| Total weight ........ do... | 1,530.0 | 1,230.2 | 1,506.6 | 1,419.5 |
| Total weight in pounds and ounces ........ | 3 lbs. 5.9 oz. | 2 lbs. 11.4 oz. | 3 lbs. 5.1 oz. | 3 lbs. 2 oz. |

| | XLI *a.* | XLI *b.* | XLI *c.* | XLI *d.* |
|---|---|---|---|---|
| Greatest length ........ millimeters.. | 480 | 460 | 450 | 450 |
| Girth at tip of pectoral fin ........ do ...... | 230 | 220 | 210 | 210 |
| Girth at anterior base of dorsal fin ...... do ...... | 240 | 225 | 210 | 200 |
| Girth at anus ........ do ...... | 177 | 175 | 168 | 160 |
| Edible portion ........ grams.. | 562.1 | 494.7 | 402.1 | 442.9 |
| Waste, entrails, &c ........ do... | 471.3 | 401.7 | 391.1 | 409.4 |
| Loss in cleaning ........ do... | 19.6 | 6.7 | 9.3 | 11.4 |
| Total weight ........ do... | 1,053.0 | 903.1 | 802.5 | 863.7 |
| Total weight in pounds and ounces ........ | 2 lbs. 5.1 oz. | 1 lb. 15.8 oz. | 1 lb. 12.3. oz. | 1 lb. 14.5. oz. |

Nos. XL *a*, XL *b*, XL *c*, XL *d*, were sampled together and analyzed as No. XL. The same was done with XLI *a*, *b*, *c*, and *d*, which were analyzed as XLI.

No. XLII. Salt Mackerel (*Scomber scombrus*).

Bought February 23, 1881, in Middletown, Conn., price 12½ cents per pound, described as "No. 1 mackerel". Caught probably in September or October, as the barrel from which sample was taken was marked as inspected at Chatham, Mass., in October. Weight of three fish at store a trifle short of 2 pounds; as received at laboratory, 857.8 grams = 1 pound 14.3 ounces. As the fish had considerable adhering salt and brine, they were rinsed in cold water and dried between folds of paper and with a linen towel. The weight of the three fish thus treated was 781.4 grams. Accordingly the three fish had (857.8—781.4 =) 76.4 grams or about 9 per cent. of adhering salt, brine, &c. Or, taking weight at store at 890 grams, the adhering brine, &c., would be 109 grams, or about one-eighth—12½ per cent. That is, one-eighth of the weight paid for at the store was brine, salt, &c., which would be rinsed off in preparing the fish for cooking. Such statements as this are of course of no importance except as data for calculating how much nutritive material is obtained in a given amount of the fish as bought.

XLIII. Spanish Mackerel (*Cybium maculatum*).

Sample received from Mr. Blackford, March 1, 1881. It was rather "soft", though entirely free from offensive odor. One whole fish weighed 1,513 grams=3 pounds 5.3 ounces.

XLIV. White Perch (*Morone americana*).

Sample received from Mr. Blackford, March 1, 1881. The fish contained considerable spawn. The proportions of flesh and refuse in two whole fish were:

| | *a.* | *b.* |
|---|---|---|
| Edible portion ........ grams.. | 128.7 | 142.7 |
| Refuse ........ do.... | 208.0 | 279.0 |
| Loss in cleaning ........ do.... | 6.7 | 5.0 |
| Total weight ........ do.... | 343.4 | 426.7 |
| Total weight ........ ounces.. | 12.1 | 15.0 |

XLV. Muskallonge (*Esox nobilior*).

From Saint Lawrence River. Received March 4, 1881, from Mr. Blackford, who says that it "is not often found in our markets." One whole fish weighed 4,118 grams=9 pounds 1.2 ounces.

XLVI. White Perch (*Morone americana*).

Received March 8, 1881, from Mr. Blackford. Proportions of flesh and refuse in four whole fish as follows:

| | *a.* | *b.* | *c.* | *d.* |
|---|---|---|---|---|
| Edible portion ........ grams.. | 78.7 | 110.6 | 78.0 | 71.9 |
| Refuse ........ do.... | 129.2 | 196.5 | 127.2 | 125.5 |
| Loss in cleaning ........ do.... | 7.1 | 4.6 | 3.3 | 3.3 |
| Total weight ........ do.... | 215.0 | 311.7 | 208.5 | 200.7 |
| Total weight ........ ounces.. | 7.6 | 11.0 | 7.4 | 7.0 |

XLVII. Herring (*Clupea harengus*).

Sample received from Mr. Blackford, March 8, 1881. Proportions of flesh and waste in four samples, as follows:

| | a. | b. | c. | d. |
|---|---|---|---|---|
| Edible portion ........ grams.. | 136.5 | 163.0 | 121.5 | 131.5 |
| Refuse ........ do.... | 142.0 | 129.0 | 83.0 | 143.2 |
| Loss in cleaning ........ do.... | 5.9 | 10.2 | 5.5 | 9.5 |
| Total weight ........ do.... | 284.4 | 302.2 | 210.0 | 284.2 |
| Total weight........ ounces.. | 10.0 | 10.6 | 7.7 | 10.0 |

XLVIII. Sheeps-head (*Archosargus probatocephalus*).

From Florida. Received from Mr. Blackford, March 10, 1881. One fish, entrails removed, weighed 1,974 grams=4 pounds 5.6 ounces.

XLIX. Turbot (*Platysomatichthys hippoglossoides*).

From Newfoundland. Received from Mr. Blackford, March 10, 1881. The fish had been frozen and partly thawed. One whole fish weighed 2,497 grams=5 pounds 8 ounces.

LII. Yellow Pike-perch (*Stizostedium vitreum*).

Received from Mr. Blackford, March 17, 1881. The proportions of flesh and waste in two whole fish, of which the heavier had considerable immature spawn, were as follows:

| | a. | b. |
|---|---|---|
| Edible portion ........ grams.. | 232.5 | 230.2 |
| Refuse ........ do.... | 369.2 | 273.5 |
| Loss in cleaning ........ do.... | 9.8 | 7.5 |
| Total weight ........ do.... | 611.5 | 511.2 |
| Total weight in pounds and ounces. ........ | 1 lb. 5.6 oz. | 1 lb. 2 oz. |

LIII. Black Bass (*Micropterus salmoides?*).

Received March 17, 1881, from Mr. Blackford. One whole fish weighed 1,676 grams=3 pounds 11.1 ounces.

## DESCRIPTION OF TABLES.

The main results of the investigation are expressed in the tables which follow.

Table I states the results of analyses of fifty-one samples of fish, in the terms commonly current in such investigations.

Table II recapitulates the analyses of Table I in such way as to set forth more fully the actual composition of the samples analyzed.

Table III recapitulates the composition of several samples on a somewhat different basis, the essential difference being in the method of estimating the amounts of albuminoids.

Table IV gives a brief résumé of the composition of the samples in forms more convenient for reference.

In Part III of this report is a table giving the nutritive valuations of the fish reported herewith and of the invertebrates, oysters, clams, lobsters, &c., reported beyond.

### TABLE I.

Under "Kinds of fish and portions taken for analysis" are given the names and the localities, when the latter are known. The full details may be found under "Descriptions of Samples" above. The meaning of the figures in the first three columns will need no explanation; the rest are explained under "Methods of Analysis," beyond.

### TABLE II.

Table II recapitulates the analyses of fish. The second column shows the percentages of flesh, edible portion, in each sample as actually received at the laboratory for analysis; some of these included the whole fish, others were dressed. As explained under "Methods of Analysis" these figures represent the proportions of edible material which we were able to separate from the skin, bones, &c., after the entrails had been removed. Thus the sample of halibut, No. IX, which was a section of the fatter part of the body, "halibut steak," gave 88¼ per cent. of flesh, the residual 11¾ per cent. being skin and bone; while a sample of flounder, No. XXII, yielded only 32 per cent. of edible substance, the remaining 68 per cent. consisting of entrails, skin, bone, and other waste. The proportion of waste in this flounder, which was whole, was naturally larger than in the other, No. II, from which the entrails had been removed, and which gave 41⅓ per cent. of flesh, and 58⅔ per cent. of refuse.

The remaining figures in Table II give the composition of the flesh computed first upon the dry substance, then upon the whole flesh including both dry substance and water. Explanations may be found under "Methods of Analysis." The albuminoids in this table are computed by multiplying the nitrogen by 6.25, as is generally customary, at present, in analyses of animal and vegetable food-products. As will be seen in the column "Albuminoids + Flats + Ash," under "Summary," the computation brings, generally, too large results; that is, a footing of over 100 per cent. In some cases, however, it falls short. The variations in the results at first led me to fear inaccuracy of the work, but the greatest possible pains has not availed to make them more uniform; they seem, therefore, to indicate wide variations in the nitrogen compounds themselves. I am inclined to think that one reason why the percentages of albuminoids here given are higher than have been obtained in many cases elsewhere, is to be found in the especial care that has been taken here in determining the nitrogen, which, when made by the soda-lime method, as is usually done, often came out too low.

The percentages of ingredients in both dry substance and flesh have been re-calculated to make the footings 100 per cent.; the original and the altered figures being given under "Summary."

Further explanations, with recapitulations of the figures in this and the following tables, may be found in Part III of this report.

## TABLE III.

As is explained in "Methods of Analysis," some attempts have been made toward what might be called a complete analysis of the flesh. The figures are recapitulated in this table. The "Extractive matters" include, as stated, all the materials dissolved out by cold water, and not coagulated by boiling; "Albumen," the portion of the cold water extract coagulated by boiling; "Gelatin," the portion soluble in hot water; Fats, the portion soluble in ether; and "Insoluble protein," the residue insoluble in water and in ether. The footings generally exceed 100 per cent., perhaps from incomplete separation of water or fats from some of the ingredients, as stated under "Methods of Analysis," though care was taken to get them as pure as practicable.

## TABLE IV.

This table gives a general résumé of such of the results as are most important for estimating the nutritive values of the samples. The figures, except those in the last column, "Total edible solids," are taken from Table II.

# METHODS OF ANALYSIS.

### PREPARATION OF SAMPLES FOR ANALYSIS.

*Separation of edible portion (flesh) from refuse (bones, skin, entrails, spawn, &c.).*—The sample, as received at the laboratory, was weighed; the edible portion, "flesh," was then separated from the refuse, and both were weighed. There was always a slight loss in cleaning, due evidently to evaporation and to slimy and fatty matters and small fragments of the tissue that adhered to the hands and to the utensils used in preparing the sample. Perfect separation of the flesh from the other tissues was difficult, but the loss resulting from this was small, so that, though the figures obtained for edible portion represent somewhat less than was actually in the sample, yet the amount thus wasted was doubtless scarcely more than would be left unconsumed at an ordinary table. The reasons for rejecting the skin, which generally has considerable nutritive value, were that its chemical constitution is different from that of the flesh, and that, so far as we have observed in this country, it is not ordinarily eaten. With the closer domestic economy that increased density of population must bring, people will doubtless become more careful hereafter to utilize such materials.

*Sampling.*—The whole edible portion was finely chopped and carefully mixed in a wooden tray.

*Drying.*—The drying was conducted in an ordinary bath at a temperature of nominally 100°, but actually about 96°, as is usual in drying-baths which consist of an air chamber with double walls inclosing boiling water. In each case two portions were dried, one, "A," in a current of hydrogen, and one, "B," in air.

*Drying in hydrogen.*—From 50 to 100 grams, in most cases preferably, 100 grams, of the freshly-chopped substance was weighed on a watch glass or small sauce-plate, dried in a current of hydrogen at 96° for 24 to 48 hours, cooled, allowed to stand in the open air for some 24 hours, weighed, ground, sifted through a sieve with circular holes of $1^{mm}$ diameter, bottled, and labeled "A." A few of the fattest samples, however, could not well be worked through so fine a sieve; for these, either a coarse sieve was used or the substance was crushed as finely as practicable, and bottled without sifting. For the complete drying, from 1 to 2 grams of "A" were weighed in small drying flasks, and dried in hydrogen three or four hours. It is extremely difficult to get an absolutely constant weight, though we find that the object is in most cases approximately attained in three hours. The total moisture and dry substance are computed from the two dryings.

*Drying in air.*—As the drying of large quantities in hydrogen was less convenient, and drying in air suffices perfectly well for certain determinations, particularly sulphur, phosphorus, and chlorine, a sufficient quantity of material for the work was insured by drying a portion in air. This was effected by weighing 200 grams or more of the freshly-chopped substance at the same time that the portion was taken for drying in hydrogen, drying in air, exposing to air of room, weighing, grinding, and bottling as above, this portion being labeled "B." The amount of water-free substance in "B" was calculated from the data obtained for "A."

*Proximate ingredients by direct determination.*—In a number of the samples, determinations were made of the ingredients soluble in cold and in hot water, and of the portion not dissolved by water, alcohol, or ether.

The objects of the determinations were to obtain data comparable with those of other investigations*, and to test the methods, as well as to learn the amounts of the ingredients. The methods have proved unsatisfactory in many respects, and we have felt it advisable to make no more determinations by them than are indicated in the tables, until the subject is worked up more thoroughly. For that matter, an at all satisfactory examination of the proximate constituents will naturally involve determinations of both the total amounts and the ultimate composition of the ingredients of the juices, as well as solids, of the flesh. Considering the complicated character of these compounds, the vagueness of our present knowledge regarding them, and the amount of preliminary work that is

* *E. g.*, Almen, *Analyse des Fleisches einiger Fische* (*Nova Acta Reg. Soc. Sc. Ups., Ser. III*), *Upsala*, 1877.

always necessary before such an investigation can be got into good running order, and adding to all this the importance of studying the mineral ingredients, it is clear that a great deal of labor will be necessary to reach the desired results.

*Cold-water extract.*—Of the freshly-chopped substance 33⅓ grams were digested for 18 to 24, generally about 20, hours, in 500$^{cc}$ of cold water, and filtered.

The filtration was conducted at first through "coffee filter paper." Later Messrs. Woods and Beamer found it better to use fine linen cloth, which has the advantages of more rapid filtration and of allowing the liquid to be squeezed through with proper care. The solids do not pass through the cloth more than through the filter paper, and by laying on a glass plate, scraping, and subsequent rinsing, they are separated much more easily and completely than they can be from the filter paper.

*Albumen.*—The filtrate thus obtained was boiled and filtered through previously dried and weighed asbestos filters. After washing with ether, the filter, with its contents, was dried and weighed. That this method for determining the albumen is accurate, is by no means proven or even probable. But we find that treatment with acid, as acetic acid, in the ordinary way, instead of increasing the amount coagulated is very apt to hinder coagulation and sometimes to prevent it altogether, while boiling the extract alone invariably produces coagulation. Very likely precipitation by alcohol, ferric acetate, or otherwise, might insure more complete separation of the albumen.

*Extractive matters.*—The filtrate from the coagulated albumen was evaporated in platinum capsules and weighed. One sample was used for determination of the ash, which was done by charring at a low temperature, extracting with water, igniting the residue until it was well burned, adding the water solution, evaporating, igniting carefully at a low temperature, and weighing. The other sample was finely ground, dried in air to determine the percentage of water, and extracted with ether until free from fat, usually two or three hours. The crude extract, minus the water, fat, and ash, is reckoned as pure extract, and is designated in Tables I and II as "Extractive matters." It of course contains any albumen which may not have been coagulated, the other nitrogenous compounds, the carbohydrates, and whatever else, except fats and mineral matters, was taken from the flesh of the fish by the digestion in cold distilled water.

*Hot-water extract—"gelatin."*—The residue left after the extraction with cold water was treated for 18 to 24 hours, generally about 20 hours, with distilled water at 100° or slightly below. It was then filtered through weighed asbestos filters, and the filtrate evaporated to dryness in platinum, and weighed as crude gelatin. In this, fat and ash were determined, and the pure extract called in the tables "gelatin," estimated as in the cold-water extract. It should be stated that in both hot and cold water extracts the figures for total extract in the tables represent water-free substance, *i. e.*, crude extract minus water. I am inclined to think it would be better to determine both water and fat in the crude extracts in one operation by extracting with ether and noting the loss.

*Insoluble protein.*—The residue left after the extraction with hot water was treated with alcohol or ether, or both, dried and weighed. Water, ash, and fat were then determined (except, of course, that fat was not determined in the cases where it had been previously extracted). The ash was determined by direct burning, it being assumed that the previous treatment with cold and hot water had sufficed to remove the easily fusible and volatile salts. The removal of the last portions of fat is often extremely difficult, and it is not impossible that in some cases traces were left and weighed as insoluble protein. The figures for total insoluble protein in the table denote water-free substance.

*Ether extract, fats.*—From 0.3 to 1.0 gram of "A" (hydrogen dried) was extracted with ether until free from fat. The operation was conducted in an apparatus similar to that described by Johnson* (*Am. Jour. Sci.*, XIII, 1877, p. 190). The fat obtained was dried in a current of hydrogen before weighing.

*Nitrogen* was estimated by the soda-lime process. Some study has been made in this laboratory of the conditions under which this method gives accurate results, especially with materials rich in nitrogen, the outcome of which may be reported elsewhere. It will suffice here to say that we find it important to have the substance well ground and mixed with the soda-lime and to insure complete ammonification of the nitrogen in the decomposition products. This last we attempt to secure by a sufficiently long anterior layer of soda-lime, preferably in coarse particles, high enough heat and rather slow burning.

The correctness of the determinations of nitrogen was tested by comparative trials by the absolute method. In this latter, two sources of error, often neglected, were taken into account, namely, the air which adheres to the interior of the tube and its contents even after long exhaustion with the Sprengel pump, and the vapor tension of the caustic potash solution over which the nitrogen is collected and measured in the eudiometer.

To determine the correction for residual air in the combustion tube, blank determinations were made with pure oxalic acid. The tube was well exhausted, the mercury being allowed to run three-quarters of an hour after the "click" was heard, before the combustion was begun. The amounts of gas obtained in four combustions were, when reduced to 0° and 760$^{mm}$, 0.3$^{cc}$, 0.6$^{cc}$, 0.5$^{cc}$, and 0.6$^{cc}$, averaging 0.5$^{cc}$, which amount was deducted from the volume of gas obtained in each determination.

It is common to disregard the vapor tension of the caustic potash solution, especially when the latter is nearly concentrated. In accurate work, however, this is hardly allowable. Even a 50 per cent.

* The same as that described by Tollens, *Fres. Zeit. Anal. Chem.*, 17, 1878, s. 320.

solution gives an appreciable vapor tension, as has been shown by Wüllner (Pogg. Annalen 110, S. 570). Wüllner's statements are not perfectly clear at first reading, but the facts appear from his formula for the tension, $V = .0032T - .00000432T^2$, where V is the decrease of tension for every part of "pentahydrate of potash" to 100 of water (0.51 $K_2O$ to 100 $H_2O$.) and T the vapor tension of pure water. Several determinations of the vapor tensions of the solutions actually used were made by my friend and assistant, Dr. J. H. Long, who has devoted considerable attention to these subjects, and who conducted the investigation here referred to. The results were in harmony with Wüllner's formula.

Applying both corrections for residual air, Dr. Long obtained, in determinations of nitrogen in several samples of fish, results agreeing very closely with those obtained with the soda-lime method by Messrs. Woods and Beamer, as appear from the following figures:

| | Soda-lime method. | | | Absolute method. |
|---|---|---|---|---|
| | a. | b. | Average. | |
| XLII. Per cent. N | 5.82 | 5.88 | 5.85 | 5.95 |
| XLIII. Per cent. N | 10.77 | 10.75 | 10.76 | 10.76 |
| XLV. Per cent. N | 13.85 | 13.79 | 13.82 | 13.91 |
| XLVII. Per cent. N | 10.19 | 10.24 | 10.22 | 10.22 |
| XLVIII. Per cent. N | 11.91 | 11.89 | 11.90 | 11.05 |
| L. Per cent. N | 11.85 | 11.85 | 11.85 | 11.78 |
| LI. Per cent. N | 10.85 | 10.83 | 10.84 | 10.83 |
| LIII. Per cent. N | 14.84 | 14.86 | 14.85 | 14.87 |

It may be added that previous comparative trials with ammonium sulphate and oxalate had given closely concordant results. Thus, Dr. Long found by the absolute, and Mr. Woods by the soda-lime method, the following percentages of nitrogen*:

| | Absolute method. | | | | | Soda-lime method. | | |
|---|---|---|---|---|---|---|---|---|
| | a. | b. | c. | d. | Average. | a. | b. | Average. |
| Ammonium sulphate | 21.24 | 21.16 | 21.29 | 21.25 | 21.23 | 21.18 | 21.17 | 21.18 |
| Ammonium oxalate | 19.84 | 19.75 | 19.71 | ........ | 19.77 | 19.68 | ...... | 19.68 |

*Ash.*—The ash was determined in the flesh in the same way as in the hot and cold water extracts, namely, by charring, extracting with water, burning the residue, adding the solution to the residue, evaporating and burning. The crude ash thus obtained was practically free from coal, and had, naturally, no sand. No determinations of carbonic acid in the ash were made. About 5 grams of substance were used for each deter-

*It may be worth while to add that direct determinations of ammonia by distillation with caustic alkali gave in the ammonium sulphate, 21.19, 21.21, and 21.22%, average 21.21%; with ammonium oxalate, 19,78 and 19,74%, average 19.76%, results midway between those by the two methods above.

mination. "B" (the air dried material) was employed for determination of ash, as well as for those of phosphorus, sulphur, and chlorine.

*Phosphorus.* (*Phosphoric Acid.*)—About 1 gram of substance was carefully burned in a platinum capsule, with some 10 grams of a mixture of equal parts of sodium nitrate and carbonate, previously proven free from phosphates. The white mass was dissolved in water, acidulated with nitric acid, evaporated, and treated with nitric acid again, the operation repeated when necessary to remove chlorine, and the phosphoric acid estimated with ammonium molybdate solution. A number of tests were made by Mr. Merrill to determine the circumstances in which phosphoric acid, in presence of large amounts of sodium nitrate, as here, is completely precipitated. The results will, I hope, be published hereafter. In brief, at the temperature of the trials, which in each case was not far from 29°, two precautions are necessary: use of a large excess of molybdate solution, and allowance of ample time for the precipitation. Neglect of these involves risk of loss of phosphoric acid, as is shown by the following brief recapitulation of results. The effect of higher temperature was not tested.

| Time of precipitation and amount of molybdic solution used. | 12–20 hours; 25cc. | | 36 hours; 25cc. | | 36 hours; 50cc. | |
|---|---|---|---|---|---|---|
| | *a* | *b* | *a* | *b* | *a* | *b* |
| 10cc $Na_2HPO_3$ Solution with no $NaNO_3$ yielded $P_2O_5$, grms. | .0212 | .0211 | | | | |
| 10cc $Na_2HPO_3$ Solution with 5 grms. $NaNO_3$ yielded $P_2O_5$, grms. | .0211 | .0212 | | | | |
| 10cc $Na_2HPO_3$ Solution with 10 grms. $NaNO_3$ yielded $P_2O_5$, grms. | .0207 | .0211 | .0211 | .0211 | .0213 | .0212 |
| 10cc $Na_2PHO_3$ Solution with 20 grms. $NaNO_3$ yielded $P_2O_5$, grms. | .0190 | .0191 | .0211 | .0211 | .0212 | .0211 |

Practically we use 25cc of molybdic solution, and allow 36 to 48 hours for the precipitation.

*Sulphur.*—About 1 gram of substance is oxidized as for determination of phosphorus, the mass dissolved in hydrochloric acid, and the sulphuric acid determined with barium chloride. Quite an extended series of determinations were made to learn the effect of varying quantities of sodium chloride upon the precipitation of barium sulphate in solutions, hot and cold, concentrated and dilute. The details, which the limits of this article compel me to defer for subsequent publication, showed conclusively that, although when precipitated cold from concentrated solutions, the barium sulphate is apt to be too heavy, *i. e.*, to bring down sodium chloride; yet, when precipitated hot, or even precipitated cold from dilute solutions, it is pure. This is in accordance with the previous observations on which general practice is based. Our determinations served simply to show the limits of concentration and amount of sodium chloride within which it is safe to work. It should be noted, however, that the solutions contained in all cases a small, but only a small, amount of free hydrochloric acid, and that only a small excess of barium chloride was used in the precipitation. Practically, we find the ordinary method as recommended by Fresenius accurate for these determinations, even in presence of the large amounts of sodium chloride, provided the proper precautions are observed. But the solution must be sufficiently dilute, and excess of free acid and of barium chloride should be avoided.

*Chlorine* was determined by burning the substance in platinum evaporating dishes, as in the determinations of phosphorus and sulphur, and estimating the chlorine in the fused mass with ammonium sulphocyanate by Volhard's process. Dr. Long, by whom the determinations were made, has, at my request, made tests of the applicability of this method of determining chlorine in animal tissues.

Ten parts of a mixture of equal weights of sodium carbonate and potassium nitrate were used to each part of the substance for the oxidation. To test the conditions in which chlorine may be lost in the burning, experiments were made with sugar and sodium chloride intimately mixed. Allowing for the very small amounts of chlorine in the sugar, it was found that when the oxidation was conducted slowly and carefully the whole of the chlorine was, in each of four trials, recovered; but with rapid burning in four trials from 1.0 to 2.7 per cent. of the whole chlorine was lost. But while no appreciable amount of chlorine escapes in careful burning there is apt to be great loss of it if its determinations in the fused mass is attempted in the ordinary way by dissolving, precipitating with silver nitrate and weighing as silver chloride. Indeed, Dr. Long found that in some cases less than half as much chlorine was obtained by the gravimetric methods as by Volhard's process.

The method actually followed in the determinations was as follows:

1st. The substance was *slowly* fused with the mixed nitrate and carbonate so as to avoid any possible loss by spurting.

2d. The fused mass was dissolved in quite dilute nitric acid, since by using a stronger acid some chlorine could easily be driven off, as was found by experiment.

3d. To the solution thus obtained an excess of silver nitrate solution was added, and the whole boiled on the water bath for about two hours. This long boiling with excess of nitric acid, added after the silver nitrate, was necessary to expel nitrous acid coming from the reduction of the nitrate in the fusion.

4th. After the boiling, the solution was allowed to become quite cold before titrating.

# PART II.

## ANALYSES OF INVERTEBRATES,

BY C. D. WOODS, B. S., AND MILES BEAMER, C. E.

[The following analyses have been undertaken and reported, at my suggestion, by Messrs. Woods and Beamer, who have also shared in the analyses of fish above described.

Thanks are due to Mr. F. T. Lane, of New Haven, Conn., and Mr. J. F. Ely, of Baltimore, Md., and especially to Mr. E. G. Blackford,* Fish Commissioner of the State of New York, for samples furnished for analysis, and for valuable information.—W. O. A.]

### DESCRIPTION OF SAMPLES.

In the descriptions as well as in the tables which follow the samples of each species are arranged in the order of locality, the most northern coming first.

### OYSTERS (*Ostrea Virginiana*).

No. LXVIII. From *Buzzard's Bay, Mass.*

Received from Messrs. Bunting and Warren, Newton, Mass., May 5, 1881. They were of medium size. The relative amount of edible portion (flesh and liquids) as compared with shell was large, 20.01 per cent. Only one sample of all gave a larger percentage of edible material than this.

No. LXX. From *Providence River, Rhode Island.*

Received at the same time and from the same parties as No. LXVIII. They were larger than the average oyster even of our northern coast, but with this larger size of shell there was relatively less edible portion, 17.00 per cent.

No. LV. From *Stony Creek, Conn.*

Purchased, April 5, in Middletown, but originally obtained from the Stony Creek Oyster Company. These were very large, the length averaging not far from 6 inches. There were 39 in one peck.

No. LXXV. From *Stony Creek, Conn.*

Purchased in Middletown, May 24, 1881. The analysis of this second sample from the same locality as the previous one was suggested by the claim of the oystermen that the oysters at this time were much better than they had been earlier in the season. The analysis shows very little difference in composition, No. LXXV containing relatively less nitrogen and more fat. The percentages of water were: in No.

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* A portion of the expense of the investigation was also borne by Mr. Blackford, as stated in the introduction to the present report.

LV, 90.04; No. LXXV, 90.89. Calculated on dry substance, the analysis of edible portion is as follows:

| | Albuminoids. | Fat. | Ash. | Nitrogen. |
|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| No. LV | 34.76 | 3.55 | 48.50 | 5.57 |
| No. LXXV | 32.89 | 3.99 | 48.93 | 5.27 |

Of course the relation between composition and quality of oysters cannot be determined by two analyses. An extended series of observations might bring very interesting results.

No. LIV. *Fair Haven, Conn.*

Purchased, April 4, 1881, in Middletown. They were described as "natives," from H. C. Rowe & Co., Fair Haven, Conn., and had been dredged three days. There were thirty-three oysters in one-half peck.

No. LVI. *Blue Point,* from *Patchogue, L. I.*

Furnished, April 8, 1881, by Mr. E. G. Blackford, Fulton Market, New York City.

No. LVIII. From *Rockaway, L. I.*

Furnished, April 12, 1881, by Mr. Blackford.

No. LVII. *East River,* from *Cow Bay, L. I.*

Furnished April 8, 1881, by Mr. Blackford.

No. LX. "*Sounds,*" from *Princes' Bay, Staten Island.*

Furnished by Mr. Blackford, April 20, 1881.

No. LXI. *Shrewsbury, N. J.*

Furnished, April 20, 1881, by Mr. Blackford.

No. LIX. *Virginias,* from *Norfolk, Va.*

Furnished, April 12, 1881, by Mr. Blackford.

No. LXXIII. *Virginias Transplanted* (to New Haven, Conn.).

Furnished by Mr. F. T. Lane, New Haven, Conn., May 16, 1881. In an accompanying letter, Mr. Lane says: "From James River, Virginia, and what we consider the best stock to plant, * * * have been planted here five weeks."

No. LXXII. *Virginias Transplanted* (to New Haven, Conn.).

Received as No. LXXIII. In an accompanying letter Mr. Lane says: "Are from Rappahannock River, Virginia, and are what we use mostly for winter and spring. They have been planted here three weeks, and taken up into a river where the water is quite fresh, and put into floats for forty-eight hours to fatten them."

No. LXXI. *Virginias Transplanted* (to New Haven).

Received as Nos. LXXIII and LXXII. Mr. Lane writes: "Are from the Potomac River, Virginia, and are the cheapest of anything that we get from the South. They have been planted here three weeks."

No. LXXIV. "*Cove*" or *Canned Oysters.*

Furnished by Mr. J. F. Ely, Baltimore, Md., May 24, 1881. In an accompanying letter, Mr. Ely says: "The oysters we *steamers* use are gathered from all points on the Chesapeake Bay and mouth of the Potomac River. There is no agency but heat applied in their preparation." We received as samples two cans, one half-pound and one pound can. The former conained 36, the latter 77 oysters.

SCALLOPS (*Pecten irradians*).

No. LI. *Shelter Island, N. Y.*

Furnished by Mr. Blackford, March 15, 1881. The sample consisted not of the whole scallop, but of the part usually eaten—the adductor muscle—and, of course, contained no refuse.

No. LXIII. *Shelter Island, N. Y.*

Furnished by Mr. Blackford, April 26, 1881.

LONG CLAMS (*Mya arenaria*).

No. LXVII. *Boston Harbor, Mass.*

Received from Messrs. Bunting & Warren, May 5, 1881.

No. LXV. *Napaug, L. I.*

Purchased in Middletown, April 28, 1881.

ROUND CLAMS (*Venus mercenaria*).

No. LXVI. *Little Neck, L. I.*

Purchased in Middletown, April 28, 1881.

LOBSTER (*Homarus americanus.*)

No. L. *Maine.*

Sample—two lobsters—furnished by Mr. Blackford, March 15, 1881. In separation of edible and refuse the weights of flesh, liquids, refuse, and loss in cleaning in the different parts of each animal were determined as follows:

| | A. | B. |
|---|---|---|
| | *Grams.* | *Grams.* |
| Whole lobster | 870.0 | 1,103.0 |
| Flesh in claws | 152.5 | 219.5 |
| Flesh in tail | 138.0 | 131.0 |
| Flesh in body | 118.5 | 127.5 |
| Liquids in whole sample | 54.4 | 94.8 |
| Waste in whole sample | 367.8 | 499.5 |
| Loss in cleaning sample | 38.8 | 30.7 |

The liquids in all the lobsters on being exposed to the air quickly gelatinized, and were put with the flesh for analysis.

No. LXII. *Maine.*

Furnished by Mr. Blackford, April 26, 1881.

No. LXIX. *Boston Bay, Mass.*

Received from Messrs. Bunting & Warren, May 5, 1881.

No. LXXVI. *Canned Lobster.*

Purchased in Middletown, May 26, 1881. The can was labelled "Thurber's Egmont Bay Fresh Lobster," H. K. & F. B. Thurber & Co., New York City. In a letter Messrs. Thurber & Co. say: "Sample was packed by Castine (Maine) Packing Company. The sample consisted of a pound can, the contents weighing 469.5 grams, or 1 pound 0.5 ounce.

CRAY FISH (*Cambarus*).

No. LXIV. *Potomac River, Virginia.*

Furnished by Mr. Blackford, April 26, 1881. The animals were whole, but only the tails were used for analysis, as this is the portion ordinarily eaten.

The weights of the different portions in the whole 21 samples were:

| Cray fish, entire. | Grams. |
|---|---|
| Tails | 170.6 |
| Bodies | 508.0 |
| Loss in cleaning | 10.4 |
| Total | 695.0 |
| TAILS. | |
| Edible portion | 85.5 |
| Refuse | 83.8 |
| Loss in preparing for analysis | 7.0 |
| Total | 170.6 |

Thus while the edible portion makes nearly 50 per cent. of the part taken for food, it is only 12.3 per cent. of the whole animal.

PREPARATION OF SAMPLES FOR ANALYSIS.

The oysters were, with the exception of the "cove" or canned oyster, all received in the shell. All adhering foreign matters—as mud, sea-weed, hydroids, gasteropods, &c.—were removed by thorough washing. The oysters were then allowed to drain, wiped, and weighed. The weighed oysters were opened, the liquid thus escaping being caught in a large evaporating dish. The oysters after being opened were put upon a porcelain colander ("crystal drainer"), and allowed to drain into a beaker. In this way some very small particles of solid matter would probably be added to the filtrate. For the purposes of analysis we have called the part remaining upon the perforated dish "flesh," and the filtrate "liquids." The flesh and liquids in the cove oyster were separated in the same way. After this separation the flesh was chopped in an ordinary wooden tray till the sample was quite fine, and evenly and thoroughly mixed, as was done with the samples of fish reported by Professor Atwater.

In the scallops we have analyzed only the part usually eaten, viz, the muscle (*adductor*) that holds the shell together. They came from the market all ready for cooking, and were analyzed just as received, the flesh being chopped and sampled in the same way as that of the oyster.

The clams were prepared in the same way as the oysters, except that in the long clam the black "mantle" was added to the refuse. In the case of the lobsters and crayfish the flesh was carefully separated from the shell and prepared as above. For parts taken for analysis see "Description of Samples" above.

In all of the samples a portion, usually about 100 grams, of the chopped flesh was dried in hydrogen and prepared for analysis in the same manner as the hydrogen dried samples (A) of fish described by Professor Atwater in "Methods of Analysis."

The liquids were evaporated on a water bath and then dried in air, as the samples of fish designated as "B."

## METHODS OF ANALYSIS.

The methods of analysis were the same that have been employed in this laboratory and described by Professor Atwater above. We are indebted to Dr. J. H. Long for the determinations of chlorine in all the samples.

## DESCRIPTION OF TABLES.

In all the tables the arrangement of samples is the same, and in order of locality, the more northern coming first. The canned oysters and lobsters are not included in the averages.

### TABLE V.

In the second column is given the date of receipt of each sample at the laboratory. In most cases they had been taken from the water two or three days before they were received by us. As will be seen in the third column, the number taken for analysis was always large in order to obtain a fair sample. In the fourth column are given the total weights of the samples taken for analysis, and in the fifth are the average weights of the animals. Details as to the proportions of shell, flesh, liquids, total edible portion, &c., in the several samples of oysters and of other invertebrates are given under the heading "In whole sample." Thus the 48 oysters in the sample from Norfolk, Va., weighed together 6,635.5 grams (14 pounds 9 ounces), and averaged 138.3 grams (4.9 ounces). Of the total weight, 11.2 per cent. consisted of "edible portion" (solid and liquid), the remaining 88.8 per cent. being reckoned as "refuse" (88.3 per cent. shell, and 0.5 per cent. matters lost in preparing for analysis), while of the total weight of the 33 oysters in the sample of Blue Points, 20.3 per cent. was edible portion, the rest being shell, &c.

In an article published in *Land and Water* and reprinted in *The Sea World* of November 10, 1880, Mr. Frank Buckland gives some determinations of the relative proportions of flesh and shell in different samples of oysters. But as he takes only three oysters for the basis of his percentages in each, and does not weigh nearer than one-fourth ounce, his estimates can be regarded as only approximate for the samples examined. We may also add that we have found as great differences in different oysters from the same sample as he finds in oysters from different localities. It was in order to obviate as far as possible this source of error that we have taken such a large number of oysters in each sample. The only American oyster Mr. Buckland notices is one from East River, New York, laid at Beaumarais, North Wales. In this he finds the proportion of flesh to shell one to ten.

The figures for "Flesh" denote the percentages of solids or "meat" those under "liquids" the liquid portion, "liquor" in the sample. The solids and liquids together are designated as "edible portion," which, with "refuse" and "loss in cleaning," make up the whole sample.

Under the heading "In Flesh" are given the percentages of water and dry substance in the flesh. After these follow the same percentages for liquids and for the whole edible portion.

Some explanation may be needed of the way in which these calculations have been made. For example, in obtaining the figures in the column headed "water" in total "edible portion", the percentages of flesh and of liquids in the total edible portion were multiplied each by its percentage of water as given in the table, the two products added and their sum divided by the sum of the percentages of flesh and liquids, the quotient being the percentage of water in the edible portion. The calculation for the Buzzard's Bay oyster is as follows:

$$\frac{(12.50 \times 84.21) + (7.51 \times 96.40)}{20.01} = 88.78.$$

The last three columns, "dry substance of flesh," "dry substance of liquids," and "dry substance of edible portion" are obtained by multiplying the percentage of each in the whole sample by its percentage of dry substance.

TABLE VI.

This table gives the figures for the dry substance in the flesh and in liquids. The only columns needing any explanation are those of albuminoids, phosphorus, and sulphur. The per cent. of "albuminoids" is obtained by multiplying the nitrogen by the factor 6.25. The phosphorus and sulphur are calculated as phosphoric and sulphuric anhydrides. The last division of the table "in flesh and liquids" is calculated as in Table V, already explained.

TABLE VII.

In the first section of Table VII the analyses of Table VI are calculated over to "fresh substance." By fresh substance are here meant the flesh and liquids as they were after the separation described under

"Preparation of Sample" above. The percentages in the column headed "extractives" are obtained by difference. That is, the albuminoids (as computed by multiplying nitrogen by 6.25), fats, and ash are added and their sum subtracted from the total dry substance. Though this method of computation is common in statements of the composition of animal and vegetable foods it is of course only a convenient and approximately accurate way of getting over the difficulty of determining and stating exactly the amounts of the several ingredients. It will be noticed that "extractives" as thus determined by difference are not the same as the "extractive matters" of the tables of analyses of fish.

The most important column from an economic point of view is the one headed "nutritive valuation." The calculations are based upon the standards assumed by König, and explained by Professor Atwater. Their valuations, though not absolute, are doubtless sufficiently accurate for purposes of comparison.

PREVIOUS ANALYSES OF INVERTEBRATES.

But very little work has been done hitherto in the way of analyses of invertebrates. In the very full compilation of analyses of this sort, given by König (*Nahrungsmittel* I. 17), one of a sample of oyster and one of the salt flesh (salted in brine) of a crustacean ("*Krebsfleisch, eingemacht*") are recorded, both analyses being by König and Kraut. The analyses are given below. Mr. R. H. Chittenden has reported analyses of two samples of American scallops (*Pecten irradians*) with results as appended, except that in the figures herewith the percentages of albuminoids have been, for reasons above stated (see Methods of Analysis), recalculated by multiplying the nitrogen by 6.25 instead of 6.4, the factor employed, perhaps more justly, by Mr. Chittenden. The extractives are estimated by difference, as explained above.

| | Water. | Albuminoids. | Fats. | Extractives. | Ash. |
|---|---|---|---|---|---|
| | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. |
| Oyster; European* | 89.69 | 4.95 | 0.37 | 2.62 | 2.37 |
| "*Krebsfleisch*," European | 72.74 | 13.63 | 0.36 | 0.21 | 13.06† |
| Scallop, American | 79.63 | 15.31 | 0.31 | 3.49 | 1.26 |
| Scallop, American | 80.25 | 14.69 | 0.28 | 3.55 | 1.23 |

* The analysis of the oyster included the total shell contents.
† "Of the ash of the *Krebsfleisch*" 11.98 per cent. was sodium chloride.

## PART III.

## GENERAL SUMMARY OF RESULTS OF ANALYSES OF FISH AND INVERTEBRATES.

The object of the present investigation has been to obtain information as to both the chemical constitution of the flesh of the animals investigated and their economic values especially for food.

The work thus far accomplished must be regarded as barely a beginning. I hope to be able to prosecute it further in both the directions named. Meanwhile it may be proper to consider some of the results already attained.

I do not yet feel prepared to enter upon the discussion of the chemical constitution of the flesh, and will therefore confine myself to the more practical question of the economic values of the samples analyzed, reserving the more abstract subject until satisfactory data shall have been obtained.

COMPARATIVE STATISTICS OF SAMPLES OF FISH.

It will facilitate a comparison of the composition of the different samples analyzed if we select some of the figures from the tables and place them in more convenient juxtaposition.

Considered from the standpoint of the food value, fish, as we buy them in the markets, consist of—

1. Flesh or edible portion.
2. Refuse—bones, skin, entrails, &c.

In Table I, under "Proportions of flesh and refuse" are given the percentages of flesh and refuse in the samples as received from the markets. As explained above, there was a slight but unimportant loss of flesh, owing to the difficulty of separating it from the skin, bones, &c. Below are some of the percentages of refuse:

*Proportion of refuse—bone, skin, entrails, &c.*

| Kind of fish and portion taken for analysis. | Number of sample. | Per cent. of refuse, individual samples. | Averages of duplicate samples. |
|---|---|---|---|
| | | *Per cent.* | *Per cent.* |
| Halibut, section of body | IX | 11.72 | |
| Halibut, posterior part of body | I | 24.08 | 17.90 |
| Salmon, entrails removed | XIV | 23.84 | |
| Cod, head and entrails removed | XI | 31.87 | |
| Cod, head and entrails removed | III | 35.43 | 33.65 |
| Mackerel, whole | XXXIX | 35.35 | |
| Mackerel, whole | VIII | 30.45 | |
| Mackerel, whole | XXX | 49.69 | |
| Mackerel, whole | XIII | 54.30 | 44.69 |
| Shad, whole | XXXII | 47.20 | |
| Shad, whole | X | 47.65 | |
| Shad, whole | VI | 51.60 | 48.85 |
| White perch, whole | XLIV | 59.50 | |
| White perch, whole | XLVI | 63.76 | 61.63 |
| Striped bass, whole | VII | 57.91 | |
| Striped bass, whole | XIX | 58.49 | 58.20 |
| Porgy, whole | XXXI | 58.19 | |
| Porgy, whole | XV | 61.66 | 59.93 |
| Flounder, entrails removed | II | 58.67 | |
| Flounder, whole | XXII | 68.03 | |

Next to the halibut, the salmon had the least waste and most flesh. Then follow salt cod, salt mackerel, fresh cod dressed, &c.; while striped bass, porgy, and flounders end the list with the largest waste and least flesh of all. It is, of course, to be understood that the variations in individual samples of the same fish are so wide as to make a much larger number of determinations necessary to give us fair averages and allow satisfactory generalizations.

The proportions not only of flesh, but also of water and solids in the flesh differ widely in the different samples, as will be seen in the tables. Thus, in the third and fourth columns of Table II we find that the flesh in the samples of flounder contained from 83 per cent. to 85 per cent. of water, and only from 17 per cent. to 15 per cent. of dry substance, solids; while in the fat shad, mackerel, and salmon we have from 65 per cent. to 63 per cent. of water, and from 35 per cent. to 37 per cent. of dry substance. Below the samples of fish are arranged in the order of their percentages of dry substance in flesh.

*Proportion of dry substance in flesh, edible portion.*

| | Number of sample. | Per cent. of dry substance in individual samples. | Averages of duplicate samples. |
|---|---|---|---|
| | | *Per cent.* | *Per cent.* |
| Salmon (California), fat | XXVII | 39.4 | |
| Salmon (eastern) | XIV | 33.6 | 36.4 |
| Canned salmon | XXIX | 34.0 | |
| Salmon trout | XVII | 33.2 | |
| Herring | XLVII | 32.8 | |
| Spanish mackerel | XLIII | 32.8 | |
| Shad | X | 35.5 | |
| Shad | VI | 30.7 | |
| Shad | XXXII | 29.4 | 31.8 |
| White fish | XVIII | 29.9 | |
| Turbot | XLIX | 29.9 | |
| Eels | IV | 29.5 | |
| Sheep's-head | XLVII | 28.5 | |
| Mackerel, very fat | XXXIX | 37.3 | |
| Mackerel | XXX | 26.3 | |
| Mackerel | XIII | 25.8 | |
| Mackerel, lean | VIII | 21.4 | 27.7 |
| Halibut, very fat | IX | 30.7 | |
| Halibut | I | 20.7 | 25.7 |
| Muskallonge | XLV | 24.7 | |
| White perch | XLIV | 24.9 | |
| White perch | XLVI | 24.1 | 24.5 |
| Alewives | V | 24.2 | |
| Porgy | XXXI | 23.1 | |
| Porgy | XV | 23.3 | 24.2 |
| Black fish | XXXVIII | 23.8 | |
| Red snapper | XX | 23.6 | |
| Red snapper | XXVI | 23.0 | 23.3 |
| Spent salmon, male | XXXV | 24.7 | |
| Spent salmon, female | XXXVI | 21.7 | 23.2 |
| Brook trout | XXIV | 22.9 | |
| Black bass | LIII | 22.2 | |
| Blue fish | XII | 21.8 | |
| Spent land-locked salmon, male | XL | 21.6 | |
| Spent land-locked salmon, female | XLI | 20.5 | 21.1 |
| Striped bass | VII | 21.4 | |
| Striped bass | XIX | 20.9 | 21.2 |
| Yellow pike-perch | LII | 20.4 | |
| Smelt | XXIII | 20.3 | |
| Haddock | XVI | 19.4 | |
| Haddock | XXI | 18.2 | 18.7 |
| Cod | XI | 17.5 | |
| Cod | III | 17.0 | 17.3 |
| Flounder | II | 17.1 | |
| Flounder | XXII | 15.2 | 16.2 |

Thus the flesh of flounder had 85 per cent. of water and only 15 per cent. of solids, while that of salmon contained 36½ per cent. of solids and 63½ per cent. of water, and the flesh of dried, smoked, and salt fish have still less water. Among the more watery kinds of fish are the flounder, cod, striped bass, and blue fish. Among those with less water and more solids are mackerel, shad, salmon, and salt and dried fish. The flesh of fish generally, though not always, contains more water than ordinary meats, as may be seen in Table VIII beyond.

Since neither the refuse, bones, entrails, &c., nor the water in the flesh have any food-value, the actual nutritive material of the fish is, of course, the dry substance of the flesh. To find the actual nutritive substance in a sample of fish we must first subtract the waste—the entrails, bones, skins, &c.—which leaves the flesh. We must then allow for the water in the flesh. What remains will be the total edible solids or actual nutrients in the sample. Thus, the sample of flounder No. II has 32 per cent. of flesh, of which only 15 per cent. is dry substance, so that the edible solids amount to only 15 per cent. of 32 per cent., or about 4.8 per cent. of the whole (as recalculated in Table IV, 4.85 per cent.). That is, 100 pounds of flounder like this sample would furnish only 4¾ pounds of nutrients, the rest being water and refuse. As explained in "Methods of analysis," however, the skin, which is nutritious and frequently eaten, is here reckoned as refuse. Considering, further, the small portions of flesh which could not be conveniently separated from the skin, bones, &c., the figures for the total edible solids are a trifle too small. Still the deficit is inconsiderable, and the figures are doubtless not far from a correct expression of the amounts of nutritive material which the samples would furnish in household use. Below the samples are arranged in the order of the percentages of edible solids.

*Total edible solids, actual nutrients, in 100 pounds of samples as received from markets.*

| Kind of fish and portion taken for analyses. | Number of sample. | Percentages of nutrients, individual samples. | Averages of duplicate samples. |
|---|---|---|---|
| | | *Per cent.* | *Per cent.* |
| California salmon, edible portion of anterior part | XXVII | 39.39 | ........ |
| Salmon, entrails removed | XIV | 26.57 | ........ |
| Smoked halibut | XXVIII | 81.63 | ........ |
| Salt mackerel | XLII | 30.07 | ........ |
| Boned cod, salt | XXV | 30.01 | ........ |
| Canned salmon | XXIX | 29.95 | ........ |
| Smoked herring | XXXIII | 28.66 | ........ |
| Eels, salt water; skin, head, and entrails removed | IV | 22.50 | ........ |
| Halibut, section of body, fat | IX | 27.13 | ........ |
| Halibut, posterior part of body, lean | I | 15.67 | 21.40 |
| Spanish mackerel, whole | XLIII | 20.65 | ........ |
| Salt cod, "boat fish" | XXXIV | 20.99 | ........ |
| Salt cod, "channel fish" | XXXVII | 19.09 | ........ |

*Total edible solids, actual nutrients, in* 100 *pounds of samples, &c.*—Continued.

| Kind of fish and portion taken for analyses. | Number of sample. | Percentages of nutrients, individual samples. | Averages of duplicate samples. |
|---|---|---|---|
| | | *Per cent.* | *Per cent.* |
| Shad, whole | X | 18.56 | |
| Shad, whole | XXXII | 15.51 | |
| Shad, whole | VI | 14.81 | 16.29 |
| Turbot, whole | XLIX | 15.61 | |
| Mackerel, whole | XXXIX | 23.95 | |
| Mackerel, whole | XXX | 13.24 | |
| Mackerel, whole | VIII | 12.97 | |
| Mackerel, whole, lean | XIII | 11.76 | 15.48 |
| Salmon trout, whole, lean | XVII | 14.38 | |
| Whitefish, whole | XVIII | 13.69 | |
| Spent salmon, male, whole | XXXV | 14.87 | |
| Spent salmon, female, whole | XXXVI | 12.17 | 13.52 |
| Muskallonge, whole | XLV | 12.52 | |
| Smelt, whole | XXIII | 12.51 | |
| Sheeps-head, entrails removed | XLVIII | 11.99 | |
| Alewives, whole | V | 11.95 | |
| Herring, whole | XLVII | 11.52 | |
| Cod, head and entrails removed | XI | 11.92 | |
| Cod, head and entrails removed | III | 10.98 | 11.45 |
| Bluefish, entrails removed | XII | 10.96 | |
| Spent land-locked salmon, male, whole | XL | 10.97 | |
| Spent land-locked salmon, female, whole | XLI | 10.74 | 10.86 |
| Brook trout, cultivated, whole | XXIV | 10.77 | |
| Blackfish, whole | XXXVIII | 10.72 | |
| Red snapper, entrails removed | XXVI | 10.87 | |
| Red snapper, whole | XX | 9.33 | 10.11 |
| Porgy, whole | XXXI | 11.73 | |
| Porgy, whole | XV | 7.78 | 9.76 |
| White perch, whole | XLIV | 10.08 | |
| White perch, whole | XLVI | 8.73 | 9.41 |
| Black bass, whole | LIII | 9.57 | |
| Striped bass, whole | VII | 9.01 | |
| Striped bass, whole | XIX | 8.87 | 8.94 |
| Haddock, entrails removed | XVI | 9.07 | |
| Haddock, entrails removed | XXI | 8.68 | 8.88 |
| Yellow pike-perch, whole | LII | 8.46 | |
| Flounder, entrails removed | II | 7.06 | |
| Flounder, whole | XXII | 4.85 | |

Before proceeding further with the discussion of the composition of the samples of fish we may note some of the figures for invertebrates.

### STATISTICS OF THE SAMPLES OF OYSTERS.

The samples of oysters showed much wider variations than might have been anticipated, both in the proportions of edible substance, solid and liquids, to shell and in actual nutritive value.

In Table IV, under the heading "In whole sample," are given the percentages of flesh, liquids, and refuse (shell, &c.), in the samples analyzed. Below the samples are arranged in the order of the percentages of these constituents by weight, those with the largest proportion of each coming first in the category.

*Proportions of flesh, of liquids, and of total shell contents (flesh and liquids) in samples of oysters.*

| Flesh in whole oysters. | Per ct. | Liquid in whole oysters. | Per ct. | Total shell contents in oysters. | Per ct. |
|---|---|---|---|---|---|
| Blue Point | 13.39 | Stony Creek | 11.81 | East River | 20.28 |
| Shrewsbury | 12.64 | Stony Creek | 11.38 | Buzzards Bay | 20.01 |
| Fair Haven | 12.63 | East River | 10.01 | Stony Creek | 19.15 |
| Buzzards Bay | 12.50 | Rockaway | 7.72 | Stony Creek | 18.90 |
| Providence River | 10.88 | Buzzards Bay | 7.50 | Blue Point | 18.62 |
| Rockaway | 10.68 | Rappahannock River | 7.31 | Rockaway | 18.40 |
| East River. | 10.27 | James River | 7.29 | Fair Haven | 18.06 |
| Staten Island | 9.13 | Staten Island | 7.10 | Shrewsbury | 17.52 |
| Rappahannock River | 7.86 | Norfolk | 6.52 | Providence River | 17.00 |
| Stony Creek | 7.52 | Providence River | 6.12 | Staten Island | 16.23 |
| Stony Creek | 7.34 | Potomac River | 5.64 | Rappahannock River | 15.17 |
| Potomac River | 6.51 | Fair Haven | 5.43 | James River | 13.79 |
| James River | 6.50 | Blue Point | 5.23 | Potomac River | 12.15 |
| Norfolk | 4.66 | Shrewsbury | 4.88 | Norfolk | 11.18 |

Thus in the samples from East River, N. Y., and Buzzard's Bay, Mass., the contents of the shells, including both flesh and liquids, "meat" and "liquor," made respectively 20.2 and 20 per cent. of the whole weight, while of the samples from the James and the Potomac the shell contents constituted only 12.2 and 11.2 per cent. of the whole. The East River and Buzzards Bay were one fifth edible matter and four-fifths shell, while in the southern samples the shell contents made only one-eighth of the whole.

The ratios of flesh to liquids were still more variable. The sample of Blue Points had 13.4 per cent. of solids and 5.3 of liquids, while one from Stony Creek had 7.3 per cent. of meat and 11.8 of liquor. Taking the flesh and liquids separately the variation is even greater. The percentages of flesh range from 13.4 in the Blue Points to 4.7 in the Norfolks, the liquids from 11.8 in the Stony Creeks to 4.9 in the Shrewsburys.

None of the above figures, however, give a measure of the actual nutrients in the oysters, since both flesh and liquids consist mostly of water, and the proportions of dry substance which constitutes the actually nutritive portion are extremely variable.

Below the samples are arranged in the order of the percentages of dry substance in flesh, in liquids, and in total shell contents.

*Proportion of dry substance, actually nutritive materials, in flesh, in liquids, and in total shell contents of oysters.*

| In flesh. | Per ct. | In liquid. | Per ct. | In total shell contents, flesh plus liquids. | Per ct. |
|---|---|---|---|---|---|
| Blue Point | 23.76 | Fair Haven | 6.00 | Blue Point | 19.24 |
| Potomac River | 21.13 | Blue Point | 5.67 | Providence River | 15.21 |
| Providence River | 20.99 | Providence River | 4.95 | Fair Haven | 14.88 |
| East River | 20.08 | Rockaway | 4.94 | Shrewsbury | 14.68 |
| Stony Creek | 18.98 | Shrewsbury | 4.93 | Potomac River | 13.40 |
| Rockaway | 18.73 | East River | 4.56 | Rockaway | 13.02 |
| Fair Haven | 18.70 | Potomac River | 4.49 | East River | 12.43 |
| Shrewsbury | 18.35 | James River | 4.09 | Buzzards Bay | 11.20 |
| Stony Creek | 17.91 | Stony Creek | 3.88 | Staten Island | 10.42 |
| Rappahannock River | 17.30 | Stony Creek | 3.67 | Rappahannock River | 10.12 |
| James River | 16.51 | Staten Island | 3.65 | Stony Creek | 9.96 |
| Norfolk | 16.14 | Buzzards Bay | 3.60 | James River | 9.93 |
| Buzzards Bay | 15.79 | Norfolk | 3.17 | Stony Creek | 9.11 |
| Staten Island | 15.53 | Rappahannock River | 2.76 | Norfolk | 8.55 |

Thus in the flesh of the oysters the dry substance varies from 23¾ per cent. in the Blue Points to 15½ per cent. in the Staten Islands. The dry substance in the liquids varies from 5⅜ per cent. in the Blue Points to 2¾ per cent. in the Rappahannocks. The flesh of oysters is quite watery, more so than that of fish and much more than ordinary meats. The dry substance in the latter ranges from about 25 per cent. in lean beef to 50 per cent. in fat pork. In fish we find from 40 to 15 per cent., in the flesh of oysters from 24 to 15 per cent., and in the liquids, from 6 to as low as 2¾ per cent. The liquids contain but very little nutriment.

By comparing the proportions of flesh and liquids and the proportions of actual nutrients in them, we arrive at the figures for the actually nutritive substances in the oysters. Precisely this is done for the whole shell contents in the last of the above categories. The figures there represent the nutrients in the flesh and liquids together; that is, they show the proportions of actual nutrients in the total shell contents of the several samples. The range of variation of the nutrients is very wide, the Blue Points containing 19¼ per cent. and the Norfolks only 8⅓ per cent. In general, the Northern samples are the richest and the Southern the poorest in nutritive material. The mean of all the samples is not far from 14 per cent., a little above that of cow's milk, which averages about 12½ per cent. of dry substance.

If, however, we place the oysters in the order of the percentages of nutritive materials in the whole sample, including shell and contents, the arrangement will be as below. The other invertebrates are appended for comparison.

*Percentages of nutritive materials in whole sample, including shell and shell contents.*

| | Per cent. | | Per cent. |
|---|---|---|---|
| Oysters, Blue Point | 3.37 | Oysters, Staten Island | 1.63 |
| Oysters, Fair Haven | 2.69 | Oysters, Potomac River | 1.68 |
| Oysters, Providence River | 2.58 | Oysters, Rappahannock River | 1.56 |
| Oysters, Shrewsbury | 2.55 | Oysters, James River | 1.37 |
| Oysters, East River | 2.53 | Oysters, Norfolk | 0.96 |
| Oysters, Rockaway | 2.38 | Long clams | 7.77 |
| Oysters, Buzzards Bay | 2.25 | Round clams | 3.38 |
| Oysters, Stony Creek | 1.87 | Lobsters | 6.80 |
| Oysters, Stony Creek | 1.76 | Cray fish | 2.31 |

These variations are the widest of all. The proportions of nutrients in the whole oyster, shell and all, are of course very small, the largest in the Blue Points, being only 3⅓ per cent. In 100 pounds of Norfolks we have less than one pound of nutritive material. Here again the samples from the New York and New England waters are the best, and those from Virginia the poorest.

## THE NUTRITIVE VALUES OF FISH AND OTHER FOODS.

This subject has of late begun to attract very general attention. The chemico-physiological research of the past two decades has brought us where we can judge, with a considerable degree of accuracy, from the chemical composition of a food material what is its value as compared with other foods for nourishment. The bulk of the best investigation of this subject has been made in Germany, where chemists and physiologists have already got so far as to feel themselves warranted in computing the nutritive values of foods and arranging them in tables, which are coming into popular use.

As this may fall into the hands of some readers not entirely familiar with the latest developments of the chemistry of food and nutrition, I may be permitted to cite a few explanatory statements from a paper read before the American Fish Cultural Association.

THE NUTRIENTS OF FOODS.

We eat meat and fish, milk and bread, to build up our bodies, to repair their wastes, to supply heat, to keep ourselves warm, and strength with which to work. This is the common way of putting it. Speaking as chemists and physiologists, we should say that our food supplies, besides mineral substances and water, albuminoids, carbohydrates, and fats, whose functions are to be transformed into the tissues and fluids of the body, muscle and fat, blood and bone, and by their consumption to produce heat and force.

*Albuminoids* occur in plants, as in the gluten of wheat; and in the animal body, as in the fibrinogen and fibrinoplastic substances of blood, in the fibrin of muscle, in albumen (white) of eggs, and in the casein (curd) of milk.

The albuminoids are the most important of the nutrients of foods. Not only do they share in the formation of the fatty tissues and in the supply of material for the production of animal heat and muscular power, thus performing all of the functions of the other food ingredients in the body, but they also have a work of their own in the building up of the nitrogenous tissues, muscles, tendons, cartilage, &c., in which none of the other ingredients can share.

*The carbohydrates*, of which we have familiar examples in sugar, starch, and cellulose, differ from the albuminoids in that they have no nitrogen. They have, according to the best experimental evidence, no share in the formation of nitrogenous tissues in the body. It is hardly probable that they are transferred into fats to any considerable extent; their chief use in food seems to be to supply fuel for the production of animal heat, and very probably of muscular power. They are very important constituents of foods, but much less so than the albuminoids and fats. They occur in only minute proportion in meats, fish, and like animal foods.

*The fats* are familiar to us in the forms of vegetable fats and oils, like linseed and olive oils, in fat meat, tallow, and lard, and in butter. The fats, like the carbohydrates, are destitute of nitrogen. The fats of the food are stored in the body as fats, transformed into carbohydrates, and serve for fuel, but do not form nitrogenous tissue. They are more valuable than the carbohydrates, because richer in carbon and hydrogen, the elements which give value to fuel, and because they supply the body with fats.

In brief, the albuminoids, the nitrogenous constituents of foods (albumen, fibrin, &c.), which make the lean meat, the muscle, the connective tissues, skin, and so on, are the most important of the nutrients. Next in importance come the fats, and last the carbohydrates—sugar, starch, and the like. One reason of the inferior position of the carbohydrates is the fact that they have no nitrogen. The albuminoids can do their own work and all the work of the carbohydrates and the fats as well, while these latter can only do their own. With albuminoids alone we might make a shift to get on for a good while, but with carbohydrates and fats alone we should speedily starve.

See Reports of Am. Fish Cult. Ass'n., 1880 and 1881.

We might live on lean meat, but not on tallow and starch. Animal foods, meats, fish, and the like, consist mainly of albuminoids and fats, and contain very little of the carbohydrates. Vegetable foods, on the other hand, consist largely of carbohydrates, and contain less of the albuminoids and fats. Science and experience unite in testifying that a proper combination of all makes the most wholesome, as we know it gives the most agreeable, diet.

The table below is constructed to illustrate the composition and food values of the samples of fish, oysters, &c., analyzed, as compared with other animal foods and with each other. The figures for meat, game, milk, eggs, &c., as well as the basis of estimating the nutritive values, are from German sources.—(König, Nahrungsmittel, I, 206–210 and 223–226.) The analyses of fish (except the dried cod) and of invertebrates are taken from Tables I–VII of this report.

## TABLE VIII.

*Composition and valuations of animal foods.*

[Valuation of medium beef assumed as 100.]

| | Total edible solids, actual nutritive materials in whole sample. (1) | In flesh free from bone and other waste. | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Solids—actual nutritive material. | | | | |
| | | Water. | Albuminoids, protein. | Fats. | Extractives. (2) | Mineral ingredients. | Nutritive valuation. |
| **MEATS.** | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* |
| Beef, lean | ........ | 76.71 | 20.61 | 1.50 | ........ | 1.18 | 91.8 |
| Beef, medium | ........ | 72.25 | 21.30 | 5.19 | ........ | 1.17 | 100.0 |
| Beef, fat | ........ | 54.76 | 16.93 | 27.23 | ........ | 1.08 | 112.0 |
| Veal, fat | ........ | 72.31 | 18.88 | 7.41 | 0.07 | 1.83 | 92.4 |
| Mutton, medium | ........ | 75.99 | 18.11 | 5.77 | ........ | 1.33 | 86.6 |
| Pork, fat | ........ | 47.40 | 14.54 | 37.34 | ........ | 0.72 | 116.0 |
| Smoked beef | ........ | 47.68 | 27.10 | 15.35 | ........ | 10.59 | 146.0 |
| Smoked ham | ........ | 27.98 | 23.97 | 36.48 | 1.50 | 10.07 | 157.0 |
| **GAME, FOWL, &C.** | | | | | | | |
| Venison | ........ | 75.76 | 19.77 | 1.92 | 1.42 | 1.13 | 88.8 |
| Hen, fat | ........ | 70.06 | 18.49 | 9.34 | 1.20 | 0.91 | 93.9 |
| Duck | ........ | 70.82 | 22.65 | 3.11 | 2.33 | 1.09 | 104.0 |
| **MILK, EGGS, &C.** | | | | | | | |
| Cow's milk | ........ | 87.41 | 3.41 | 3.66 | 4.82 | 0.70 | 28.8 |
| Cow's milk, skimmed | ........ | 90.63 | 3.06 | 0.79 | 4.77 | 0.75 | 18.5 |
| Cow's milk, cream | ........ | 66.41 | 3.70 | 25.72 | 3.54 | 0.63 | 56.1 |
| Butter | ........ | 14.14 | 0.86 | 83.11 | 0.70 | 1.19 | 124.0 |
| Cheese, skimmed milk | ........ | 48.02 | 32.65 | 8.41 | 6.80 | 4.12 | 159.0 |
| Cheese, whole milk | ........ | 46.82 | 27.62 | 20.54 | 1.97 | 3.05 | 151.6 |
| Cheese, very fat | ........ | 35.75 | 27.16 | 30.43 | 2.53 | 4.13 | 163.0 |
| Hens' eggs | ........ | 73.67 | 12.55 | 12.11 | 0.55 | 1.12 | 72.2 |

(1.) The figures in the first column give the percentages of actual nutrients in the samples as actually found in the markets. Those for fish apply to either the whole or dressed samples, as stated in Tables I–IV of Part I of this report; those for oysters and clams to the shell contents; scallops, the muscle; lobsters and cray fish, the whole animal.

(2.) Essentially the carbohydrates, except in the European dried cod and in the invertebrates, in which the extractives are calculated as explained in Part II, "Methods of analysis," page 25.

*Composition and valuations of animal foods*—Continued.

| | Total edible solids, actual nutritive materials in whole sample. | IN FLESH FREE FROM BONE AND OTHER WASTE. | | | | | |
|---|---|---|---|---|---|---|---|
| | | Water. | Solids—actual nutritive material. | | | | |
| | | | Albuminoids, protein. | Fats. | Extractives. | Mineral ingredients. | Nutritive valuation. |
| FISH (fresh). | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* |
| Halibut | 21.40 | 74.31 | 18.23 | 6.33 | ........ | 1.14 | 87.9 |
| Flounder | 4.85 | 83.86 | 14.20 | 0.70 | ........ | 1.25 | 62.4 |
| Cod | 11.81 | 82.46 | 15.94 | 0.24 | ........ | 1.23 | 69.1 |
| Haddock | 8.86 | 81.22 | 17.26 | 0.16 | ........ | 1.36 | 74.9 |
| Alewives | 12.05 | 75.67 | 18.94 | 3.93 | ........ | 1.40 | 86.8 |
| Eels (salt water) | 22.50 | 70.48 | 18.85 | 9.77 | ........ | 0.90 | 95.6 |
| Shad | 16.30 | 68.17 | 18.80 | 11.66 | ........ | 1.36 | 98.2 |
| Striped bass | 8.94 | 78.86 | 17.86 | 2.15 | ........ | 1.14 | 80.4 |
| Yellow pike-perch | 8.42 | 79.61 | 18.55 | 0.47 | ........ | 1.37 | 80.9 |
| Black bass | 9.43 | 78.68 | 19.72 | 1.02 | ........ | 1.18 | 86.5 |
| Mackerel | 15.52 | 72.32 | 18.30 | 8.15 | ........ | 1.23 | 90.9 |
| Blue fish | 10.96 | 78.16 | 19.32 | 1.25 | ........ | 1.27 | 85.4 |
| Salmon | 32.99 | 63.52 | 19.73 | 15.67 | ........ | 1.08 | 107.9 |
| Salmon trout | 14.38 | 66.80 | 17.22 | 14.69 | ........ | 1.29 | 95.7 |
| Brook trout | 10.78 | 77.04 | 18.47 | 3.08 | ........ | 1.41 | 84.2 |
| White fish | 13.60 | 70.08 | 22.10 | 6.20 | ........ | 1.62 | 104.5 |
| Porgy | 9.66 | 75.84 | 18.15 | 4.65 | ........ | 1.36 | 85.2 |
| Black fish | 10.04 | 76.66 | 19.25 | 2.81 | ........ | 1.28 | 87.3 |
| Red Snapper | 10.10 | 76.74 | 20.53 | 1.81 | ........ | 1.42 | 90.7 |
| Smelt | 12.53 | 79.71 | 16.43 | 1.94 | ........ | 1.92 | 73.8 |
| Spanish mackerel | 20.63 | 67.77 | 21.34 | 9.39 | ........ | 1.50 | 105.9 |
| White perch | 8.74 | 75.43 | 19.[illegible]8 | 4.00 | ........ | 1.19 | 89.2 |
| Muskallenge | 12.47 | 75.33 | 20.24 | 2.87 | ........ | 1.56 | 91.8 |
| Herring | 11.48 | 67.77 | 19.43 | 11.32 | ........ | 1.48 | 100.4 |
| Sheep's-head | 11.97 | 71.54 | 20.68 | 6.68 | ........ | 1.10 | 96.9 |
| Turbot | 15.62 | 70.10 | 14.49 | 14.15 | ........ | 1.26 | 84.4 |
| Spent salmon | 12.96 | 76.84 | 18.41 | 3.60 | ........ | 1.14 | 84.8 |
| CURED FISH. | | | | | | | |
| Salt cod | 19.79 | 52.50 | 25.00 | 0.51 | ........ | 1.87 | 108.9 |
| Boned cod | 28.78 | 51.85 | 26.45 | 0.38 | ........ | 1.90 | 114.8 |
| Dried cod (European) | ........ | 16.16 | 78.91 | 0.78 | 2.59 | 1.56 | 346.0 |
| Smoked halibut | 32.45 | 50.85 | 18.43 | 15.57 | ........ | 1.64 | 102.2 |
| Smoked herring | 28.92 | 35.60 | 31.57 | 18.66 | ........ | 2.87 | 163.4 |
| Canned salmon | 29.91 | 66.00 | 21.10 | 11.04 | ........ | 1.86 | 107.2 |
| Salt mackerel | 33.14 | 42.66 | 21.87 | 22.84 | ........ | 1.63 | 125.4 |
| INVERTEBRATES. | | | | | | | |
| Oysters, Stony Creek, Connecticut | 9.54 | 90.47 | 4.42 | 0.62 | 1.84 | 2.66 | 21.6 |
| Oysters, Fair Haven, Connecticut | 14.88 | 85.12 | 7.53 | 1.44 | 3.41 | 2.50 | 37.6 |
| Oysters, Blue Point, New York | 19.24 | 80.76 | 8.20 | 1.72 | 7.30 | 2.02 | 44.3 |
| Oysters, East River, New York | 12.43 | 87.57 | 6.31 | 1.10 | 3.15 | 1.87 | 31.6 |
| Oysters, Norfolk, Va | 8.55 | 91.45 | 4.50 | 0.61 | 1.90 | 1.54 | 22.0 |
| Oysters, Virginia (transplanted) (3) | 5.04 | 88.84 | 5.09 | 1.02 | 2.99 | 2.06 | 26.1 |
| Oysters, average of 14 samples | 12.29 | 87.71 | 5.78 | 1.12 | 3.41 | 1.98 | 29.6 |
| Oysters, "Cove" (canned) | 13.86 | 86.14 | 7.89 | 2.04 | 2.51 | 1.42 | 39.2 |
| Scallops, Shelter Island, New York | 19.68 | 80.32 | 14.75 | 0.17 | 3.38 | 1.38 | 67.0 |
| Long clams | 13.92 | 86.08 | 7.97 | 0.94 | 2.54 | 2.47 | 38.0 |
| Round clams | 13.80 | 86.20 | 6.56 | 0.40 | 4.17 | 2.67 | 32.6 |
| Lobsters | 6.80 | 82.73 | 13.57 | 1.97 | 0.00 | 1.74 | 62.0 |
| Lobsters (canned) | 20.64 | 79.36 | 16.75 | 4.62 | 0.00 | 2.78 | 79.1 |
| Cray fish | 2.31 | 81.22 | 16.00 | 0.46 | 1.01 | 1.31 | 70.7 |

Three things should be said with reference to this table.

First. The figures represent simply the averages of analyses made up to the present time.

(3.) To New Haven, Conn.

Second. The figures of some of the kinds of food, indeed all except the fresh meats, milk and its products, and eggs, are based upon few analyses. More are needed to show the actual ranges of variation and the actual averages. Sometimes different samples of the same kind of flesh will show widely varying percentages of constituents. This is especially true of the fats, and to a less extent of the water. But the figures in the table are probably not very far from true representations of the average composition of the several kinds of foods.

Third. The nutritive valuations are made with only an imperfect knowledge of the digestibility of the foods and the influence of palatibility and other factors upon the nutritive value. They are, therefore, of necessity somewhat crude, and to be relied upon rather as approximations than as accurate quantitative statements. Much more chemical and physiological investigation is needed to make our knowledge of these as complete and satisfactory as it should be.

This table is, I think, worth studying. As above explained, after taking out the refuse, bones, skin, entrails, &c., of the sample we have left the edible portion, the flesh (or, in case of oysters, clams, &c., the flesh and liquids together). Multiplying the percentage of flesh by that of actual nutrients in each sample gives the actual nutrients in the sample, as is done in the first column. The composition of the edible portion is given in the four columns under "In flesh," the figures being taken from Tables IV and VII. As shown above, the proportions of flesh and of water and dry substance in the flesh differ greatly in the different samples.

## PROPORTIONS OF NUTRIENTS.

The proportions of albuminoids, fats, &c., are, if anything, still more varied. The cod, haddock, and bass, have scarcely any fat, and the oysters, scallops, and clams, very little. But the eels, shad, mackerel, salmon, herring, and turbot are very fat. On the whole, fish average about the same percentages of albuminoids as the meats, but generally have less of fats.

It would be interesting to note in more detail the proportions of the constituents of the flesh, especially as illustrated in Tables II, III, and IV. The constituents soluble in cold and hot water, for instance, which so far as is known are analogous to those of meats, are of considerable interest, but demand much more investigation. Meat extract has become an important article of commerce. There is a fortune for somebody, I mistrust, in the extract from menhaden.

## "FOUL" OR "SPENT" FISH *vs.* THE SAME IN GOOD CONDITION.

Some very interesting results are found in comparing the composition of the foul or spent fish with the same in good condition, as shown in Table II. As the fish becomes lean, it loses nutritive value in three ways; first, in total loss of weight; second, in relative increase of refuse and decrease of flesh; and, third, in the deterioration of the quality of the flesh which, in the lean fish, is more watery and considerably less valuable, pound for pound, than the flesh of the same fish in good condition. Thus the flesh of spent salmon is rated in the last column at 85, while that of fat salmon came up to 108. There is in this a strong argument in favor of legislation against the capture of fish out of season. In general the fatter fish are more valuable than the leaner, pound for pound, because they have more nutritive material and less water.

### RELATIVE NUTRITIVE VALUES OF FISH AND OTHER FOODS.

The above table will help us to a very fair idea of the comparative composition of some of our more common animal foods.

Looking down the first column we see that while medium beef contains 72 per cent. of water, milk contains 87½ per cent. Roughly speaking, beefsteak is about three-fourths, and milk seven-eighths, water. A pound of beefsteak would thus contain four ounces of solids, and, if we assume a pint of milk to weigh a pound, a quart would contain four ounces of solids also; that is, a pound of steak and a quart of milk contain about the same weight of actual nutrients. But we know that for ordinary use the pound of beefsteak is worth more for food than the quart of milk. The reason is simple. The solids of the lean steak are nearly all albuminoid, while those of the milk consist largely of fats and of milk-sugar, a carbohydrate.

The figures in the last column are intended to show how the foods compare in nutritive value, "medium beef" being taken as a standard. They are computed by ascribing certain values to the albuminoids and fats, and taking the sum in each case for the value of that particular food. The ratio here adopted, which assumes one pound of albuminoids to be equal to three pounds of fats and five pounds of carbohydrates, is that assumed by prominent German chemists.*

Taking medium beef at 100, the same weight of milk comes to 23.8; mutton, medium, to 86.6; fat pork, 116, and so on. The samples of fish run from flounders, 65, to smoked herring, 163; while the European dried cod is rated at 346. Thus we have for example the following valuations for flesh, free from bone, skin, shell, and other refuse—

FISH.

| | | | |
|---|---|---|---|
| Smoked herring | 163.4 | Shad | 98.2 |
| Salt mackerel | 125.4 | Mackerel | 90.9 |
| Boned cod | 114.8 | Red snapper | 90.7 |
| Salt cod | 108.9 | Blue fish | 85.4 |
| Salmon | 107.9 | Striped bass | 80.4 |
| Canned salmon | 107.2 | Haddock | 74.9 |
| Spanish mackerel | 105.9 | Cod | 69.1 |
| White fish | 104.5 | Flounder | 62.4 |

INVERTEBRATES.

| | | | |
|---|---|---|---|
| Oysters, Blue Point | 44.3 | Oysters, Norfolk | 22.0 |
| Oysters, "Cove" or "canned" | 39.2 | Scallops | 67.0 |
| Oysters, East River | 31.6 | Long clams | 38.0 |
| Oysters, Virginia (transplanted) | 26.1 | Round clams | 32.6 |
| | | Lobsters | 62.0 |

*E. g., *König*, *Zeitschrift für Biologie*, 1876, 497.

### CHEAP *versus* DEAR FOOD.

These figures differ widely from the market values. But we pay for our foods according to, not their value for nourishing our bodies, but their abundance and their agreeableness to our palates.

As was stated in the introduction to this report, taking the samples of fish at their retail prices in the Middletown markets, the total edible solids in striped bass came to about $2.30 per pound, while in the Connecticut River shad, whose price was very low, we bought nutritive material at 44 cents per pound. The cost of the nutritive material in one sample of halibut was 57 cents, and in the other $1.45 per pound, though both were bought in the same place, at the same price, 15 cents per pound, gross weight.

As I have said, to the man whose income will permit him to eat what he likes regardless of cost, it makes very little difference how much he pays for the albuminoids and fats of his food, but it does make a difference to people of small means, and the knowledge that just study of these matters will bring, when obtained and diffused among the people, cannot fail to do great good.

The cook-books and newspapers have occasionally something to say upon these points, but their statements are apt to be as vague and far from the truth as in the lack of authoritative information they might be expected to be. Certain it is that we need to know more about these things, and that proper investigations may help us toward that knowledge.

### FISH AS BRAIN FOOD.

Before closing I ought, perhaps, to refer briefly to the widespread notion that fish is particularly valuable for brain food. The percentages of phosphorus in the analyses above reported are not larger than are found, according to the best analyses, in the flesh of other animals used for food. The number of reliable determinations of flesh in the latter are, however, small, and it is, though very improbable, yet within the range of possibility that a more complete investigation of the subject might reveal a smaller proportion of phosphorus in meats than in fish.

But even if the fish be richer in phosphorus there is no proof that it would on that account be better for brain food. The question of the nourishment of the brain and the sources of intellectual energy are too indeterminate to allow decisive statements, and too abstruse for speedy solution in the present condition of our knowledge.

# INDEX


Page.

Albumen in fish .......... 14
Alewives analysis of .......... 4
nutritive valuation of .......... 84
Almen, Analyse des Fleisches einiger Fische, cited .......... 13
Alosa sapidissima, analysis of .......... 4, 7
Analyses of fish .......... 2, 3, 12, *et seq.*
preparation of specimens .......... 12
sampling .......... 12
drying .......... 13
in hydrogen .......... 13
in air .......... 13
proximate ingredients .......... 13
cold-water extract .......... 14
albumen .......... 14
extractive matter .......... 14
hot-water extract .......... 14
gelatine .......... 14
insoluble protein .......... 15
other extracts, fats .......... 15
nitrogen .......... 15, 16
phosphorus .......... 17
sulphur .......... 17
chlorine .......... 18
Analyses of invertebrates .......... 2, 10 *et seq.*
preparation of samples .......... 22
methods of analyses .......... 23
preparation of tables .......... 23
previous analyses .......... 25
Analyses tables, description of .......... 10, 11, 12
Anguilla rostrata, analysis of .......... 4
Archosargus probatocephalus, analysis of. .......... 10
Atkins, Charles G., fishes furnished by... .......... 7, 8
Atwater, W. O., chemical composition and economic values of fish and invertebrates 1 *et seq.*
Baird, Prof. S. F .......... 8
Bass, black, analysis of .......... 10
striped, analysis of .......... 4, 5
nutritive valuation of .......... 34, 36
Beamer, Miles, assistance rendered by .......... 2
analyses of invertebrates. 19 *et seq.*
Beef, nutritive substance in .......... 2
nutritive valuation of .......... 33
Black bass, analysis of .......... 10
Black-fish, analysis of .......... 7
nutritive valuation of .......... 34
Blackford, E. G., contribution by .......... 8
fish furnished by .......... 4, 5, 6, 9, 10
furnished invertebrates. 20, 21, 22
thanks due .......... 17
Blue-fish, analysis of .......... 4
nutritive valuation of .......... 34, 36
Boned codfish, analysis of .......... 6

Page.

Buckland, Mr., on East River oyster .......... 24
Butter, nutritive valuation of .......... 33
California salmon, analysis of .......... 6
Cambarus, analysis of .......... 22
Camp, S. T., fish furnished by .......... 7, 8
Canned salmon, analysis of .......... 6
Chemical composition of fish and invertebrates .......... 1 *et seq.*,
Chemico-physiological research, results of .......... 31
Chittenden, R. H., analyses by .......... 25
Chlorine in fish .......... 18
in invertebrates .......... 23
Clams, analysis of .......... 21
nutritive valuation of .......... 34, 36
Clupea harengus, analysis of .......... 7, 10
Codfish, analysis of .......... 3, 4, 6, 7, 8
nutritive valuation of .......... 34, 36
Coregonus clupeiformis, analysis of .......... 5
Crayfish, analysis of .......... 22
nutritive valuation of .......... 34
weight of .......... 22
Crittenden, A. R., contribution by .......... 8
Cybium maculatum, analysis of .......... 9
Duck, nutritive valuation of .......... 33
Eels, analysis of .......... 4
nutritive valuation of .......... 34
Eggs, nutritive valuation of .......... 33
Ely, J. F., thanks due .......... 19, 21
Esox nobilior, analysis of .......... 9
European oyster, analysis of .......... 25
Fish, analyses of .......... 3
as brain food .......... 37
chemical composition and economic valuation of .......... 1 *et seq.*
(cured), nutritive valuation of .......... 34
(fresh), nutritive valuation of .......... 34, 36
measurements of .......... 7, 8
weights of .......... 3, 7, 8, 9, 10
samples, statistics of .......... 26
refuse .......... 26
dry substance .......... 27
edible portion .......... 27
total edible solids .......... 28
Flounder, analysis of .......... 5
nutritive substance in .......... 2
nutritive valuation of .......... 34, 36
Fowl, nutritive valuation of .......... 33
Gadus morrhua, analysis of .......... 3, 4
Game, nutritive valuation of .......... 33
Gelatine in fish .......... 14
Germany, investigations of the nutritive value of foods .......... 2

| | Page. |
|---|---|
| Haddock, analysis of | 5 |
| nutritive valuation of | 34, 36 |
| Halibut, analysis of | 3, 4 |
| nutritive valuation of | 34 |
| Hen, nutritive valuation of | 33 |
| Herring, analysis of | 7, 10 |
| nutritive valuation of | 34, 36 |
| Hippoglossus americanus, analysis of | 3, 4 |
| Homarus americanus, analysis of | 21 |
| Invertebrates, analyses of | 19 *et seq.* |
| chemical composition and economic values of | 1 *et seq.* |
| nutritive valuation of | 34, 36 |
| Jordan, W. H., assistance rendered by | 2 |
| König. analyses by | 25 |
| Nahrungsmittel, cited | 25, 33 |
| Zeitschrift für Biologie, cited | 36 |
| Kraut, analyses by | 25 |
| Krebsfleisch, analyses of | 25 |
| Lane, F. T., thanks due | 19, 20 |
| Lobster, analysis of | 21 |
| nutritive valuation of | 34, 36 |
| weight of | 21 |
| Long clams, analysis of | 21 |
| Long, Dr. J. H., determination of chlorine | 18, 23 |
| determination of vapor tensions | 16 |
| Lutjanus Blackfordii, analysis of | 5, 6 |
| Mackerel, analysis of | 4, 6, 8, 9 |
| nutritive valuation of | 34, 36 |
| Mackinaw trout, analysis of | 5 |
| Measurements of fish | 7, 8 |
| Meat, nutritive valuation of | 33 |
| Melanogrammus aeglefinus, analysis of | 5 |
| Merrill, G. P., assistance rendered by | 2 |
| tests made by | 17 |
| Micropterus salmoides, analysis of | 10 |
| Milk, nutritive valuation of | 33 |
| Morone americana, analysis of | 9 |
| Muskallonge, analysis of | 9 |
| nutritive valuation of | 34 |
| Mutton, nutritive valuation of | 33 |
| Mya arenaria, analysis of | 21 |
| Nitrogen in fish | 15, 16 |
| Nutrients in fish and beef | 2 |
| Nutritive values of fish and other food | 31 |
| Oncorhynchus chouicha, analysis of | 6 |
| Osborn, H. L., measurements of fish | 7 |
| Osmerus mordax, analysis of | 5 |
| Ostrea virginiana, analysis of | 19 |
| Oyster, European, analysis of | 25 |
| nutritive valuation of | 34, 36 |
| samples, statistics | 29 |
| proportions of flesh, liquids, and shell contents | 30 |
| proportion of dry substance | 30 |
| percentages of nutritive materials | 31 |
| analysis of | 19 |
| Paralichthys dentatus, analysis of | 5 |
| Pecten irradians, analysis of | 21, 25 |
| Perch, analysis of | 9 |
| nutritive valuation of | 34 |
| Phosphorous in fish | 17 |
| Pike-perch, analysis of | 10 |
| nutritive valuation of | 34 |
| Platysomatichthys hippoglossoides, analysis of | 10 |
| Pleuronectus americanus, analysis of | 3 |
| Pomatomus saltatrix, analysis of | 4 |
| Pomalobus vernalis, analysis of | 4 |
| Porgy, analysis of | 4, 6 |
| nutritive valuation of | 34 |
| Pork, nutritive valuation of | 33 |
| Protein, insoluble, in fish | 15 |
| Red snapper, analysis of | 5, 6 |
| Report of progress of an investigation of the chemical composition and economic values of fish and invertebrates used for food. By W. O. Atwater, Ph. D. (title) | 1 *et seq.* |
| Roccus lineatus, analysis of | 4, 5 |
| Round clams, analysis of | 21 |
| Salmo salar, analysis of | 4, 7, 8 |
| Salmon, analysis of | 4, 7, 8 |
| nutritive substance in | 28 |
| nutritive valuation of | 34, 36 |
| Salmon trout, analysis of | 5 |
| Salvelinus, fontinalis, analysis of | 6 |
| namaycush, analysis of | 5 |
| Scallops, analysis of | 21, 25 |
| nutritive valuation of | 34, 36 |
| Schoodic salmon-breeding establishment, fish furnished by | 8 |
| Scomber scombrus, analysis of | 4, 6, 8, 9 |
| Shad, analysis of | 4, 7 |
| nutritive valuation of | 34, 36 |
| Sheeps-head, analysis of | 10 |
| nutritive valuation of | 34 |
| Smelt, analysis of | 5 |
| Smoked halibut, analysis of | 6 |
| herring, analysis of | 7 |
| Snapper, nutritive valuation of | 34, 36 |
| Spanish mackerel, analysis of | 9 |
| Spotted brook trout, analysis of | 6 |
| Stenotomus argyrops, analysis of | 4, 6 |
| Stizostedium vitreum, analysis of | 10 |
| Striped bass, analysis of | 4, 5 |
| Sulphur in fish | 17 |
| Tables of analysis, description of | 10, 11, 12 |
| Tautoga onitis, analysis of | 8 |
| Trout, nutritive valuation of | 34 |
| Turbot, analysis of | 10 |
| nutritive valuation of | 37 |
| Vapor tensions, determination of | 16 |
| Veal, nutritive valuation of | 33 |
| Venus mercenaria, analysis of | 21 |
| Venison, nutritive valuation of | 33 |
| Weights of fishes | 3, 7, 8, 9, 10 |
| Whitefish, analysis of | 5 |
| nutritive valuation of | 34, 36 |
| White perch, analysis of | 9 |
| Woods, C. D., analysis by | 1 |
| analysis of invertebrates | 19. *et seq.* |
| assistance rendered by | 2 |
| Wüllner's formula | 16 |

TABLE I.

| Laboratory number of sample. | Kinds of fish and portions taken for analysis. | Number of fish in sample. | Cost per pound. | Proportions of flesh and refuse in sample as received for analysis: Flesh, edible portion. | Refuse, bones, skin, entrails, etc. | Loss in preparing for analysis. | Total weight of sample. | Percentage of flesh in sample. | Analysis of flesh. In flesh: Water. | Dry substance, solids. | In dry substance, percentages calculated on basis of dry substance = 100. Cold-water extract: Albumen (coagulated by heating to 100°). | Cold-water extract, not coagulated: Total. | Ash. | Fat. | Extractive matters. | Hot-water extract: Total. | Ash. | Fat. | Gelatin. | Insoluble: Crude residue. | Ash. | Fat. | Insoluble protein. | Fat, ether extract. | Ash. | Nitrogen. | Albuminoids: Nitrogen × 6.25. | Albumen + gelatin + insoluble protein. | Phosphoric acid (total phosphorus calculated as $P_2O_5$). | Sulphuric acid (total sulphur calculated as $SO_3$). | Chlorine. | Laboratory number of sample. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cts. | Grms. | Grms. | Grms. | Grms. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | |
| I | Halibut (*Hippoglossus americanus*). Posterior part of body, lean | ...... | 15 | 1,438.0 | 438.0 | 18.0 | 1,894.0 | 75.92 | 79.15 | 20.85 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 10.26 | 5.48 | 13.45 | 84.06 | ...... | 2.11 | 2.11 | ...... | I |
| II | Flounder (*Paralichthys dentatus*). Entrails removed | 2 | 10 | 954.0 | 1,316.0 | 38.0 | 2,308.0 | 41.33 | 83.37 | 16.63 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 3.72 | 7.76 | 14.76 | 92.25 | ...... | 1.86 | 2.23 | ...... | II |
| III | Cod (*Gadus morrhua*). Head and entrails removed | 1 | 10 | 1,795.0 | 937.0 | 48.0 | 2,780.0 | 64.57 | 83.12 | 16.88 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 1.66 | 7.46 | 14.68 | 91.75 | ...... | 2.19 | ...... | ...... | III |
| IV | Eels (*Anguilla rostrata*). Skin, head, and entrails removed | 11 | 15 | 1,043.0 | 293.0 | 32.0 | 1,368.0 | 76.24 | 69.80 | 30.20 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 32.27 | 2.08 | 9.85 | 61.56 | ...... | 1.70 | ...... | ...... | IV |
| V | Alewives (*Pomolobus vernalis*). Whole. Connecticut River | 12 | 15 | 425.0 | 434.0 | ...... | 859.0 | 49.48 | 75.92 | 24.08 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 16.35 | 6.08 | 12.61 | 78.81 | ...... | 2.06 | ...... | ...... | V |
| VI | Shad (*Alosa sapidissima*). Whole. Hudson River | 2 | 20 | 930.0 | 950.0 | 45.0 | 1,925.0 | 48.31 | 69.65 | 30.35 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 35.67 | 4.27 | 9.83 | 61.44 | ...... | ...... | ...... | ...... | VI |
| VII | Striped bass (*Roccus lineatus*). Whole. Connecticut River | 1 | 20 | 865.0 | 1,165.0 | 25.0 | 2,055.0 | 42.09 | 79.18 | 20.82 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 7.56 | 4.42 | 14.58 | 91.13 | ...... | 2.54 | ...... | ...... | VII |
| VIII | Mackerel (*Scomber scombrus*). Whole | 4 | 15 | 775.0 | 490.0 | 15.0 | 1,280.0 | 60.55 | 78.69 | 21.31 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 10.31 | 4.46 | 13.72 | 85.75 | ...... | 2.36 | ...... | ...... | VIII |
| IX | Halibut (*Hippoglossus americanus*). Section of fatter portion of body | ...... | 15 | 949.0 | 120.0 | 6.0 | 1,075.0 | 88.28 | 70.13 | 29.87 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 35.65 | 3.83 | 10.26 | 64.13 | ...... | 1.51 | ...... | ...... | IX |
| X | Shad (*Alosa sapidissima*). Whole. Connecticut River | 1 | 08 | 835.0 | 740.0 | 20.0 | 1,595.0 | 52.35 | 65.25 | 34.75 | 6.33 | ...... | ...... | ...... | ...... | 5.35 | .46 | ...... | 4.89 | ...... | ...... | ...... | ...... | 41.33 | 4.26 | 9.29 | 58.06 | ...... | 2.44 | ...... | ...... | X |
| XI | Cod (*Gadus morrhua*). Head and entrails removed | 1 | 08 | 1,725.0 | 774.0 | 33.0 | 2,532.0 | 68.13 | 83.39 | 16.61 | 10.17 | ...... | ...... | ...... | ...... | 14.81 | .90 | ...... | 13.91 | ...... | ...... | ...... | ...... | 2.39 | 7.33 | 14.94 | 93.38 | ...... | 3.05 | ...... | ...... | XI |
| XII | Bluefish (*Pomatomus saltatrix*). Entrails removed | 1 | 10 | 702.0 | 680.0 | 18.0 | 1,400.0 | 50.14 | 78.46 | 21.54 | 7.10 | ...... | ...... | ...... | ...... | 9.52 | .70 | ...... | 8.82 | ...... | ...... | ...... | ...... | 5.79 | 5.91 | 14.42 | 90.13 | ...... | 2.93 | ...... | ...... | XII |
| XIII | Mackerel (*Scomber scombrus*). Whole | 2 | 18 | 411.0 | 465.0 | 22.2 | 898.2 | 45.76 | 74.26 | 25.74 | 7.69 | ...... | ...... | ...... | ...... | 12.12 | 1.19 | ...... | 11.03 | ...... | ...... | ...... | ...... | 27.26 | 4.83 | 10.89 | 68.06 | ...... | 2.43 | ...... | ...... | XIII |
| XIV | Salmon (*Salmo salar*). Entrails removed. Maine | 1 | ...... | 3,628.4 | 1,135.9 | ...... | 4,764.3 | 76.16 | 67.15 | 32.85 | 5.57 | ...... | ...... | ...... | ...... | 6.18 | .61 | ...... | 5.57 | ...... | ...... | ...... | ...... | 39.29 | 3.35 | 9.72 | 60.75 | ...... | 1.79 | ...... | ...... | XIV |
| XV | Porgy (*Stenotomus argyrops*). Whole | 4 | ...... | 494.8 | 775.8 | 19.9 | 1,290.5 | 38.34 | 79.68 | 20.32 | 4.97 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 7.18 | 6.88 | 13.74 | 85.88 | ...... | 3.04 | ...... | ...... | XV |
| XVI | Haddock (*Melanogrammus æglefinus*). Entrails removed | 1 | 08 | 890.0 | 977.0 | 33.0 | 1,900.0 | 46.84 | 80.30 | 19.70 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | .90 | 5.79 | 14.59 | 91.19 | ...... | 2.43 | ...... | ...... | XVI |
| XVII | Salmon trout, "Mackinaw trout" (*Salvelinus namaycush*). Whole. Lake Ontario | 1 | ...... | 1,559.2 | 2,028.0 | 13.2 | 3,600.4 | 43.31 | 68.78 | 31.22 | 2.21 | ...... | ...... | ...... | ...... | 6.15 | 1.73 | ...... | 4.42 | ...... | ...... | ...... | ...... | 48.48 | 4.27 | 9.08 | 56.75 | ...... | 1.78 | 1.94 | ...... | XVII |
| XVIII | Whitefish (*Coregonus clupeiformis*). Whole. Lake Champlain | 1 | ...... | 601.0 | 702.0 | 10.0 | 1,313.0 | 45.78 | 70.83 | 29.17 | 5.31 | ...... | ...... | ...... | ...... | 6.58 | .65 | ...... | 5.93 | ...... | ...... | ...... | ...... | 21.46 | 5.56 | 12.26 | 76.63 | ...... | 2.48 | 1.44 | ...... | XVIII |
| XIX | Striped bass (*Roccus lineatus*). Whole. Bridge Hampton, L. I. | 1 | ...... | 467.0 | 625.0 | 6.5 | 1,098.5 | 42.51 | 79.73 | 20.27 | 8.88 | ...... | ...... | ...... | ...... | 14.50 | .74 | ...... | 13.76 | ...... | ...... | ...... | ...... | 13.40 | 6.69 | 13.34 | 83.38 | ...... | 3.37 | 2.28 | ...... | XIX |
| XX | Red snapper (*Lutjanus Blackfordii*). Whole. Fernandina, Fla. | 1 | ...... | 1,388.9 | 2,104.6 | 14.0 | 3,507.5 | 39.60 | 76.81 | 23.19 | 6.85 | 11.17 | 3.32 | ...... | 7.85 | 16.47 | .73 | ...... | 15.74 | 57.14 | ...... | ...... | ...... | 2.08 | 6.40 | 14.82 | 92.63 | ...... | 2.24 | 2.23 | ...... | XX |
| XXI | Haddock (*Melanogrammus æglefinus*). Entrails removed. Rockaway, L. I. | 1 | ...... | 1,140.9 | 1,240.1 | 21.2 | 2,402.2 | 47.50 | 82.03 | 17.97 | 7.96 | 9.96 | 3.78 | ...... | 6.18 | 17.25 | .89 | ...... | 16.36 | ...... | ...... | ...... | ...... | .78 | 8.72 | 14.77 | 92.31 | ...... | 2.54 | 2.23 | ...... | XXI |
| XXII | Flounder (*Paralichthys dentatus*). Whole. Amagansett, L. I. | 1 | ...... | 402.0 | 840.0 | 15.5 | 1,257.5 | 31.97 | 85.04 | 14.96 | 6.56 | 18.18 | 5.41 | ...... | 12.77 | 25.67 | 1.60 | ...... | 24.07 | ...... | ...... | ...... | ...... | 5.18 | 8.16 | 14.14 | 88.38 | ...... | 2.73 | 3.05 | ...... | XXII |
| XXIII | Smelt (*Osmerus mordax*). Whole. Hackensack River, N. J. | 73 | ...... | 632.0 | 356.2 | 34.8 | 1,023.0 | 61.78 | 80.16 | 19.84 | 8.02 | 20.06 | 3.83 | ...... | 16.23 | 26.31 | 1.56 | ...... | 24.75 | 37.50 | ...... | ...... | ...... | 9.76 | 9.65 | 13.32 | 83.25 | ...... | 3.88 | 2.66 | ...... | XXIII |
| XXIV | Brook trout (*Salvelinus fontinalis*). Whole. Cultivated | 6 | ...... | 608.0 | 619.0 | 38.0 | 1,265.0 | 48.05 | 77.54 | 22.46 | 8.01 | 16.34 | 4.90 | ...... | 11.44 | 10.60 | .72 | ...... | 9.88 | ...... | ...... | ...... | ...... | 13.82 | 6.33 | 13.25 | 82.81 | ...... | 2.72 | 2.13 | ...... | XXIV |
| XXV | Boned cod (*Gadus morrhua*) | | ...... | ...... | ...... | ...... | ...... | ...... | 54.35 | 45.65 | 1.84 | 50.25 | 43.24 | ...... | 7.01 | 10.23 | 3.61 | ...... | 6.62 | 32.81 | ...... | ...... | ...... | .88 | 50.62 | 9.81 | 61.31 | ...... | .70 | 1.48 | ...... | XXV |
| XXVI | Red snapper (*Lutjanus Blackfordii*). Entrails removed. Florida Coast | 1 | ...... | 2,604.0 | 2,884.0 | 10.7 | 5,498.7 | 47.36 | 77.34 | 22.66 | 8.12 | 12.80 | 4.64 | ...... | 8.16 | 13.50 | .75 | ...... | 12.75 | 58.09 | ...... | ...... | ...... | 8.56 | 5.92 | 13.96 | 87.25 | ...... | 2.04 | 2.06 | ...... | XXVI |
| XXVII | California salmon (*Oncorhynchus chouicha*). Edible portions of anterior part. California | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 62.68 | 37.32 | 4.21 | 6.07 | 2.12 | ...... | 4.85 | 5.06 | .32 | ...... | 4.74 | 32.02 | ...... | ...... | ...... | 61.69 | 2.90 | 8.76 | 54.75 | ...... | 1.91 | 1.14 | ...... | XXVII |
| XXVIII | Smoked halibut (*Hippoglossus americanus*) | ...... | ...... | 1,470.0 | 130.0 | 10.0 | 1,610.0 | 91.34 | 51.03 | 48.97 | 1.51 | 34.12 | 28.46 | ...... | 5.66 | 6.98 | 3.75 | ...... | 3.23 | 27.79 | 1.22 | ...... | 26.57 | 31.90 | 31.01 | 6.04 | 37.75 | 31.31 | 1.14 | .98 | ...... | XXVIII |
| XXIX | Canned salmon (*Oncorhynchus chouicha*). California. (Oregon?) | ...... | ...... | 765.5 | 101.5 | 3.0 | 870.0 | 87.99 | 65.86 | 34.14 | ...... | 19.22 | 5.01 | ...... | 14.21 | 5.80 | .53 | ...... | 5.27 | 43.09 | .65 | ...... | 42.44 | 32.48 | 5.43 | 9.87 | 61.69 | 47.71 | 1.77 | 1.38 | ...... | XXIX |
| XXX | Mackerel (*Scomber scombrus*). Whole. Cape May, N. J. | 4 | ...... | 1,305.0 | 1,267.0 | 22.0 | 2,594.0 | 50.29 | 74.14 | 25.86 | 7.27 | 13.26 | 3.72 | .76 | 8.78 | 7.31 | 1.39 | ...... | 5.92 | 47.67 | .50 | ...... | 47.37 | 27.04 | 5.02 | 11.25 | 70.31 | 60.56 | 2.10 | 1.68 | ...... | XXX |
| XXXI | Porgy (*Stenotomus argyrops*). Whole. Rhode Island | 4 | ...... | 1,190.0 | 1,638.0 | 19.0 | 2,847.0 | 41.80 | 71.98 | 28.02 | 10.64 | 9.60 | 2.47 | .56 | 6.57 | 8.77 | 1.20 | .18 | 7.39 | 45.25 | .85 | ...... | 44.40 | 28.04 | 4.81 | 10.77 | 67.31 | 62.43 | 1.98 | 1.84 | ...... | XXXI |
| XXXII | Shad (*Alosa sapidissima*). Whole. Connecticut River | 1 | ...... | 925.0 | 804.0 | 23.0 | 1,752.0 | 52.80 | 70.78 | 29.22 | 6.57 | 10.75 | 3.51 | .74 | 6.50 | 8.18 | .97 | .84 | 6.37 | 44.65 | .55 | ...... | 43.60 | 34.37 | 4.51 | 9.90 | 61.88 | 56.54 | 1.77 | 1.78 | 0.74 | XXXII |
| XXXIII | Smoked herring (*Clupea harengus*) | 6 | ...... | 250.0 | 202.0 | 2.7 | 454.7 | 54.98 | 33.14 | 66.86 | .48 | 30.89 | 17.47 | .65 | 12.77 | 10.02 | 2.38 | .28 | 7.36 | 33.35 | .91 | ...... | 32.44 | 28.00 | 19.72 | 7.03 | 43.94 | 40.28 | 1.24 | 1.84 | 11.01 | XXXIII |
| XXXIV | Salt cod (*Gadus morrhua*). "Channel fish." George's Banks | 1 | ...... | 3,068.6 | 1,055.9 | 21.2 | 4,145.7 | 74.02 | 53.62 | 46.38 | 1.07 | 48.21 | 44.49 | .40 | 3.32 | 13.45 | 3.10 | .02 | 10.33 | 33.46 | .70 | ...... | 32.67 | .59 | 53.63 | 8.43 | 52.69 | 44.07 | .53 | 1.56 | 25.66 | XXXIV |
| XXXV | Spent salmon, male (*Salmo salar*). Whole. Penobscot River, Maine | 2 | ...... | 4,726.8 | 3,718.4 | 42.5 | 8,487.7 | 55.73 | 75.27 | 24.73 | 4.69 | 13.34 | 4.17 | ...... | 9.17 | 10.35 | .61 | .04 | 9.70 | 63.60 | .40 | 10.10 | 53.10 | 17.06 | 4.51 | 12.39 | 77.44 | 67.49 | 1.01 | 1.58 | 0.74 | XXXV |
| XXXVI | Spent salmon, female (*Salmo salar*). Whole. Penobscot River, Maine | 2 | ...... | 5,733.2 | 4,443.4 | 28.3 | 10,204.9 | 56.18 | 78.20 | 21.80 | 4.50 | 9.90 | 3.44 | .23 | 6.23 | 15.00 | 1.09 | .09 | 13.82 | 65.18 | 1.56 | 8.72 | 54.90 | 12.98 | 5.36 | 12.93 | 80.81 | 73.31 | 1.18 | 1.45 | 0.85 | XXXVI |
| XXXVII | Salt cod (*Gadus morrhua*). "Boat fish." Vicinity of Nantucket, Mass. | 1 | ...... | 2,089.0 | 694.8 | 30.6 | 2,813.4 | 74.25 | 53.54 | 46.46 | 2.07 | ...... | ...... | ...... | ...... | 9.30 | 2.22 | ...... | 7.08 | ...... | ...... | ...... | ...... | 1.90 | 42.43 | 8.45 | 52.81 | ...... | .48 | 1.61 | 25.71 | XXXVII |
| XXXVIII | Blackfish (*Tautoga onitis*). Whole. Stonington, Conn. | 2 | ...... | 868.5 | 1,158.7 | 34.8 | 2,060.0 | 42.16 | 71.95 | 28.05 | 11.32 | 12.80 | 4.73 | .61 | 7.55 | 16.80 | .83 | .28 | 15.79 | 58.32 | 5.85 | ...... | 50.97 | 12.20 | 5.54 | 13.42 | 83.88 | 78.08 | 2.24 | 1.07 | 1.03 | XXXVIII |
| XXXIX | Mackerel (*Scomber scombrus*). Whole. Cape Cod, Mass. | 1 | ...... | 337.3 | 176.4 | 8.4 | 522.1 | 64.60 | 64.01 | 35.99 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 48.53 | 4.11 | 8.76 | 54.75 | ...... | 1.60 | 1.13 | 0.68 | XXXIX |
| XL | Spent land-locked salmon, male (*Salmo salar*, subsp., *sebago*) | 4 | ...... | 2,885.0 | 2,753.0 | 48.3 | 5,686.3 | 50.74 | 77.88 | 22.12 | 2.94 | 14.46 | 5.29 | ...... | 9.17 | 9.67 | .72 | .05 | 8.90 | ...... | ...... | ...... | ...... | 18.12 | 5.76 | 11.70 | 73.13 | ...... | 2.31 | 1.77 | 0.95 | XL |
| XLI | Spent land-locked salmon, female (*Salmo salar*, subsp., *sebago*). Whole. Grand Lake Stream, Maine | 4 | ...... | 1,901.8 | 1,673.5 | 47.0 | 3,622.3 | 52.50 | 79.20 | 20.80 | 5.14 | 16.34 | 5.77 | ...... | 10.57 | 11.73 | .77 | .38 | 10.58 | ...... | ...... | ...... | ...... | 9.86 | 5.76 | 13.26 | 82.88 | ...... | 2.43 | 1.98 | 0.93 | XLI |
| XLII | Salt mackerel (*Scomber scombrus*). "No. 1 mackerel" | 3 | ...... | 564.8 | 179.0 | 37.6 | 781.4 | 72.28 | 42.19 | 57.81 | .50 | 27.12 | 22.15 | .09 | 4.88 | 4.62 | 1.68 | .03 | 2.91 | ...... | ...... | ...... | ...... | 30.08 | 22.47 | 5.85 | 36.56 | ...... | .61 | 1.05 | 15.52 | XLII |
| XLIII | Spanish mackerel (*Cybium maculatum*). Whole | 1 | ...... | 968.0 | 523.5 | 20.9 | 1,512.4 | 64.02 | 68.10 | 31.90 | 3.92 | 11.06 | 3.98 | .09 | 6.99 | 10.13 | .91 | .09 | 9.13 | ...... | ...... | ...... | ...... | 20.56 | 4.71 | 10.76 | 67.25 | ...... | 1.68 | 1.81 | 0.49 | XLIII |
| XLIV | White perch (*Morone americana*) | 2 | ...... | 271.4 | 487.0 | 11.7 | 770.1 | 35.24 | 75.04 | 24.96 | 7.35 | 10.80 | 3.33 | .25 | 6.72 | 14.40 | .90 | .04 | 13.46 | ...... | ...... | ...... | ...... | 23.07 | 4.56 | 12.03 | 75.19 | ...... | 1.46 | 2.54 | 0.06 | XLIV |
| XLV | Masquallonge (*Esox nobilior*). Whole. St. Lawrence River | 1 | ...... | 2,082.6 | 2,027.4 | 8.0 | 4,118.0 | 50.57 | 76.26 | 23.74 | 6.75 | 14.48 | 6.91 | .17 | 7.40 | 11.20 | 1.01 | ...... | 10.19 | 58.88 | .50 | 1.56 | 56.73 | 12.18 | 6.63 | 13.82 | 86.38 | 73.67 | 2.21 | 1.55 | 0.86 | XLV |
| XLVI | White perch (*Morone americana*). Whole | 4 | ...... | 339.2 | 578.4 | 18.3 | 935.9 | 36.24 | 75.77 | 24.23 | 9.78 | 13.95 | 7.22 | .08 | 6.65 | 12.30 | 1.20 | .04 | 11.06 | ...... | ...... | ...... | ...... | 9.96 | 5.27 | 13.42 | 83.88 | ...... | 2.13 | 2.80 | 0.83 | XLVI |
| XLVII | Herring (*Clupea harengus*). Whole. Florida | 4 | ...... | 552.5 | 497.2 | 31.1 | 1,080.8 | 51.13 | 69.03 | 30.97 | 5.23 | 6.78 | 2.00 | .10 | 4.68 | 10.29 | .61 | .10 | 9.58 | ...... | ...... | ...... | ...... | 37.20 | 4.83 | 10.22 | 63.88 | ...... | 1.77 | 1.77 | 0.99 | XLVII |
| XLVIII | Sheep's-head (*Archosargus probatocephalus*). Entrails removed. Florida | 1 | ...... | 830.5 | 1,117.3 | 26.4 | 1,974.2 | 42.07 | 72.01 | 27.99 | 7.11 | 10.71 | 4.32 | 1.25 | 5.14 | 13.50 | 1.50 | ...... | 12.00 | ...... | ...... | ...... | ...... | 24.02 | 3.83 | 11.90 | 74.38 | ...... | 1.62 | 1.71 | 0.72 | XLVIII |
| XLIX | Turbot (*Platysomatichthys hippoglossoides*). Whole. Newfoundland | 1 | ...... | 1,305.0 | 1,149.3 | 42.2 | 2,496.5 | 52.27 | 71.39 | 28.61 | .42 | 10.67 | 3.22 | .45 | 7.00 | 14.49 | 1.08 | .49 | 12.92 | 43.09 | .18 | 14.47 | 28.44 | 50.38 | 4.47 | 8.25 | 51.56 | 41.78 | 1.68 | 1.12 | 1.12 | XLIX |
| LII | Yellow pike-perch (*Stizostedium vitreum*). Whole | 2 | ...... | 462.7 | 642.7 | 17.3 | 1,122.7 | 41.27 | 79.74 | 20.26 | 5.87 | 17.87 | 4.44 | .30 | 13.13 | 18.16 | 1.09 | .10 | 16.97 | 53.90 | .64 | 1.09 | 52.17 | 2.31 | 6.75 | 14.67 | 91.69 | 75.01 | 2.24 | 4.43 | 0.77 | LII |
| LIII | Black bass (*Micropterus pallidus*). Whole. North Carolina | 1 | ...... | 723.5 | 939.8 | 13.2 | 1,676.5 | 43.16 | 78.61 | 21.39 | 8.54 | 15.80 | 4.91 | .42 | 10.47 | 15.84 | 1.03 | .14 | 14.67 | ...... | ...... | ...... | ...... | 4.75 | 5.57 | 14.85 | 92.81 | ...... | 2.04 | 4.11 | 0.74 | LIII |

TABLE II.—*Recapitulation.*

[Albuminoids computed by multiplying nitrogen by 6.25.]

| Laboratory number of sample. | Kind of fish and portion taken for analysis. | Percentage of flesh, edible portion, of sample. | In flesh: Water. | In flesh: Dry substance, solids. | In dry substance: Cold-water extract: Albumen, coagulated. | In dry substance: Cold-water extract: Extractive matters (not coagulated). | In dry substance: Gelatin, hot water extract. | In dry substance: Insoluble protein. | In dry substance: Phosphoric acid. Total phosphorus calculated as $P_2O_5$. | In dry substance: Sulphuric acid. Total sulphur calculated as $SO_3$. | In dry substance: Chlorine. | In dry substance: Nitrogen. | In dry substance: Summary, per analyses: Albuminoids, Nitrogen × 6.25. | Summary, per analyses: Fats. | Summary, per analyses: Crude ash. | Summary, per analyses: Albuminoids + fats + ash. | Summary, calculated to basis of 100 per cent: Albuminoids. | Calculated to basis of 100 per cent: Fats. | Calculated to basis of 100 per cent: Crude ash. | In flesh, dry substance plus water: Cold-water extract: Albumen, coagulated. | Cold-water extract: Extractive matters (not coagulated). | Gelatin. | Insoluble protein. | Phosphoric acid. Total phosphorus calculated as $P_2O_5$. | Sulphuric acid. Total sulphur calculated as $SO_3$. | Chlorine. | Nitrogen. | Summary, per analyses: Water. | Per analyses: Albuminoids. | Per analyses: Fat. | Per analyses: Crude ash. | Per analyses: Water + albuminoids + fat + ash. | Summary, calculated to basis of 100 per cent: Water. | Calculated to basis of 100 per cent: Albuminoids. | Calculated to basis of 100 per cent: Fats. | Calculated to basis of 100 per cent: Crude ash. | Laboratory number of sample. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | |
| | FRESH FISH. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| I | Halibut (*Hippoglossus americanus*). Posterior part of body, lean | 75.92 | 79.15 | 20.85 | ...... | ...... | ...... | ...... | 2.11 | 2.11 | ...... | 13.45 | 84.06 | 10.26 | 5.48 | 99.80 | 84.13 | 10.36 | 5.51 | ...... | ...... | ...... | ...... | 0.44 | 0.44 | ...... | 2.80 | 79.15 | 17.50 | 2.14 | 1.14 | 99.93 | 79.20 | 17.52 | 2.14 | 1.14 | I |
| IX | Halibut (*Hippoglossus americanus*). Section of fatter portion of body | 88.28 | 70.13 | 29.87 | ...... | ...... | ...... | ...... | 1.51 | ...... | ...... | 10.28 | 64.13 | 35.65 | 3.83 | 103.61 | 62.06 | 34.21 | 3.73 | ...... | ...... | ...... | ...... | 0.45 | ...... | ...... | 3.06 | 70.13 | 19.13 | 10.65 | 1.14 | 101.05 | 69.41 | 18.93 | 10.53 | 1.13 | IX |
| II | Flounder (*Paralichthys dentatus*). Entrails removed | 41.83 | 83.37 | 16.63 | ...... | ...... | ...... | ...... | 1.88 | 2.23 | ...... | 14.76 | 92.25 | 3.72 | 7.76 | 103.73 | 88.93 | 3.58 | 7.49 | ...... | ...... | ...... | ...... | 0.31 | 0.37 | ...... | 2.45 | 83.37 | 15.31 | 0.62 | 1.29 | 100.59 | 82.89 | 15.23 | 0.61 | 1.27 | II |
| XXII | Flounder (*Paralichthys dentatus*). Whole. Amagansett, L. I | 31.97 | 85.04 | 14.96 | 6.56 | 12.77 | 24.07 | ...... | 2.73 | 3.05 | ...... | 14.14 | 88.38 | 5.18 | 8.16 | 101.72 | 86.89 | 5.07 | 8.04 | 0.98 | 1.91 | 3.60 | ...... | 0.41 | 0.46 | ...... | 2.12 | 85.04 | 13.22 | 0.77 | 1.22 | 100.25 | 84.82 | 13.19 | 0.77 | 1.22 | XXII |
| III | Cod (*Gadus morrhua*). Head and entrails removed | 64.57 | 83.12 | 16.88 | ...... | ...... | ...... | ...... | 2.19 | ...... | ...... | 14.68 | 91.75 | 1.66 | 7.46 | 100.87 | 90.94 | 1.64 | 7.42 | ...... | ...... | ...... | ...... | 0.37 | ...... | ...... | 2.48 | 83.12 | 15.48 | 0.28 | 1.26 | 100.14 | 83.00 | 15.46 | 0.28 | 1.26 | III |
| XI | Cod (*Gadus morrhua*). Head and entrails removed | 63.19 | 83.39 | 16.61 | 10.17 | ...... | 13.91 | ...... | 3.05 | ...... | ...... | 14.94 | 93.38 | 2.39 | 7.33 | 103.10 | 90.64 | 2.23 | 7.13 | 1.69 | ...... | 2.31 | ...... | 0.51 | ...... | ...... | 2.67 | 83.39 | 16.69 | 0.40 | 1.22 | 101.70 | 81.99 | 16.42 | 0.39 | 1.20 | XI |
| XVI | Haddock (*Melanogrammus æglefinus*). Entrails removed | 46.84 | 80.30 | 19.70 | ...... | ...... | ...... | ...... | 2.43 | ...... | ...... | 14.59 | 91.19 | 0.90 | 5.79 | 97.88 | 93.16 | 0.93 | 5.91 | ...... | ...... | ...... | ...... | 0.48 | ...... | ...... | 2.87 | 80.30 | 17.96 | 0.18 | 1.14 | 99.58 | 80.64 | 18.04 | 0.18 | 1.14 | XVI |
| XXI | Haddock (*Melanogrammus æglefinus*). Entrails removed. Rockaway, L. I | 47.50 | 82.03 | 17.97 | 7.96 | 6.18 | 16.38 | ...... | 2.54 | 2.23 | ...... | 14.77 | 92.31 | 0.78 | 8.72 | 101.81 | 90.65 | 0.77 | 8.58 | 1.43 | 1.11 | 2.94 | ...... | 0.46 | 0.40 | ...... | 2.65 | 82.03 | 16.55 | 0.14 | 1.57 | 100.29 | 81.79 | 16.50 | 0.14 | 1.57 | XXI |
| IV | Eels, salt-water (*Anguilla rostrata*). Skin, head, and entrails removed | 78.24 | 69.80 | 30.20 | ...... | ...... | ...... | ...... | 1.70 | ...... | ...... | 9.85 | 61.56 | 32.27 | 2.98 | 96.81 | 63.65 | 33.28 | 3.07 | ...... | ...... | ...... | ...... | 0.51 | ...... | ...... | 2.97 | 69.80 | 18.60 | 9.72 | 0.90 | 99.02 | 70.48 | 18.85 | 9.77 | 0.90 | IV |
| V | Alewives (*Pomolobus vernalis*). Whole. Connecticut River | 49.49 | 75.92 | 24.08 | ...... | ...... | ...... | ...... | 2.08 | ...... | ...... | 12.61 | 78.81 | 16.85 | 6.08 | 101.24 | 77.85 | 16.15 | 6.00 | ...... | ...... | ...... | ...... | 0.50 | ...... | ...... | 3.04 | 75.92 | 19.00 | 3.94 | 1.46 | 100.32 | 75.67 | 18.94 | 3.93 | 1.46 | V |
| VI | Shad (*Alosa sapidissima*). Whole. Hudson River, first of season | 48.31 | 69.65 | 30.35 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 9.83 | 61.44 | 35.67 | 4.27 | 101.38 | 60.65 | 35.15 | 4.20 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 2.98 | 69.65 | 18.64 | 10.80 | 1.30 | 100.39 | 69.37 | 18.57 | 10.76 | 1.30 | VI |
| X | Shad (*Alosa sapidissima*). Whole. Connecticut River, early in season | 52.95 | 65.25 | 34.75 | 6.33 | ...... | 4.89 | ...... | 2.44 | ...... | ...... | 9.29 | 58.06 | 41.83 | 4.26 | 103.65 | 55.82 | 40.04 | 4.14 | 2.20 | ...... | 1.70 | ...... | 0.85 | ...... | ...... | 3.23 | 65.25 | 20.16 | 14.38 | 1.48 | 101.25 | 64.53 | 19.80 | 14.20 | 1.47 | X |
| XXXII | Shad (*Alosa sapidissima*). Whole. Connecticut River | 52.80 | 70.78 | 29.22 | 6.57 | 6.50 | 6.37 | 43.60 | 1.77 | 1.78 | 0.74 | 9.80 | 61.88 | 34.37 | 4.51 | 100.76 | 61.46 | 34.12 | 4.42 | 1.92 | 1.90 | 1.86 | 12.74 | 0.52 | 0.52 | 0.22 | 2.89 | 70.78 | 18.08 | 10.04 | 1.32 | 100.22 | 70.62 | 18.04 | 10.02 | 1.32 | XXXII |
| VII | Striped bass (*Roccus lineatus*). Whole. Connecticut River | 42.09 | 79.18 | 20.82 | ...... | ...... | ...... | ...... | 2.54 | ...... | ...... | 14.58 | 91.13 | 7.56 | 4.42 | 103.11 | 88.41 | 7.33 | 4.26 | ...... | ...... | ...... | ...... | 0.53 | ...... | ...... | 3.04 | 79.18 | 18.99 | 1.58 | 0.92 | 100.67 | 78.58 | 18.92 | 1.58 | 0.92 | VII |
| XIX | Striped bass (*Roccus lineatus*). Whole. Bridge Hampton, L. I | 42.51 | 79.73 | 20.27 | 8.88 | ...... | 13.76 | ...... | 3.37 | 2.28 | ...... | 13.34 | 83.38 | 13.40 | 6.69 | 103.47 | 80.63 | 13.00 | 6.47 | 1.80 | ...... | 2.79 | ...... | 0.68 | 0.46 | ...... | 2.71 | 79.73 | 16.90 | 2.71 | 1.36 | 100.70 | 79.13 | 16.80 | 2.71 | 1.36 | XIX |
| VIII | Mackerel (*Scomber scombrus*). Whole | 60.65 | 78.69 | 21.31 | ...... | ...... | ...... | ...... | 2.26 | ...... | ...... | 13.72 | 85.75 | 10.81 | 4.46 | 100.52 | 85.30 | 10.25 | 4.45 | ...... | ...... | ...... | ...... | 0.48 | ...... | ...... | 2.92 | 78.69 | 18.27 | 2.20 | 0.95 | 100.11 | 78.59 | 18.27 | 2.19 | 0.95 | VIII |
| XIII | Mackerel (*Scomber scombrus*). Whole | 45.76 | 74.26 | 25.74 | 7.69 | ...... | 11.03 | ...... | 2.43 | ...... | ...... | 10.89 | 68.06 | 27.28 | 4.83 | 100.15 | 67.93 | 27.25 | 4.82 | 1.98 | ...... | 2.84 | ...... | 0.62 | ...... | ...... | 2.80 | 74.26 | 17.51 | 7.02 | 1.24 | 100.03 | 74.23 | 17.51 | 7.02 | 1.24 | XIII |
| XXX | Mackerel (*Scomber scombrus*). Whole. Cape May, N. J | 50.29 | 74.14 | 25.86 | 7.27 | 8.78 | 5.92 | 47.37 | 2.16 | 1.68 | ...... | 11.25 | 70.31 | 27.04 | 5.02 | 102.37 | 68.68 | 26.41 | 4.91 | 1.88 | 2.27 | 1.53 | 12.25 | 0.56 | 0.43 | ...... | 2.91 | 74.14 | 18.18 | 6.99 | 1.30 | 100.61 | 73.69 | 18.07 | 6.95 | 1.29 | XXX |
| XXXIX | Mackerel (*Scomber scombrus*). Whole. Cape Cod, Mass | 64.60 | 64.01 | 35.99 | ...... | ...... | ...... | ...... | 1.60 | 1.18 | 0.68 | 8.76 | 54.75 | 46.53 | 4.11 | 105.39 | 51.93 | 44.16 | 3.91 | ...... | ...... | ...... | ...... | 0.58 | 0.41 | 0.24 | 3.15 | 64.01 | 19.71 | 16.75 | 1.48 | 101.95 | 62.75 | 19.34 | 16.45 | 1.46 | XXXIX |
| XII | Bluefish (*Pomatomus saltatrix*). Entrails removed | 50.14 | 78.46 | 21.54 | 7.10 | ...... | 8.82 | ...... | 2.93 | ...... | ...... | 14.42 | 90.13 | 5.79 | 5.91 | 101.83 | 88.51 | 5.68 | 5.81 | 1.53 | ...... | 1.90 | ...... | 0.63 | ...... | ...... | 3.11 | 78.46 | 19.41 | 1.25 | 1.27 | 100.39 | 78.16 | 19.32 | 1.25 | 1.27 | XII |
| XIV | Salmon (*Salmo salar*). Entrails removed. Maine | 76.18 | 67.15 | 32.85 | 5.57 | ...... | 5.67 | ...... | 1.79 | | | 9.72 | 60.75 | 39.29 | 3.35 | 103.39 | 58.63 | 38.12 | 3.25 | 1.83 | ...... | 1.83 | ...... | 0.59 | ...... | ...... | 3.21 | 67.15 | 20.06 | 12.91 | 1.10 | 101.22 | 66.33 | 19.81 | 12.77 | 1.09 | XIV |
| XXVII | California salmon (*Oncorhynchus chouicha*). Edible portions of anterior part. California | ...... | 62.68 | 37.32 | 4.21 | 4.85 | 4.74 | 82.02 | 1.91 | 1.14 | ...... | 8.76 | 54.75 | 51.59 | 2.99 | 109.33 | 50.08 | 47.19 | 2.73 | 1.57 | 1.81 | 1.77 | 11.05 | 0.71 | 0.49 | ...... | 3.27 | 62.68 | 20.43 | 19.25 | 1.12 | 103.48 | 60.57 | 19.75 | 18.60 | 1.08 | XXVII |
| XVII | Salmon trout, "Mackinaw trout" (*Salvelinus namaycush*). Whole. Lake Ontario | 43.31 | 68.78 | 31.22 | 2.21 | ...... | 4.42 | ...... | 1.78 | 1.94 | ...... | 9.08 | 56.75 | 48.48 | 4.27 | 109.50 | 51.80 | 44.23 | 3.97 | 0.69 | ...... | 1.38 | ...... | 0.56 | 0.60 | ...... | 2.83 | 68.78 | 17.71 | 15.13 | 1.33 | 102.95 | 66.80 | 17.22 | 14.69 | 1.29 | XVII |
| XXIV | Brook trout (*Salvelinus fontinalis*). Whole. Cultivated | 46.95 | 77.54 | 22.46 | 8.01 | 11.44 | 9.88 | ...... | 2.72 | 2.13 | ...... | 13.25 | 82.81 | 13.82 | 6.33 | 102.96 | 80.41 | 13.43 | 6.16 | 1.80 | 2.57 | 2.22 | ...... | 0.61 | 0.48 | ...... | 2.98 | 77.54 | 18.60 | 3.10 | 1.42 | 100.66 | 77.04 | 18.47 | 3.08 | 1.41 | XXIV |
| XVIII | Whitefish (*Coregonus clupeiformis*). Whole. Lake Champlain | 45.76 | 70.83 | 29.17 | 5.81 | ...... | 5.93 | ...... | 2.48 | 1.44 | ...... | 12.26 | 76.63 | 21.46 | 5.58 | 103.65 | 73.83 | 20.76 | 5.41 | 1.65 | ...... | 1.73 | ...... | 0.72 | 0.42 | ...... | 3.57 | 70.83 | 22.35 | 6.26 | 1.62 | 101.06 | 70.08 | 22.10 | 6.20 | 1.62 | XVIII |
| XV | Porgy (*Stenotomus argyrops*). Whole | 38.84 | 79.68 | 20.32 | 4.97 | ...... | ...... | ...... | 3.04 | ...... | ...... | 13.74 | 85.88 | 7.18 | 6.88 | 99.94 | 85.94 | 7.18 | 6.88 | 1.01 | ...... | ...... | ...... | 0.62 | ...... | ...... | 2.79 | 79.68 | 17.44 | 1.46 | 1.40 | 99.98 | 79.72 | 17.44 | 1.45 | 1.39 | XV |
| XXXI | Porgy (*Stenotomus argyrops*). Whole. Rhode Island | 41.80 | 71.98 | 28.02 | 10.64 | 6.57 | 7.39 | 44.40 | 1.98 | 1.84 | ...... | 10.77 | 67.31 | 28.04 | 4.81 | 100.16 | 67.21 | 27.99 | 4.80 | 2.98 | 1.84 | 2.07 | 12.44 | 0.56 | 0.52 | ...... | 3.02 | 71.98 | 18.86 | 7.86 | 1.35 | 100.05 | 71.94 | 18.85 | 7.86 | 1.35 | XXXI |
| XXXVIII | Blackfish (*Tautoga onitis*). Whole. Stonington, Conn | 42.16 | 76.95 | 23.05 | 11.32 | 7.55 | 15.79 | 50.97 | 2.24 | 1.97 | 1.03 | 13.42 | 83.88 | 12.20 | 5.64 | 101.62 | 82.56 | 12.00 | 5.44 | 2.61 | 1.75 | 3.64 | 11.75 | 0.52 | 0.46 | 0.24 | 3.09 | 76.95 | 19.33 | 2.81 | 1.28 | 100.37 | 76.60 | 19.25 | 2.81 | 1.28 | XXXVIII |
| XX | Red snapper (*Lutjanus Blackfordii*). Whole. Fernandina, Fla | 39.60 | 76.81 | 23.19 | 6.85 | 7.85 | 15.74 | 57.14 | 2.24 | 2.23 | ...... | 14.82 | 92.63 | 2.98 | 6.40 | 102.01 | 90.80 | 2.92 | 6.28 | 1.59 | 1.82 | 3.65 | 13.25 | 0.52 | 0.52 | ...... | 3.44 | 76.81 | 21.48 | 0.69 | 1.49 | 100.47 | 76.45 | 21.38 | 0.69 | 1.48 | XX |
| XXVI | Red snapper (*Lutjanus Blackfordii*). Entrails removed. Florida coast | 47.86 | 77.34 | 22.66 | 8.12 | 8.16 | 12.75 | 56.09 | 2.04 | 2.06 | ...... | 13.96 | 87.25 | 8.58 | 5.92 | 101.75 | 85.76 | 8.43 | 5.82 | 1.84 | 1.85 | 2.89 | ...... | 0.46 | 0.47 | ...... | 3.16 | 77.34 | 19.75 | 1.94 | 1.34 | 100.37 | 77.06 | 19.66 | 1.94 | 1.34 | XXVI |
| XXIII | Smelt (*Osmerus mordax*). Whole. Hackensack River, New Jersey | 61.78 | 80.16 | 19.84 | 3.02 | 10.23 | 24.75 | 37.50 | 3.88 | 2.66 | ...... | 13.32 | 83.25 | 9.76 | 9.65 | 102.66 | 81.09 | 9.51 | 9.40 | 0.60 | 2.03 | 4.91 | 7.44 | 0.77 | 0.53 | ...... | 2.64 | 80.16 | 16.52 | 1.94 | 1.91 | 100.53 | 79.71 | 16.43 | 1.94 | 1.92 | XXIII |
| XLIII | Spanish mackerel (*Cybium maculatum*). Whole | 64.02 | 68.10 | 31.90 | 3.92 | 6.99 | 9.13 | ...... | 1.88 | 1.81 | 0.40 | 10.76 | 67.25 | 29.56 | 4.71 | 101.52 | 66.24 | 29.12 | 4.64 | 1.25 | 2.23 | 2.91 | ...... | 0.60 | 0.58 | 0.13 | 3.43 | 68.10 | 21.45 | 9.43 | 1.50 | 100.48 | 67.77 | 21.34 | 9.39 | 1.50 | XLIII |
| XLIV | White perch (*Morone americana*) | 35.24 | 75.64 | 24.36 | 7.35 | 6.72 | 13.46 | ...... | 1.46 | 2.54 | 0.66 | 12.03 | 75.19 | 23.07 | 4.56 | 102.82 | 73.13 | 22.44 | 4.43 | 1.79 | 1.64 | 3.28 | ...... | 0.36 | 0.62 | 0.16 | 2.93 | 75.64 | 18.32 | 5.62 | 1.11 | 100.69 | 75.12 | 18.20 | 5.57 | 1.11 | XLIV |
| XLVI | White perch (*Morone americana*). Whole | 38.24 | 75.77 | 24.23 | 9.78 | 6.65 | 11.08 | ...... | 2.13 | 2.80 | 0.83 | 13.42 | 83.88 | 9.96 | 5.27 | 99.11 | 84.05 | 10.35 | 5.60 | 2.37 | 1.61 | 2.68 | ...... | 0.52 | 0.68 | 0.20 | 3.25 | 75.77 | 20.32 | 2.41 | 1.28 | 99.78 | 75.94 | 20.36 | 2.42 | 1.28 | XLVI |
| XLV | Masquallonge (*Esox nobilior*). Whole. St. Lawrence River | 50.57 | 76.26 | 23.74 | 6.95 | 7.40 | 10.19 | 56.78 | 2.21 | 1.55 | 0.86 | 13.82 | 86.38 | 12.18 | 6.63 | 105.19 | 82.04 | 11.59 | 6.37 | 1.65 | 1.76 | 2.42 | 13.48 | 0.52 | 0.37 | 0.20 | 3.28 | 76.26 | 20.51 | 2.89 | 1.57 | 101.23 | 75.33 | 20.24 | 2.87 | 1.56 | XLV |
| XLVII | Herring (*Clupea harengus*). Whole. Florida | 51.18 | 69.03 | 30.97 | 5.23 | 4.68 | 9.58 | ...... | 1.77 | 1.77 | 0.99 | 10.22 | 63.88 | 37.20 | 4.83 | 105.91 | 60.32 | 35.12 | 4.56 | 1.62 | 1.42 | 2.97 | ...... | 0.55 | 0.55 | 0.31 | 3.16 | 69.03 | 19.78 | 11.52 | 1.50 | 101.83 | 67.77 | 19.43 | 11.32 | 1.48 | XLVII |
| XLVIII | Sheepshead (*Archosargus probatocephalus*). Entrails removed. Florida | 42.07 | 72.01 | 27.99 | 7.11 | 5.14 | 12.00 | ...... | 1.62 | 1.71 | 0.72 | 11.90 | 74.38 | 24.02 | 3.93 | 102.33 | 72.69 | 23.47 | 3.84 | 1.99 | 1.44 | 3.36 | ...... | 0.45 | 0.48 | 0.20 | 3.33 | 72.01 | 20.82 | 6.72 | 1.10 | 100.65 | 71.54 | 20.68 | 6.69 | 1.09 | XLVIII |
| XLIX | Turbot (*Platysomatichthys hippoglossoides*). Whole. Newfoundland | 52.27 | 71.39 | 28.61 | 0.42 | 7.00 | 12.92 | 28.44 | 1.66 | 1.12 | 1.12 | 8.25 | 51.56 | 50.36 | 4.47 | 106.39 | 48.41 | 47.30 | 4.29 | 0.12 | 2.00 | 3.69 | 8.14 | 0.48 | 0.32 | 0.32 | 2.36 | 71.39 | 14.75 | 14.40 | 1.28 | 101.82 | 70.10 | 14.49 | 14.15 | 1.26 | XLIX |
| LII | Yellow pike-perch (*Stizostedium vitreum*). Whole | 41.27 | 79.74 | 20.26 | 5.87 | 13.13 | 16.97 | 52.17 | 2.24 | 4.43 | 0.77 | 14.67 | 91.69 | 2.31 | 6.75 | 100.75 | 91.03 | 2.29 | 6.68 | 1.19 | 2.66 | 3.44 | 10.60 | 0.45 | 0.90 | 0.16 | 2.97 | 79.74 | 18.58 | 0.47 | 1.37 | 100.16 | 79.61 | 18.55 | 0.47 | 1.37 | LII |
| LIII | Black bass (*Micropterus pallidus*). Whole. North Carolina | 43.16 | 78.61 | 21.39 | 9.54 | 10.47 | 14.67 | ...... | 2.04 | 4.11 | 0.74 | 14.85 | 92.81 | 4.75 | 5.57 | 103.13 | 89.99 | 4.61 | 5.40 | 2.04 | 2.24 | 3.10 | ...... | 0.44 | 0.88 | 0.16 | 3.18 | 78.61 | 19.85 | 1.02 | 1.19 | 100.67 | 78.08 | 19.72 | 1.02 | 1.18 | LIII |
| XXXV | Spent salmon (*Salmo salar*), male. Whole. Penobscot River, Maine | 55.73 | 75.27 | 24.73 | 4.69 | 9.17 | 9.70 | 53.10 | 1.01 | 1.58 | 0.74 | 12.39 | 77.44 | 17.66 | 4.51 | 99.61 | 77.75 | 17.72 | 4.53 | 1.16 | 2.27 | 2.39 | 13.13 | 0.25 | 0.39 | 0.18 | 3.06 | 75.27 | 19.15 | 4.37 | 1.12 | 99.91 | 75.34 | 19.17 | 4.37 | 1.12 | XXXV |
| XXXVI | Spent salmon (*Salmo salar*), female. Whole. Penobscot River, Maine | 50.18 | 78.20 | 21.80 | 4.60 | 6.23 | 13.82 | 54.90 | 1.18 | 1.45 | 0.85 | 12.93 | 80.81 | 12.98 | 5.36 | 99.15 | 81.35 | 13.12 | 5.53 | 1.00 | 1.36 | 3.03 | 11.98 | 0.26 | 0.32 | 0.19 | 2.82 | 78.20 | 17.62 | 2.83 | 1.17 | 99.82 | 78.34 | 17.65 | 2.84 | 1.17 | XXXVI |
| XL | Spent land-locked salmon (*Salmo salar, subsp., sebago*), male. Whole. Grand Lake Stream, Maine | 50.74 | 77.88 | 22.12 | 2.94 | 9.17 | 8.90 | ...... | 2.31 | 1.77 | 0.95 | 11.70 | 73.13 | 18.12 | 5.76 | 97.01 | 75.38 | 18.68 | 5.94 | 0.65 | 2.03 | 1.96 | ...... | 0.51 | 0.39 | 0.21 | 2.59 | 77.88 | 16.18 | 4.01 | 1.27 | 99.34 | 78.40 | 16.29 | 4.04 | 1.27 | XL |
| XLI | Spent land-locked salmon (*Salmo salar, subsp., sebago*), female. Whole. Grand Lake Stream, Maine | 52.50 | 79.20 | 20.80 | 5.14 | 10.57 | 10.58 | ...... | 2.43 | 1.98 | 0.93 | 13.26 | 82.88 | 9.36 | 5.76 | 98.00 | 84.52 | 9.54 | 5.94 | 1.07 | 2.20 | 2.20 | ...... | 0.51 | 0.41 | 0.19 | 2.76 | 79.20 | 17.24 | 1.95 | 1.20 | 99.59 | 79.53 | 17.31 | 1.96 | 1.20 | XLI |
| | CURED FISH. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| XXV | Boned cod (*Gadus morrhua*) | ...... | 54.35 | 45.65 | 1.84 | 7.01 | 6.02 | 32.81 | 0.70 | 1.48 | ...... | 9.81 | 61.31 | 0.88 | 50.82 | 113.01 | 54.06 | 0.78 | 45.10 | 0.84 | 3.20 | 3.02 | 14.98 | 0.36 | 0.68 | ...... | 4.48 | 54.35 | 28.00 | 0.40 | 23.20 | 105.95 | 51.35 | 26.45 | 0.38 | 21.82 | XXV |
| XXXIV | Salt cod (*Gadus morrhua*), "Channel fish." George's Banks | 74.02 | 53.62 | 46.38 | 1.07 | 3.32 | 10.33 | 32.87 | 0.53 | 1.56 | 25.68 | 8.49 | 52.69 | 0.53 | 53.82 | 107.04 | 49.24 | 0.50 | 50.26 | 0.50 | 1.54 | 4.79 | 15.15 | 0.25 | 0.72 | 11.90 | 3.91 | 53.62 | 24.44 | 0.25 | 24.96 | 103.27 | 51.92 | 23.67 | 0.24 | 24.17 | XXXIV |
| XXXVII | Salt cod (*Gadus morrhua*), "Boat fish." Vicinity of Nantucket, Mass | 74.25 | 53.54 | 46.46 | 2.07 | ...... | 7.08 | ...... | 0.48 | 1.61 | 25.71 | 8.45 | 52.81 | 1.90 | 42.43 | 97.14 | 54.38 | 1.95 | 43.67 | 0.96 | ...... | 3.29 | ...... | 0.22 | 0.75 | 11.94 | 3.93 | 53.54 | 24.56 | 0.90 | 19.72 | 98.72 | 54.24 | 24.87 | 0.91 | 19.98 | XXXVII |
| XXVIII | Smoked halibut (*Hippoglossus americanus*) | 91.34 | 51.03 | 48.97 | 1.51 | 5.68 | 3.23 | 26.87 | 1.14 | 0.96 | ...... | 6.04 | 37.75 | 31.80 | 31.01 | 100.56 | 37.50 | 31.69 | 30.81 | 0.74 | 2.77 | 1.58 | 13.01 | 0.56 | 0.48 | ...... | 2.96 | 51.03 | 18.49 | 15.62 | 15.20 | 100.34 | 50.85 | 18.43 | 15.57 | 15.15 | XXVIII |
| XXXIII | Smoked herring (*Clupea harengus*) | 54.08 | 33.14 | 66.86 | 0.48 | 12.77 | 7.30 | 32.44 | 1.24 | 1.84 | 11.01 | 7.03 | 43.94 | 26.00 | 19.72 | 89.66 | 49.01 | 29.00 | 21.99 | 0.32 | 8.54 | 4.92 | 21.69 | 0.83 | 1.23 | 7.36 | 4.70 | 33.14 | 29.38 | 17.39 | 13.20 | 93.11 | 35.60 | 31.57 | 18.60 | 14.17 | XXXIII |
| XXIX | Canned salmon (*Oncorhynchus chouicha*). California. (Oregon) | 87.80 | 65.86 | 34.14 | ...... | 14.21 | 5.27 | 42.44 | 1.77 | 1.38 | ...... | 9.87 | 61.69 | 32.46 | 5.43 | 99.60 | 61.94 | 32.61 | 5.45 | ...... | 4.85 | 1.80 | 14.49 | 0.60 | 0.47 | ...... | 3.37 | 65.86 | 21.06 | 11.09 | 1.85 | 99.86 | 66.00 | 21.10 | 11.04 | 1.86 | XXIX |
| XLII | Salt mackerel (*Scomber scombrus*), "No. 1 mackerel" | 72.28 | 42.19 | 57.81 | 0.50 | 4.68 | 2.91 | ...... | 0.61 | 1.05 | 15.52 | 5.85 | 36.56 | 39.08 | 22.47 | 98.11 | 37.27 | 39.83 | 22.90 | 0.29 | 3.57 | 1.68 | ...... | 0.35 | 0.61 | 8.97 | 3.38 | 42.19 | 21.14 | 22.59 | 12.99 | 98.91 | 42.66 | 21.37 | 22.84 | 13.13 | XLII |

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TABLE III.—*Recapitulation.*

[Albuminoids as directly determined.]

**Per analyses.**

| Laboratory number of sample. | Kind of fish and portion taken for analysis. | In dry substance: Extractive matters, cold-water extract, not coagulated. | In dry substance: Proteids, &c.: Albumen, coagulated from cold-water extract. | In dry substance: Proteids, &c.: Gelatin, hot-water extract. | In dry substance: Proteids, &c.: Insoluble protein. | In dry substance: Fats. | In dry substance: Ash. | In dry substance: Total. | In flesh, dry substance plus water: Water. | In flesh: Extractive matters, cold-water extract, not coagulated. | In flesh: Proteids, &c.: Albumen, coagulated from cold-water extract. | In flesh: Proteids, &c.: Gelatin, hot-water extract. | In flesh: Proteids, &c.: Insoluble protein. | In flesh: Fats. | In flesh: Ash. | In flesh: Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. |
| XXXII | Shad (*Alosa sapidissima*). Whole. Connecticut River | 6.50 | 6.67 | 6.87 | 43.60 | 34.37 | 4.51 | 101.92 | 70.78 | 1.90 | 1.92 | 1.86 | 12.74 | 10.04 | 1.32 | 100.56 |
| XXX | Mackerel (*Scomber scombrus*). Whole. Cape May, N. J | 8.78 | 7.27 | 5.92 | 47.37 | 27.04 | 5.02 | 101.40 | 74.14 | 2.27 | 1.88 | 1.53 | 12.25 | 6.99 | 1.30 | 100.36 |
| XXVII | California salmon (*Oncorhynchus chouicha*). Edible portion of anterior part. California | 4.85 | 4.21 | 4.74 | 32.02 | 51.50 | 2.90 | 100.40 | 62.68 | 1.81 | 1.57 | 1.77 | 11.95 | 19.25 | 1.12 | 100.15 |
| XXXI | Porgy (*Stenotomus argyrops*). Whole. Rhode Island | 6.57 | 10.64 | 7.30 | 44.40 | 28.04 | 4.81 | 101.85 | 71.08 | 1.84 | 2.98 | 2.07 | 12.44 | 7.80 | 1.35 | 100.52 |
| XXXVIII | Blackfish (*Tautoga onitis*). Whole. Stonington, Conn | 7.55 | 11.32 | 15.79 | 50.97 | 12.20 | 5.54 | 103.37 | 76.95 | 1.75 | 2.61 | 3.64 | 11.75 | 2.81 | 1.28 | 100.70 |
| XX | Red snapper (*Lutjanus Blackfordii*). Whole. Fernandina, Fla | 7.85 | 6.85 | 15.74 | 57.14 | 2.08 | 6.40 | 96.06 | 76.81 | 1.82 | 1.59 | 3.65 | 13.25 | 0.69 | 1.49 | 99.30 |
| XXVI | Red snapper (*Lutjanus Blackfordii*). Entrails removed. Florida Coast | 8.16 | 8.12 | 12.75 | 56.09 | 8.58 | 5.92 | 99.62 | 77.34 | 1.85 | 1.84 | 2.89 | 12.71 | 1.94 | 1.34 | 99.91 |
| XXIII | Smelt (*Osmerus mordax*). Whole. Hackensack River, New Jersey | 16.23 | 3.02 | 24.75 | 37.50 | 9.76 | 9.65 | 100.91 | 80.16 | 3.22 | 0.60 | 4.91 | 7.44 | 1.95 | 1.92 | 100.20 |
| XLV | Masquallonge (*Esox nobilior*). Whole. St. Lawrence River | 7.40 | 6.95 | 10.10 | 56.73 | 12.18 | 6.63 | 100.08 | 70.26 | 1.76 | 1.65 | 2.42 | 13.48 | 2.89 | 1.57 | 100.03 |
| XLIX | Turbot (*Platysomatichthys hippoglossoides*). Whole. New Foundland | 7.00 | 0.42 | 12.92 | 28.44 | 50.36 | 4.47 | 103.61 | 71.30 | 2.00 | 0.12 | 3.09 | 8.14 | 14.40 | 1.28 | 101.02 |
| LII | Yellow pike-perch (*Stizostedium vitreum*). Whole | 13.13 | 5.87 | 18.07 | 52.17 | 2.31 | 6.75 | 97.20 | 79.74 | 2.66 | 1.19 | 3.44 | 10.00 | 0.47 | 1.37 | 99.47 |
| XXXV | Spent salmon (*Salmo salar*), male. Whole. Penobscot River, Maine | 9.17 | 4.69 | 9.70 | 53.10 | 17.66 | 4.51 | 98.83 | 75.27 | 2.27 | 1.16 | 2.39 | 13.13 | 4.37 | 1.12 | 99.71 |
| XXXVI | Spent salmon (*Salmo salar*), female. Whole. Penobscot River, Maine | 6.23 | 4.59 | 13.82 | 54.90 | 12.98 | 5.36 | 97.88 | 78.20 | 1.36 | 1.00 | 3.03 | 11.98 | 2.83 | 1.17 | 99.57 |
| XXV | Boned Cod (*Gadus morrhua*) | 7.01 | 1.84 | 6.62 | 32.81 | 0.88 | 50.82 | 99.98 | 54.85 | 3.20 | 0.84 | 3.02 | 14.98 | 0.40 | 23.20 | 99.99 |
| XXXIV | Salt Cod (*Gadus morrhua*), "channel fish." George's Banks | 3.32 | 1.07 | 10.33 | 33.07 | 0.53 | 53.82 | 101.74 | 53.62 | 1.54 | 0.50 | 4.79 | 15.15 | 0.25 | 24.98 | 100.81 |
| XXVIII | Smoked halibut (*Hippoglossus americanus*) | 5.60 | 1.51 | 3.28 | 26.57 | 31.90 | 31.01 | 99.88 | 51.03 | 2.77 | 0.74 | 1.58 | 13.01 | 15.62 | 15.20 | 99.95 |
| XXXIII | Smoked herring (*Clupea harengus*) | 12.77 | 0.48 | 7.36 | 32.44 | 26.00 | 10.72 | 98.77 | 23.14 | 8.54 | 0.32 | 4.92 | 21.69 | 17.39 | 13.20 | 99.20 |
| XXIX | Canned salmon (*Oncorhynchus chouicha*). California. (Oregon) | 14.21 | ...... | 5.27 | 42.44 | 32.48 | 5.43 | 99.83 | 65.86 | 4.85 | ...... | 1.80 | 14.49 | 11.00 | 1.85 | 99.91 |

**Calculated to basis of 100 per cent.**

| Laboratory number of sample. | In dry substance: Extractive matters, cold-water extract, not coagulated. | In dry substance: Proteids, &c.: Albumen, coagulated from cold-water extract. | In dry substance: Proteids, &c.: Gelatin, hot-water extract. | In dry substance: Proteids, &c.: Insoluble protein. | In dry substance: Fats. | In dry substance: Ash. | In flesh, dry substance plus water: Water. | In flesh: Extractive matters, cold-water extract, not coagulated. | In flesh: Proteids, &c.: Albumen, coagulated from cold-water extract. | In flesh: Proteids, &c.: Gelatin, hot-water extract. | In flesh: Proteids, &c.: Insoluble protein. | In flesh: Fats. | In flesh: Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. | Pr. ct. |
| XXXII | 6.38 | 6.45 | 6.25 | 42.80 | 33.69 | 4.43 | 70.42 | 1.90 | 1.92 | 1.86 | 12.64 | 9.94 | 1.32 |
| XXX | 8.66 | 7.18 | 5.83 | 46.78 | 26.64 | 4.94 | 73.90 | 2.27 | 1.88 | 1.53 | 12.17 | 6.95 | 1.30 |
| XXVII | 4.83 | 4.19 | 4.72 | 31.88 | 51.40 | 2.98 | 62.54 | 1.81 | 1.57 | 1.77 | 11.85 | 19.25 | 1.11 |
| XXXI | 6.45 | 10.45 | 7.25 | 43.60 | 27.52 | 4.73 | 71.58 | 1.84 | 2.98 | 2.07 | 12.88 | 7.80 | 1.35 |
| XXXVIII | 7.33 | 10.95 | 15.27 | 49.20 | 11.79 | 5.37 | 76.16 | 1.74 | 2.59 | 3.60 | 11.65 | 2.79 | 1.27 |
| XX | 8.08 | 7.07 | 16.24 | 58.96 | 3.07 | 6.58 | 77.36 | 1.83 | 1.60 | 3.68 | 13.35 | 0.60 | 1.49 |
| XXVI | 8.19 | 8.15 | 12.80 | 56.31 | 8.61 | 5.94 | 77.43 | 1.85 | 1.84 | 2.89 | 12.71 | 1.95 | 1.34 |
| XXIII | 16.07 | 3.04 | 24.51 | 37.15 | 9.67 | 9.58 | 79.98 | 3.22 | 0.60 | 4.91 | 7.44 | 1.95 | 1.92 |
| XLV | 7.39 | 6.94 | 10.18 | 56.69 | 12.17 | 6.63 | 78.29 | 1.76 | 1.65 | 2.42 | 13.48 | 2.89 | 1.51 |
| XLIX | 6.76 | 0.41 | 12.47 | 27.45 | 48.60 | 4.31 | 70.60 | 1.98 | 0.12 | 3.65 | 8.16 | 14.26 | 1.27 |
| LII | 13.00 | 6.04 | 17.44 | 53.62 | 2.37 | 6.93 | 80.14 | 2.68 | 1.20 | 3.47 | 10.65 | 0.48 | 1.38 |
| XXXV | 9.28 | 4.75 | 9.82 | 53.72 | 17.87 | 4.56 | 75.51 | 2.27 | 1.16 | 2.39 | 13.17 | 4.38 | 1.12 |
| XXXVI | 6.36 | 4.69 | 14.12 | 56.09 | 13.28 | 5.48 | 78.57 | 1.36 | 1.00 | 3.04 | 12.02 | 2.84 | 1.17 |
| XXV | 7.01 | 1.84 | 6.62 | 32.82 | 0.88 | 50.83 | 54.86 | 3.20 | 0.84 | 3.02 | 14.98 | 0.40 | 23.20 |
| XXXIV | 3.27 | 1.05 | 10.16 | 32.11 | 0.52 | 52.89 | 53.10 | 1.53 | 0.50 | 4.75 | 15.03 | 0.25 | 24.75 |
| XXVIII | 5.68 | 1.51 | 3.23 | 26.61 | 31.94 | 31.05 | 51.11 | 2.27 | 0.74 | 1.54 | 13.01 | 15.63 | 15.20 |
| XXXIII | 12.91 | 0.48 | 7.46 | 32.84 | 26.33 | 10.98 | 33.44 | 8.60 | 0.82 | 4.95 | 21.87 | 17.61 | 3.21 |
| XXIX | 14.21 | ...... | 5.27 | 42.53 | 32.56 | 5.43 | 65.02 | 4.85 | ...... | 1.80 | 14.49 | 11.09 | 1.85 |

ANALYSES

TABLE IV.—*Gen*

| Laboratory number of sample. | Kind of fish and portion taken for analysis. |
|---|---|
| | FRESH FISH. |
| I | Halibut (*Hippoglossus americanus*). Posterior part of body, lean |
| IX | Halibut (*Hippoglossus americanus*). Section of fatter portion of body |
| | Halibut, average of two samples |
| II | Flounder (*Paralichthys dentatus*). Entrails removed |
| XXII | Flounder (*Paralichthys dentatus*). Whole. Amagansett, L. I |
| | Flounder, average of two samples |
| III | Cod (*Gadus morrhua*). Head and entrails removed |
| XI | Cod (*Gadus morrhua*). Head and entrails removed |
| | Cod, average of two samples |
| XVI | Haddock (*Melanogrammus æglefinus*). Entrails removed |
| XXI | Haddock (*Melanogrammus æglefinus*). Entrails removed. Rockaway, L. I |
| | Haddock, average of two samples |
| IV | Eels, salt water (*Anguilla rostrata*). Skin, head, and entrails removed |
| V | Alewives (*Pomolobus vernalis*). Whole. Connecticut River |
| VI | Shad (*Alosa sapidissima*). Whole. Hudson River. First of season |
| X | Shad (*Alosa sapidissima*). Whole. Connecticut River. Early in season |
| XXXII | Shad (*Alosa sapidissima*). Whole. Connecticut River |
| | Shad, average of three samples |
| VII | Striped bass (*Roccus lineatus*). Whole. Connecticut River |
| XIX | Striped bass (*Roccus lineatus*). Whole. Bridgehampton, L. I |
| | Striped bass, average of two samples |
| VIII | Mackerel (*Scomber scombrus*). Whole |
| XIII | Mackerel (*Scomber scombrus*). Whole |
| XXX | Mackerel (*Scomber scombrus*). Whole. Cape May, N. J |
| XXXIX | Mackerel (*Scomber scombrus*). Whole. Cape Cod, Mass |
| | Mackerel, average of four samples |
| XII | Blue fish (*Pomatomus saltatrix*). Entrails removed |
| XIV | Salmon (*Salmo salar*). Entrails removed. Maine |
| XXVII | California salmon (*Oncorhynchus chouicha.*) Edible portion of anterior part. California |
| XVII | Salmon trout, Mackinaw trout (*Salvelinus namaycush*). Whole. Lake Ontario |
| XXIV | Brook trout (*Salvelinus fontinalis*). Whole. Cultivated |
| XVIII | White fish (*Coregonus clupeiformis*). Whole. Lake Champlain |
| XV | Porgy (*Stenotomus argyrops*). Whole |
| XXXI | Porgy (*Stenotomus argyrops*). Whole. Rhode Island |
| | Porgy, average of two samples |
| XXXVIII | Black fish (*Tautoga onitis*). Whole. Stonington, Conn |
| XX | Red snapper (*Lutjanus Blackfordii*). Whole. Fernandina, Fla |
| XXVI | Red snapper (*Lutjanus Blackfordii*). Entrails removed. Florida Coast |
| I | Red snapper, average of two samples |
| XXXII | Smelt (*Osmerus mordax*). Whole. Hackensack River, New Jersey |
| XLIII | Spanish mackerel (*Cybium maculatum*). Whole |
| XLIV | White perch (*Morone americana*). Whole |
| XLVI | White perch (*Morone americana*). Whole |
| | White perch, average of two samples |

OF FISH.

*eral Résumé.*

| Flesh, edible portion. | | | | | Whole or dressed fish. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ingredients of solids (nutrients). | | | | Edible portion. | | | | | |
| Water. | Solids. | Albuminoids. | Fats. | Mineral matter. | Waste: bones, skin, entrails, &c. | Water. | Albuminoids. | Fats. | Mineral matter. | Total edible solids, actual nutritive substance. | Laboratory number of sample. |
| *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | |
| 79.20 | 20.80 | 17.52 | 2.14 | 1.14 | 24.08 | 60.12 | 13.30 | 1.63 | 0.87 | 15.80 | I |
| 69.41 | 30.59 | 18.93 | 10.53 | 1.13 | 11.72 | 61.27 | 16.71 | 9.30 | 1.00 | 27.01 | IX |
| 74.31 | 25.69 | 18.23 | 6.33 | 1.14 | ....... | ....... | ....... | ....... | ....... | ....... | |
| 82.89 | 17.11 | 15.23 | 0.61 | 1.27 | 58.07 | 34.27 | 6.29 | 0.25 | 0.52 | 6.87 | II |
| 84.82 | 15.18 | 13.19 | 0.77 | 1.22 | 68.03 | 27.12 | 4.21 | 0.25 | 0.39 | 4.78 | XXII |
| 83.86 | 16.14 | 14.20 | 0.70 | 1.25 | ....... | ....... | ....... | ....... | ....... | ....... | |
| 83.00 | 17.00 | 15.46 | 0.28 | 1.26 | 35.43 | 53.59 | 9.98 | 0.18 | 0.82 | 10.98 | III |
| 81.91 | 18.09 | 16.42 | 0.39 | 1.20 | 31.87 | 55.61 | 11.43 | 0.27 | 0.82 | 12.54 | XI |
| 82.46 | 17.54 | 15.94 | 0.34 | 1.23 | 33.60 | 54.60 | 10.76 | 0.23 | 0.82 | 11.81 | |
| 80.64 | 19.36 | 18.04 | 0.18 | 1.14 | 53.16 | 37.77 | 8.45 | 0.08 | 0.54 | 9.07 | XVI |
| 81.79 | 18.27 | 16.50 | 0.14 | 1.57 | 52.50 | 38.85 | 7.84 | 0.07 | 0.74 | 8.65 | XXI |
| 81.22 | 18.78 | 17.26 | 0.16 | 1.36 | 52.83 | 38.31 | 8.15 | 0.07 | 0.64 | 8.86 | |
| 70.48 | 29.52 | 18.85 | 9.77 | 0.90 | 23.76 | 53.74 | 14.87 | 7.45 | 0.68 | 22.50 | IV |
| 75.67 | 24.33 | 18.94 | 3.93 | 1.46 | 50.52 | 37.43 | 9.37 | 1.95 | 0.73 | 12.05 | V |
| 69.37 | 30.63 | 18.57 | 10.76 | 1.30 | 51.69 | 33.51 | 8.97 | 5.20 | 0.63 | 14.80 | VI |
| 64.53 | 35.47 | 19.80 | 14.20 | 1.47 | 47.65 | 33.78 | 10.37 | 7.43 | 0.77 | 18.57 | X |
| 70.62 | 29.38 | 18.04 | 10.02 | 1.32 | 47.20 | 37.27 | 9.54 | 5.29 | 0.70 | 15.53 | XXXII |
| 68.17 | 31.83 | 18.80 | 11.66 | 1.36 | 47.43 | 34.35 | 9.63 | 5.97 | 0.70 | 16.30 | |
| 78.58 | 21.42 | 18.92 | 1.58 | 0.92 | 57.91 | 33.08 | 7.96 | 0.66 | 0.39 | 9.01 | VII |
| 79.13 | 20.87 | 16.80 | 2.71 | 1.36 | 57.40 | 33.64 | 7.14 | 1.15 | 0.58 | 8.87 | XIX |
| 78.86 | 21.14 | 17.86 | 2.15 | 1.14 | 57.70 | 33.36 | 7.55 | 0.90 | 0.49 | 8.94 | |
| 78.59 | 21.41 | 18.27 | 2.19 | 0.95 | 39.45 | 47.58 | 11.06 | 1.33 | 0.58 | 12.97 | VIII |
| 74.23 | 25.77 | 17.51 | 7.02 | 1.24 | 54.24 | 33.97 | 8.01 | 3.21 | 0.57 | 11.79 | XIII |
| 73.69 | 26.31 | 18.07 | 6.95 | 1.29 | 49.71 | 37.05 | 9.09 | 3.50 | 0.65 | 13.24 | XXX |
| 62.75 | 37.25 | 19.34 | 16.45 | 1.46 | 35.40 | 40.54 | 12.49 | 10.63 | 0.94 | 24.06 | XXXIX |
| 72.32 | 27.68 | 18.30 | 8.15 | 1.23 | 44.70 | 39.78 | 10.16 | 4.68 | 0.68 | 15.52 | |
| 78.16 | 21.84 | 19.32 | 1.25 | 1.27 | 49.86 | 39.18 | 9.69 | 0.63 | 0.64 | 10.96 | XII |
| 66.33 | 34.67 | 19.81 | 12.77 | 1.09 | 23.84 | 50.52 | 15.09 | 9.73 | 0.82 | 25.64 | XIV |
| 60.57 | 39.43 | 19.75 | 18.60 | 1.08 | 00.00 | 60.57 | 19.75 | 18.60 | 1.08 | 39.43 | XXVII |
| 66.80 | 33.20 | 17.22 | 14.69 | 1.29 | 56.69 | 28.93 | 7.46 | 6.36 | 0.56 | 14.38 | XVII |
| 77.04 | 22.96 | 18.47 | 3.08 | 1.41 | 53.05 | 36.17 | 8.67 | 1.45 | 0.66 | 10.78 | XXIV |
| 70.08 | 29.92 | 22.10 | 6.20 | 1.62 | 54.24 | 32.07 | 10.11 | 2.84 | 0.74 | 13.69 | XVIII |
| 79.72 | 20.28 | 17.44 | 1.45 | 1.39 | 61.66 | 30.56 | 6.69 | 0.56 | 0.53 | 7.78 | XV |
| 71.94 | 28.06 | 18.85 | 7.86 | 1.35 | 58.19 | 30.09 | 7.88 | 3.28 | 0.56 | 11.72 | XXXI |
| 75.84 | 24.16 | 18.15 | 4.65 | 1.36 | 59.92 | 30.33 | 7.29 | 1.82 | 0.55 | 9.66 | |
| 76.66 | 23.34 | 19.25 | 2.81 | 1.28 | 57.84 | 32.12 | 8.31 | 1.19 | 0.54 | 10.04 | XXXVIII |
| 76.45 | 23.55 | 21.88 | 0.69 | 1.48 | 60.40 | 30.27 | 8.47 | 0.27 | 0.59 | 9.33 | XX |
| 77.06 | 22.94 | 19.66 | 1.94 | 1.34 | 52.64 | 36.50 | 9.31 | 0.92 | 0.63 | 10.86 | XXVI |
| 76.74 | 23.26 | 20.52 | 1.31 | 1.42 | ....... | ....... | ....... | ....... | ....... | ....... | |
| 79.71 | 20.29 | 16.43 | 1.94 | 1.92 | 38.22 | 49.25 | 10.15 | 1.20 | 1.18 | 12.53 | XXIII |
| 67.77 | 32.23 | 21.34 | 9.39 | 1.50 | 35.98 | 43.39 | 13.66 | 6.01 | 0.96 | 20.63 | XLIII |
| 75.12 | 24.88 | 18.20 | 5.57 | 1.11 | 64.76 | 26.47 | 6.41 | 1.96 | 0.39 | 8.76 | XLIV |
| 75.94 | 24.06 | 20.36 | 2.42 | 1.28 | 63.76 | 27.51 | 7.38 | 0.88 | 0.47 | 8.73 | XLVI |
| 75.43 | 24.57 | 19.28 | 4.00 | 1.10 | 64.26 | 26.98 | 6.89 | 1.42 | 0.43 | 8.74 | |

ANALYSES

TABLE IV.—General

| Laboratory number of sample. | Kind of fish and portion taken for analysis. | Salt.* |
|---|---|---|
| | FRESH FISH—Continued. | |
| XLV | Masquallonge (*Esox nobilior*). Whole St. Lawrence River | |
| XLVII | Herring (*Clupea harengus*). Whole. Florida | |
| XLVIII | Sheepshead (*Archosargus probatocephalus*). Entrails removed. Florida | |
| XLIX | Turbot (*Platysomatichthys hippoglossoides*). Whole. Newfoundland | |
| LII | Yellow pike-perch (*Stizostedium vitreum.*) Whole | |
| LIII | Black bass (*Micropterus pallidus*). Whole. North Carolina | |
| XXXV | Spent salmon (*Salmo salar*), male. Whole. Penobscot River, Maine | |
| XXXVI | Spent salmon (*Salmo salar*), female. Whole. Penobscot River, Maine | |
| XL | Spent land-locked salmon (*Salmo salar*, subsp. *sebago*), male. Whole. Grand Lake Stream, Maine | |
| XLI | Spent land-locked salmon (*Salmo salar*, subsp., *sebago*), female. Whole. Grand Lake Stream, Maine | |
| | CURED FISH. | Per ct. |
| XXIX | Canned salmon (*Oncorhynchus chouicha*). California. (Oregon) | |
| XXVIII | Smoked halibut (*Hippoglossus americanus*) | 13.51 |
| XXXIII | Smoked herring (*Clupea harengus*) | 11.80 |
| XXV | Boned cod (*Gadus morrhua*) | 19.02 |
| XXXIV | Salt cod (*Gadus morrhua*). "Channel fish." St. George's Banks | 22.33 |
| XXXVII | Salt cod (*Gadus morrhua*). "Boat fish." Vicinity of Nantucket, Mass | 18.12 |
| | Salt cod, average of three samples† | |
| XLII | Salt mackerel (*Scomber scombrus*). "No. 1 mackerel" | 11.50 |

*In computing the mineral matter in the salted and smoked fish, it was assumed that the mineral as in the averages of the corresponding samples of fresh fish; the excess actually found is counted

OF FISH.

*Résumé*—Continued.

| Flesh, edible portion. | | | | | Whole or dressed fish. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ingredients of solids (nutrients). | | | | Edible portion. | | | | | |
| Water. | Solids. | Albuminoids. | Fats. | Mineral matter. | Waste: bones, skin, entrails, &c. | Water. | Albuminoids. | Fats. | Mineral matter. | Total edible solids, actual nutritive substance. | Laboratory number of sample. |
| *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | |
| 75.33 | 24.67 | 20.24 | 2.87 | 1.56 | 40.43 | 38.10 | 10.23 | 1.45 | 0.79 | 12.47 | XLV |
| 67.77 | 82.23 | 19.43 | 11.32 | 1.48 | 48.87 | 84.65 | 9.93 | 5.79 | 0.76 | 11.48 | XLVII |
| 71.54 | 28.46 | 20.68 | 6.69 | 1.00 | 57.93 | 80.10 | 8.70 | 2.81 | 0.46 | 11.97 | XLVIII |
| 70.10 | 29.90 | 14.49 | 14.15 | 1.26 | 47.73 | 86.65 | 7.57 | 7.30 | 0.66 | 15.62 | XLIX |
| 79.61 | 20.39 | 18.55 | 0 47 | 1.37 | 58.73 | 32.86 | 7.66 | 0.19 | 0.57 | 8.42 | LII |
| 78.08 | 21.92 | 19.72 | 1.02 | 1.18 | 56.84 | 83.73 | 8.51 | 0.44 | 0.48 | 9.43 | LIII |
| 75.84 | 24.66 | 19.17 | 4.37 | 1.12 | 44.27 | 41.99 | 10.68 | 2.44 | 0.62 | 13.74 | XXXV |
| 78.34 | 21.66 | 17.05 | 2.84 | 1.17 | 43.82 | 44.00 | 9.02 | 1.60 | 0.66 | 12.18 | XXXVI |
| 78.40 | 21.60 | 16.29 | 4.04 | 1.27 | 49.26 | 89.78 | 8.27 | 2.05 | 0.64 | 10.96 | XL |
| 79.53 | 20.47 | 17.31 | 1.96 | 1.20 | 47.50 | 41.75 | 9.09 | 1.03 | 0.63 | 10.75 | XLI |
| 66.00 | 34.00 | 21.10 | 11.04 | 1.86 | 12.01 | 58.08 | 18.56 | 9.71 | 1.64 | 29.91 | XXIX |
| 50.85 | 49.15 | 18.43 | 15.57 | 1.64 | 8.66 | 46.45 | 10.83 | 14.22 | 1.40 | 32.45 | XXVIII |
| 35.00 | 64.30 | 31.57 | 18.66 | 2.37 | 45.02 | 10.57 | 17.36 | 10.26 | 1.30 | 28.92 | XXXIII |
| 51.35 | 48.65 | 26.45 | 0.38 | 1.90 | ........ | 51.35 | 26.45 | 0.38 | 1.90 | 28.73 | XXV |
| 51.92 | 48.08 | 23.07 | 0.24 | 1.84 | 25.98 | 38.43 | 17.52 | 0.18 | 1.39 | 19.09 | XXXIV |
| 54.24 | 45.76 | 24.87 | 0.91 | 1.86 | 25.75 | 39.95 | 18.46 | 0.68 | 1.35 | 20.49 | XXXVII |
| 52.50 | 47.49 | 25.00 | 0.51 | 1.87 | 25.87 | 38.69 | 17.90 | 0.43 | 1.37 | 19.79 | |
| 42.66 | 57.34 | 21.37 | 22.84 | 1.63 | 27.72 | 30.83 | 15.45 | 16.51 | 1.18 | 33.14 | XLII |

matters properly belonging to the fish would bear the same ratio to the flesh (albuminoids plus fats), as "Salt."  † Under "Whole or Dressed Fish," two samples.

ANALYSES OF

TABLE V.—*Statistics and propor*

| Laboratory number of sample. | Name and locality of sample. | Sample received. | | Number taken for analysis. | Total weight. | Average weight. | In whole sample. | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Flesh. | Liquids. |
| | OYSTERS (*Ostrea virginiana*). | | | | | | | |
| | | 1881. | | | *Grams.* | *Grams.* | *Pr. ct.* | *Pr. ct.* |
| LXVIII | Buzzard's Bay, Mass | May | 5 | 29 | 2,764.0 | 95.3 | 12.50 | 7.50 |
| LXX | Providence River, R. I | May | 5 | 28 | 3,301.0 | 117.9 | 10.88 | 6.12 |
| LV | Stony Creek, Conn | Apr. | 5 | 39 | 6,685.0 | 171.4 | 7.52 | 11.38 |
| LXXV | ......do | May | 24 | 30 | 3,448.0 | 114.9 | 7.34 | 11.81 |
| LIV | Fair Haven, Conn | Apr. | 4 | 33 | 3,784.5 | 114.7 | 12.03 | 5.43 |
| LVI | Blue Point, N. Y | Apr. | 8 | 47 | 3,725.5 | 79.3 | 13.39 | 5.23 |
| LVIII | Rockaway, N. Y | Apr. | 12 | 50 | 5,058.0 | 101.2 | 10.68 | 7.72 |
| LVII | East River, N. Y | Apr. | 8 | 51 | 5,433.7 | 106.5 | 10.27 | 10.01 |
| LX | Staten Island, N. Y | Apr. | 20 | 30 | 3,901.5 | 130.4 | 9.13 | 7.10 |
| LXI | Shrewsbury, N. J | Apr. | 20 | 28 | 3,904.0 | 139.4 | 12.64 | 4.88 |
| LIX | Norfolk, Va | Apr. | 12 | 48 | 6,635.5 | 138.3 | 4.66 | 6.52 |
| LXXIII | Potomac River, Va. (Transplanted.) | May | 16 | 55 | 3,501.4 | 63.7 | 6.51 | 5.64 |
| LXXII | Rappahannock River, Va. (Transplanted.) | May | 16 | 28 | 3,309.5 | 118.2 | 7.86 | 7.31 |
| LXXI | James River, Va. (Transplanted.) | May | 16 | 30 | 3,085.9 | 102.8 | 6.50 | 7.29 |
| | Average of 14 samples | .......... | | 37.4 | 4,181.2 | 113.8 | 9.47 | 7.42 |
| LXXIV | "Cove," Chesapeake Bay. (Canned.) | May | 24 | ...... | .......... | ........ | 50.23 | 49.77 |
| | SCALLOPS (*Pecten irradians.*) | | | | | | | |
| LI | Shelter Island, N. Y | Mar. | 15 | ...... | .......... | ........ | 100.00 | ........ |
| LXIII | ......do | Apr. | 26 | ...... | .......... | ........ | 100.00 | ........ |
| | Average of 2 samples | .......... | | ...... | .......... | ........ | 100.00 | ........ |
| | LONG CLAMS (*Mya arenaria*). | | | | | | | |
| LXVII | Boston, Mass | May | 5 | 20 | 1,504.0 | 75.2 | 29.26 | 24.64 |
| LXV | Long Island, N. Y | Apr. | 28 | 20 | 1,378.5 | 68.9 | 36.49 | 21.15 |
| | Average of 2 samples | .......... | | 20 | 1,441.3 | 72.1 | 32.87 | 22.90 |
| | ROUND CLAMS (*Venus mercenaria*). | | | | | | | |
| LXVI | Little Neck, N. Y | Apr. | 28 | 20 | 1,907.5 | 95.4 | 16.80 | 14.91 |
| | LOBSTERS (*Homarus americanus*). | | | | | | | |
| L | Maine | Mar. | 15 | 2 | 1,973.0 | 986.5 | ........ | ........ |
| LXII | ......do | Apr. | 26 | 1 | 876.5 | 876.5 | ........ | ........ |
| LXIX | Boston, Mass | May | 5 | 1 | 1,335.0 | 1,335.0 | ........ | ........ |
| | Average of 3 samples | .......... | | ...... | .......... | 1,065.7 | ........ | ........ |
| LXXVI | Canned lobster. Maine | May | 26 | ...... | .......... | ........ | ........ | ........ |
| | CRAY-FISH. | | | | | | | |
| LXIV | Potomac River, Va | Apr. | 26 | 21 | 695.0 | 33.1 | 12.30 | ........ |

INVERTEBRATES.

*tions of water and dry substance.*

| In whole sample. | | | In flesh. | | In liquids. | | In edible portion. | | In whole sample. | | | Laboratory number of sample. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total edible portion. | Refuse (shell). | Loss in cleaning. | Water. | Dry substance. | Water. | Dry substance. | Water. | Dry substance. | Dry substance in flesh. | Dry substance in liquids. | Dry substance in edible portion. | |
| *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | |
| 20.01 | 79.77 | 0.22 | 84.21 | 15.79 | 96.40 | 3.60 | 88.80 | 11.20 | 1.98 | 0.27 | 2.25 | LXVIII |
| 17.00 | 82.41 | 0.59 | 79.01 | 20.99 | 95.05 | 4.95 | 84.79 | 15.21 | 2.28 | 0.30 | 2.58 | LXX |
| 18.90 | 79.74 | 1.36 | 81.02 | 18.98 | 96.12 | 3.88 | 90.04 | 9.96 | 1.43 | 0.44 | 1.87 | LV |
| 19.15 | 79.66 | 1.19 | 82.09 | 17.91 | 96.33 | 3.67 | 90.89 | 9.11 | 1.34 | 0.43 | 1.76 | LXXV |
| 18.06 | 79.92 | 2.02 | 81.30 | 18.70 | 94.00 | 6.00 | 85.12 | 14.88 | 2.36 | 0.33 | 2.69 | LIV |
| 18.62 | 80.16 | 1.22 | 76.24 | 23.76 | 94.33 | 5.67 | 89.76 | 10.24 | 3.18 | 0.19 | 3.37 | LVI |
| 18.40 | 81.18 | 0.42 | 81.27 | 18.73 | 95.06 | 4.94 | 86.98 | 13.02 | 2.00 | 0.38 | 2.38 | LVIII |
| 20.28 | 78.86 | 0.86 | 79.92 | 20.08 | 95.44 | 4.56 | 87.57 | 12.43 | 2.07 | 0.46 | 2.53 | LVII |
| 16.23 | 83.16 | 0.61 | 84.47 | 15.53 | 96.35 | 3.65 | 89.58 | 10.42 | 1.42 | 0.26 | 1.68 | LX |
| 17.52 | 81.76 | 0.72 | 81.65 | 18.35 | 95.07 | 4.93 | 85.37 | 14.63 | 2.31 | 0.24 | 2.55 | LXI |
| 11.18 | 88.31 | 0.51 | 83.86 | 16.14 | 96.83 | 3.17 | 91.45 | 8.55 | 0.75 | 0.21 | 0.96 | LIX |
| 12.15 | 87.10 | 0.75 | 78.87 | 21.13 | 95.51 | 4.49 | 86.60 | 13.40 | 1.38 | 0.25 | 1.63 | LXXIII |
| 15.17 | 84.02 | 0.81 | 82.64 | 17.36 | 97.24 | 2.76 | 89.88 | 10.12 | 1.36 | 0.20 | 1.56 | LXXII |
| 13.79 | 85.30 | 0.91 | 83.49 | 16.51 | 95.81 | 4.09 | 90.05 | 9.95 | 1.07 | 0.30 | 1.37 | LXXI |
| 16.89 | 82.23 | 0.88 | 81.43 | 18.57 | 95.69 | 4.31 | 87.71 | 12.29 | 1.85 | 0.30 | 2.08 | |
| 100.00 | ........ | ..... | 78.73 | 21.27 | 93.57 | 6.43 | 86.14 | 13.88 | 10.68 | 3.20 | 13.88 | LXXIV |
| 100.00 | ........ | ...... | 77.79 | 22.21 | ........ | ...... | 77.79 | 22.21 | 22.21 | ...... | 22.21 | LI |
| 100.00 | ........ | ...... | 82.84 | 17.16 | ........ | ...... | 82.84 | 17.16 | 17.16 | ...... | 17.16 | LXIII |
| 100.00 | ........ | ...... | 80.32 | 19.68 | ........ | ...... | 80.32 | 19.68 | 19.68 | ...... | 19.68 | |
| 53.90 | 44.28 | 1.82 | 77.98 | 22.04 | 95.73 | 4.27 | 86.11 | 13.89 | 6.45 | 1.05 | 7.50 | LXVII |
| 57.64 | 39.93 | 2.43 | 81.05 | 18.95 | 94.76 | 5.24 | 86.05 | 13.95 | 6.91 | 1.08 | 7.98 | LXV |
| 55.77 | 42.11 | 2.12 | 79.52 | 20.48 | 95.25 | 4.75 | 86.08 | 13.92 | 6.68 | 1.07 | 7.74 | |
| 31.71 | 67.50 | 0.79 | 78.24 | 21.76 | 95.22 | 4.78 | 86.20 | 13.80 | 3.66 | 0.73 | 4.39 | LXVI |
| 52.52 | 43.96 | 3.52 | 84.30 | 15.70 | ........ | ...... | 84.30 | 15.70 | 8.25 | ...... | 8.25 | L |
| 36.24 | 60.87 | 2.89 | 81.77 | 18.23 | ........ | ...... | 81.77 | 18.23 | 6.60 | ...... | 6.60 | LXII |
| 30.56 | 67.57 | 1.87 | 82.11 | 17.89 | ........ | ...... | 82.11 | 17.89 | 5.47 | ...... | 5.47 | LXIX |
| 39.77 | 57.47 | 2.76 | 82.73 | 17.27 | ........ | ...... | 82.73 | 17.27 | 6.77 | ...... | 6.77 | |
| 100.00 | ........ | ...... | 79.36 | 20.64 | ........ | ...... | 79.36 | 20.64 | 20.64 | ...... | 20.64 | LXXVI |
| 12.30 | 85.15 | 2.55 | 81.22 | 18.78 | ........ | ...... | 81.22 | 18.78 | 2.31 | ...... | 2.31 | LXIV |

ANALYSES OF

TABLE VI.—*Analyses cal*

| Laboratory number of sample. | Name and locality of sample. | In flesh. Nitrogen. | In flesh. Albuminoids (nitrogen × 6.25). | In flesh. Fat. | In flesh. Crude ash. |
|---|---|---|---|---|---|
| | OYSTERS (*Ostrea virginiana*). | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* |
| LXVIII | Buzzard's Bay, Mass | 7.85 | 49.06 | 9.95 | 9.39 |
| LXX | Providence River, R. I | 7.85 | 49.06 | 12.25 | 10.15 |
| LV | Stony Creek, Conn | 8.82 | 55.13 | 8.41 | 14.58 |
| LXXV | ......do | 8.83 | 55.19 | 8.29 | 14.30 |
| LIV | Fairhaven, Conn | 8.46 | 52.88 | 10.02 | 11.77 |
| LVI | Blue Point, N. Y | 7.08 | 44.25 | 9.89 | 8.66 |
| LVIII | Rockaway, N. Y | 7.84 | 49.00 | 11.34 | 8.94 |
| LVII | East River, N. Y | 8.32 | 52.00 | 10.79 | 8.89 |
| LX | Staten Island, N. Y | 8.51 | 53.18 | 10.84 | 9.10 |
| LXI | Shrewsbury, N. J | 7.15 | 44.69 | 12.00 | 7.24 |
| LIX | Norfolk, Va | 9.24 | 57.75 | 9.01 | 11.27 |
| LXXIII | Potomac River, Va. (Transplanted) | 7.43 | 46.44 | 10.77 | 12.02 |
| LXXII | Rappahannock River, Va. (Transplanted | 7.83 | 48.94 | 10.96 | 9.12 |
| LXXI | James River, Va. (Transplanted) | 8.01 | 50.06 | 10.76 | 10.48 |
| | Average of 14 samples | 8.09 | 50.56 | 10.44 | 10.42 |
| LXXIV | "Cove," Chesapeake Bay. (Canned) | 10.50 | 65.62 | 17.76 | 7.51 |
| | SCALLOPS (*Pecten irradians*). | | | | |
| LI | Shelter Island, N. Y | 10.84 | 67.75 | 0.13 | 6.68 |
| LXIII | ......do | 13.46 | 84.13 | 1.76 | 7.51 |
| | Average of 2 samples | 12.15 | 75.94 | 0.95 | 7.10 |
| | LONG CLAM (*Mya arenaria*). | | | | |
| LXVII | Boston, Mass | 10.56 | 66.00 | 8.13 | 12.51 |
| LXV | Long Island, N. Y | 10.57 | 66.06 | 8.03 | 8.23 |
| | Average of 2 samples | 10.57 | 66.03 | 8.08 | 10.37 |
| | ROUND CLAM (*Venus mercenaria*). | | | | |
| LXVI | Little Neck, N. Y | 8.52 | 53.25 | 8.39 | 10.19 |
| | LOBSTERS (*Homarus americanus*). | | | | |
| L | Maine | 11.85 | 74.06 | 11.62 | 10.38 |
| LXII | ......do | 12.33 | 77.06 | 8.47 | 9.36 |
| LXIX | Boston, Mass | 13.44 | 84.00 | 14.19 | 10.43 |
| | Average of 3 samples | 12.54 | 78.37 | 11.43 | 10.06 |
| LXXVI | Canned lobster, Maine | 12.98 | 81.13 | 2.24 | 13.44 |
| | CRAY-FISH. | | | | |
| LXIV | Potomac River, Va | 13.63 | 85.19 | 2.45 | 6.98 |

INVERTEBRATES.

*culated on dry substance.*

| In flesh. | | | In liquids. | | | | In flesh and liquids. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Phosphorus (calculated as $P_2O_5$). | Sulphur (calculated as $SO_3$). | Chlorine. | Nitrogen. | Albuminoids (nitrogen × 6.25). | Fat. | Crude ash. | Nitrogen. | Albuminoids (nitrogen × 6.25). | Fat. | Crude ash. | Laboratory number of sample. |
| *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | *Pr. ct.* | |
| 1.17 | 4.15 | 3.53 | 5.58 | 34.87 | 0.07 | 45.27 | 7.00 | 43.08 | 6.21 | 22.34 | LXVIII |
| 1.64 | 3.55 | 2.39 | 4.78 | 29.87 | 0.04 | 48.79 | 6.74 | 42.17 | 7.86 | 24.06 | LXX |
| 1.40 | 5.31 | 4.83 | 3.42 | 21.35 | 0.35 | 70.91 | 5.57 | 34.76 | 8.55 | 48.50 | LV |
| 1.77 | 3.65 | 3.70 | 3.06 | 19.12 | 1.31 | 70.46 | 5.27 | 32.89 | 8.99 | 48.93 | LXXV |
| 1.57 | 5.58 | 3.11 | 5.56 | 34.76 | 0.27 | 53.13 | 7.01 | 47.49 | 7.70 | 24.35 | LIV |
| 1.28 | 3.70 | 1.96 | 6.50 | 40.62 | 1.54 | 33.74 | 6.92 | 43.18 | 7.55 | 15.71 | LVI |
| 1.59 | 3.89 | 2.81 | 5.32 | 33.27 | 0.71 | 45.75 | 6.78 | 42.31 | 6.68 | 24.38 | LVIII |
| 1.02 | 9.01 | 2.04 | 5.85 | 36.57 | 0.45 | 34.45 | 7.10 | 44.31 | 5.69 | 21.51 | LVII |
| 1.98 | 3.19 | 1.98 | 5.71 | 35.68 | 2.55 | 23.15 | 7.29 | 45.42 | 7.21 | 15.25 | LX |
| 1.61 | 2.23 | 1.58 | 6.60 | 41.25 | 0.88 | 37.18 | 7.00 | 43.68 | 8.86 | 15.58 | LXI |
| 1.79 | 2.88 | 2.76 | 5.22 | 32.63 | 0.18 | 52.03 | 6.90 | 43.05 | 8.86 | 35.08 | LIX |
| 1.70 | 2.59 | 3.18 | 5.16 | 32.24 | 0.25 | 54.96 | 6.37 | 39.75 | 5.89 | 31.96 | LXXIII |
| 1.80 | 2.13 | 1.93 | 5.89 | 36.81 | 0.24 | 53.06 | 6.90 | 43.05 | 5.80 | 30.59 | LXXII |
| 1.70 | 2.78 | 3.24 | 4.64 | 29.00 | 0.27 | 62.64 | 6.23 | 38.88 | 5.21 | 38.06 | LXXI |
| 1.63 | 3.63 | 2.82 | 5.24 | 32.75 | 0.51 | 49.01 | 6.69 | 41.79 | 6.16 | 28.31 | |
| 1.02 | 0.94 | 2.56 | 4.41 | 27.56 | 4.14 | 19.32 | 7.47 | 46.61 | 10.98 | 13.89 | LXXIV |
| 2.17 | 2.23 | 1.76 | ....... | ....... | ....... | ....... | 10.84 | 67.75 | 0.13 | 6.68 | LI |
| 2.75 | 2.76 | 1.87 | ....... | ....... | ....... | ....... | 13.46 | 84.13 | 1.76 | 7.51 | LXIII |
| 2.46 | 2.55 | 1.81 | ....... | ....... | ....... | ....... | 12.15 | 75.94 | 0.95 | 7.10 | |
| 2.23 | 3.14 | 2.98 | 1.86 | 11.62 | 0.14 | 77.20 | 6.58 | 41.07 | 4.48 | 42.08 | LXVII |
| 2.48 | 2.35 | 1.84 | 3.92 | 24.50 | 0.55 | 56.00 | 8.14 | 50.79 | 5.29 | 25.75 | LXV |
| 2.36 | 2.75 | 2.41 | 2.89 | 18.06 | 0.35 | 66.60 | 7.36 | 45.93 | 4.89 | 33.97 | |
| 1.71 | 4.11 | 3.22 | 2.96 | 18.50 | 0.34 | 64.07 | 5.90 | 36.83 | 1.95 | 35.94 | LXVI |
| 2.13 | 2.89 | 4.35 | ....... | ....... | ....... | ....... | 11.85 | 74.06 | 11.62 | 10.38 | L |
| 2.24 | 1.07 | 3.23 | ....... | ....... | ....... | ....... | 12.33 | 77.06 | 8.47 | 9.36 | LXII |
| 2.35 | 3.06 | 2.81 | ....... | ....... | ....... | ....... | 13.44 | 84.00 | 14.19 | 10.43 | LXIX |
| 2.24 | 2.47 | 3.46 | ....... | ....... | ....... | ....... | 12.54 | 78.37 | 11.43 | 10.06 | |
| 1.14 | 2.34 | 5.05 | ....... | ....... | ....... | ....... | 12.98 | 81.13 | 2.24 | 13.44 | LXXVI |
| 2.85 | 1.39 | 1.44 | ....... | ....... | ....... | ....... | 13.63 | 85.19 | 2.45 | 6.98 | LXIV |

ANALYSES OF

TABLE VII.—*Recap*

| Laboratory number of sample. | Name and locality of sample. | Calculated on — In flesh. — Water. | Nitrogen. | Albuminoids (nitrogen × 6.25). | Fat. | Crude ash. | Phosphorus (calculated as $P_2O_5$). | Sulphur (calculated as $SO_3$). | Chlorine. |
|---|---|---|---|---|---|---|---|---|---|
| | OYSTERS (*Ostrea virginiana*). | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* |
| LXVIII | Buzzard's Bay, Mass | 84.21 | 1.24 | 7.75 | 1.57 | 1.48 | 0.16 | 0.66 | 0.56 |
| LXX | Providence River, R. I | 79.01 | 1.65 | 10.30 | 2.58 | 2.13 | 0.40 | 0.75 | 0.50 |
| LV | Stony Creek, Conn | 81.02 | 1.67 | 10.46 | 1.60 | 2.76 | 0.28 | 1.01 | 0.82 |
| LXXV | ......do | 82.09 | 1.57 | 9.83 | 1.48 | 2.55 | 0.32 | 0.65 | 0.69 |
| LIV | Fair Haven, Conn | 81.30 | 1.58 | 9.89 | 2.05 | 2.20 | 0.29 | 1.04 | 0.58 |
| LVI | Blue Point, N. Y | 76.24 | 1.68 | 10.51 | 2.35 | 2.06 | 0.30 | 0.88 | 0.47 |
| LVIII | Rockaway, N. Y | 81.27 | 1.47 | 9.18 | 2.13 | 1.67 | 0.30 | 0.73 | 0.53 |
| LVII | East River, N. Y | 79.92 | 1.67 | 10.44 | 2.10 | 1.70 | 0.33 | 1.01 | 0.59 |
| LX | Staten Island, N. Y | 84.47 | 1.33 | 8.30 | 1.68 | 1.41 | 0.31 | 0.50 | 0.31 |
| LXI | Shrewsbury, N. J | 81.65 | 1.31 | 8.20 | 2.20 | 1.33 | 0.20 | 0.41 | 0.29 |
| LIX | Norfolk, Va | 83.86 | 1.49 | 9.32 | 1.45 | 1.82 | 0.29 | 0.46 | 0.45 |
| LXXIII | Potomac River, Va. (Transplanted.) | 78.87 | 1.57 | 9.81 | 2.27 | 2.54 | 0.38 | 0.55 | 0.67 |
| LXXII | Rappahannock River, Va. (Transplanted.) | 82.64 | 1.36 | 8.49 | 1.90 | 1.58 | 0.31 | 0.37 | 0.34 |
| LXXI | James River, Va. (Transplanted.) | 83.40 | 1.32 | 8.19 | 1.78 | 1.71 | 0.36 | 0.46 | 0.54 |
| | Average of 14 samples | 81.43 | 1.49 | 9.31 | 1.94 | 1.93 | 0.30 | 0.68 | 0.53 |
| LXIV | Cove, Chesapeake Bay (Canned). | 78.73 | 2.24 | 13.96 | 3.78 | 1.60 | 0.34 | 0.20 | 0.54 |
| | SCALLOPS (*Pecten irradians*). | | | | | | | | |
| LI | Shelter Island, N. Y | 77.79 | 2.41 | 15.05 | 0.03 | 1.48 | 0.48 | 0.50 | 0.39 |
| LXIII | ......do | 82.84 | 2.31 | 14.44 | 0.30 | 1.29 | 0.47 | 0.47 | 0.32 |
| | Average of 2 samples | 80.32 | 2.36 | 14.75 | 0.17 | 1.38 | 0.48 | 0.49 | 0.36 |
| | LONG CLAM (*Mya arenaria*). | | | | | | | | |
| LXVII | Boston, Mass | 77.98 | 2.16 | 13.46 | 1.65 | 2.55 | 0.46 | 0.64 | 0.66 |
| LXV | Long Island, N. Y | 81.05 | 2.00 | 12.53 | 1.52 | 1.56 | 0.47 | 0.45 | 0.35 |
| | Average of 2 samples | 79.52 | 2.08 | 12.99 | 1.59 | 2.05 | 0.47 | 0.55 | 0.50 |
| | ROUND CLAM (*Venus mercenaria*). | | | | | | | | |
| LXVI | Little Neck, N. Y | 78.24 | 1.80 | 11.50 | 0.74 | 2.22 | 0.37 | 0.89 | 0.70 |
| | LOBSTER (*Homarus americanus*). | | | | | | | | |
| L | Maine | 84.30 | 1.86 | 11.65 | 1.82 | 1.63 | 0.33 | 0.38 | 0.68 |
| LXII | ......do | 81.77 | 2.24 | 14.05 | 1.55 | 1.71 | 0.41 | 0.36 | 0.59 |
| LXIX | Boston, Mass | 82.11 | 2.41 | 15.03 | 2.54 | 1.87 | 0.42 | 0.55 | 0.50 |
| | Average of 3 samples | 82.73 | 2.17 | 13.57 | 1.97 | 1.74 | 0.39 | 0.43 | 0.59 |
| LXVI | Canned lobster, Maine | 79.86 | 2.68 | 16.75 | 4.62 | 2.78 | 0.24 | 0.48 | 1.05 |
| | CRAY-FISH. | | | | | | | | |
| LXIV | Potomac River | 81.22 | 2.56 | 16.00 | 0.46 | 1.31 | 0.54 | 0.26 | 0.27 |

IN VERTEBRATES.

*itulation of analyses.*

fresh substance.

| In liquids: Water. | In liquids: Nitrogen. | In liquids: Albuminoids (nitrogen × 6.25). | In liquids: Fat. | In liquids: Crude ash. | In edible portion = flesh and liquids: Water. | In edible portion: Dry substance. | In dry substance: Albuminoids (nitrogen × 6.25). | In dry substance: Fat. | In dry substance: Crude ash. | In dry substance: Extractives. | In dry substance: Nitrogen. | Nutritive valuation (medium beef 100). | Total edible portion in whole sample (from Table V). | Laboratory number of sample. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | |
| 96.40 | 0.20 | 1.23 | 0.03 | 1.63 | 88.80 | 11.20 | 5.30 | 0.99 | 1.54 | 3.87 | 0.85 | 28.00 | 20.01 | LXVIII |
| 95.05 | 0.24 | 1.48 | 0.00 | 2.41 | 84.79 | 15.21 | 7.12 | 1.65 | 2.23 | 4.21 | 1.14 | 36.83 | 17.00 | LXX |
| 96.12 | 0.13 | 0.80 | 0.01 | 2.72 | 90.04 | 9.96 | 4.64 | 0.64 | 2.73 | 1.95 | 0.74 | 22.68 | 18.90 | LV |
| 96.33 | 0.11 | 0.68 | 0.05 | 2.61 | 90.89 | 9.11 | 4.10 | 0.60 | 2.59 | 1.73 | 0.67 | 20.48 | 19.15 | LXXV |
| 94.00 | 0.33 | 2.03 | 0.02 | 3.19 | 85.12 | 14.88 | 7.53 | 1.44 | 2.50 | 3.41 | 1.20 | 37.60 | 18.06 | LIV |
| 94.33 | 0.37 | 2.26 | 0.09 | 1.91 | 80.76 | 19.24 | 8.20 | 1.72 | 2.02 | 7.30 | 1.31 | 44.26 | 18.62 | LVI |
| 95.06 | 0.26 | 1.60 | 0.04 | 2.26 | 86.98 | 13.02 | 6.00 | 1.25 | 1.92 | 3.85 | 0.96 | 31.09 | 18.40 | LVIII |
| 95.44 | 0.31 | 1.91 | 0.02 | 1.83 | 87.57 | 12.43 | 6.31 | 1.10 | 1.87 | 3.15 | 1.01 | 31.61 | 20.28 | LVII |
| 96.35 | 0.21 | 1.30 | 0.09 | 0.85 | 89.58 | 10.42 | 5.24 | 0.98 | 1.17 | 3.03 | 0.84 | 26.70 | 16.23 | LX |
| 95.07 | 0.33 | 2.03 | 0.04 | 1.83 | 85.37 | 14.63 | 6.48 | 1.00 | 1.47 | 5.08 | 1.04 | 34.72 | 17.52 | LXI |
| 96.83 | 0.17 | 1.05 | 0.01 | 1.64 | 91.45 | 8.55 | 4.50 | 0.61 | 1.54 | 1.90 | 0.72 | 21.99 | 11.18 | LIX |
| 95.51 | 0.23 | 1.42 | 0.01 | 2.47 | 86.60 | 13.40 | 5.92 | 1.22 | 2.51 | 3.75 | 0.95 | 30.61 | 12.15 | LXXIII |
| 97.24 | 0.16 | 0.99 | 0.01 | 1.48 | 89.88 | 10.12 | 4.68 | 0.99 | 1.52 | 2.73 | 0.78 | 24.90 | 15.17 | LXXII |
| 95.81 | 0.19 | 1.17 | 0.01 | 2.56 | 90.05 | 9.95 | 4.47 | 0.84 | 2.16 | 2.48 | 0.74 | 22.69 | 13.79 | LXXI |
| 95.69 | 0.23 | 1.42 | 0.03 | 2.10 | 87.71 | 12.29 | 5.78 | 1.12 | 1.98 | 3.41 | 0.93 | 20.58 | 16.89 | |
| 93.5 | 70.28 | 1.77 | 0.27 | 1.24 | 86.14 | 13.86 | 7.89 | 2.04 | 1.42 | 2.51 | 1.26 | 39.24 | 100.00 | LXIV |
| ...... | ...... | ...... | ...... | ...... | 77.79 | 22.21 | 15.05 | 0.03 | 1.48 | 5.65 | 2.41 | 70.03 | 100.00 | LI |
| ...... | ...... | ...... | ...... | ...... | 82.84 | 17.16 | 14.44 | 0.80 | 1.29 | 1.13 | 2.31 | 63.87 | 100.00 | LXIII |
| ...... | ...... | ...... | ...... | ...... | 80.82 | 19.68 | 14.75 | 0.17 | 1.38 | 3.38 | 2.36 | 66.95 | 100.00 | |
| 95.78 | 0.08 | 0.49 | 0.01 | 3.29 | 86.11 | 13.89 | 7.53 | 0.90 | 2.89 | 2.57 | 1.21 | 36.00 | 53.90 | LXVII |
| 94.76 | 0.21 | 1.30 | 0.03 | 2.93 | 86.05 | 13.95 | 8.40 | 0.97 | 2.06 | 2.52 | 1.34 | 39.91 | 57.64 | LXV |
| 95.25 | 0.15 | 0.89 | 0.02 | 3.11 | 86.08 | 13.92 | 7.97 | 0.94 | 2.47 | 2.54 | 1.27 | 38.00 | 55.77 | |
| 95.22 | 0.14 | 0.86 | 0.02 | 3.17 | 86.20 | 13.80 | 6.56 | 0.40 | 2.67 | 4.17 | 1.05 | 32.56 | 81.71 | LXVI |
| ...... | ...... | ...... | ...... | ...... | 84.30 | 15.70 | 11.63 | 1.82 | 1.63 | 0.62 | 1.86 | 53.47 | 52.52 | L |
| ...... | ...... | ...... | ...... | ...... | 81.77 | 18.23 | 14.05 | 1.55 | 1.71 | 0.92 | 2.24 | 63.78 | 36.24 | LXII |
| ...... | ...... | ...... | ...... | ...... | 82.11 | 17.89 | 15.03 | 2.54 | 1.87 | 0.00 | 2.41 | 68.08 | 30.56 | LXIX |
| ...... | ...... | ...... | ...... | ...... | 82.78 | 17.27 | 13.57 | 1.97 | 1.74 | 0.00 | 2.17 | 61.97 | 39.77 | |
| ...... | ...... | ...... | ...... | ...... | 70.36 | 20.64 | 16.75 | 4.62 | 2.78 | 0.00 | 2.68 | 79.11 | 100.00 | LXVI |
| ...... | ...... | ...... | ...... | ...... | 81.22 | 18.78 | 16.00 | 0.46 | 1.81 | 1.01 | 2.56 | 70.74 | 12.80 | LXIV |