REPORT

OF THE

OYSTER INVESTIGATION

AND

SHELL-FISH COMMISSION,

For the Year Ending November 30th, 1887.

BY

EUGENE G. BLACKFORD,

COMMISSIONER OF FISHERIES.

TRANSMITTED TO THE LEGISLATURE JANUARY 25, 1888.

THE TROY PRESS COMPANY, PRINTERS.
1888.

Long Island Sound Set of 1887.
Average Five Month's Growth, Life Size.

ARTOTYPE, E. BIERSTADT N. Y.

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STATE OF NEW YORK.

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IN ASSEMBLY,

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REPORT

OF

EUGENE G. BLACKFORD, SHELL-FISH COMMISSIONER AND COMMISSIONER OF FISHERIES IN CHARGE OF OYSTER INVESTIGATION AND SURVEY OF OYSTER TERRITORY FOR THE YEAR ENDING NOVEMBER 30, 1887.

To the Legislature of the State of New York:

I hereby have the honor to submit a report of the work accomplished in the survey of the oyster territory of the State, and since June, 1887, as Shell-Fish Commissioner.

The section in the Supply bill of eighteen hundred and eighty-six, authorizing the oyster investigation, reads as follows:

"For the Commissioner of Fisheries appointed under chapter three hundred and nine, Laws of eighteen hundred and seventy-nine, the sum of two thousand dollars to be expended as said commissioner may deem proper, upon vouchers to be approved by the Comptroller for the purpose of oyster investigation."

An item in the supply bill of 1887, directed me to finish and complete the survey of all the lands under the waters of the State, suitable for oyster culture, and appropriating the sum of $5,000, but no part of this sum was to be expended until the Comptroller should be satisfied that the work contemplated could be done within the limits of

the appropriation. In addition to this work of investigation and survey, I was designated by chapter 584, Laws of 1887, as Shell-Fish Commissioner and directed to survey the oyster territory of the State, designate and set apart the natural growth beds of oysters, ascertain the owners of all artificially planted beds and survey and definitely locate such beds.

As far as the work of oyster investigation is concerned, this is the third and final report, and I take great pleasure in submitting it. That the work is finished is in itself a great satisfaction, and that it is finished successfully and agreeably to the oystermen of the State is an additional source of gratification to me. In my report for 1886 in which I gave the results of two years of diligent investigation, I suggested a remedy for what was the principal cause of the inspiration of the item in the supply bill, authorizing the investigation, *i. e.*, the cause of the decrease in the supply of oysters and recommended the passage of a law. In my report I said "the cause of the decrease in the supply of oysters is two-fold; first, the depletion of the natural growth oyster beds from over-fishing, and second, the lack of a thorough and scientific culture of planted beds.

As a remedy for the first cause, I suggested that the beds of oysters of natural growth be set apart and preserved, and that I continue the experiments already begun in the artificial propagation of oysters.

In regard to the second, I said:

"Planters can not be expected to cultivate oysters scientifically, and at great expense unless they can be reasonably certain that they will not be disturbed in the possession of their grounds. Security of tenure must first be given the planter, before the cultivation of private beds can reach its fullest and most profitable development."

To carry out this idea I recommended the passage of a law, which passed with some slight modifications, providing for the sale, at a nominal price to planters, of all the lands under the waters of the State, suitable for the cultivation of shell-fish. At this point, it may be interesting to speak more at length regarding the depletion of the beds

of oysters of natural growth, once the only source of oyster supply.

Bed after bed of oysters of natural growth has gradually disappeared and, as in every other instance, when natural supplies fail, recourse was had to artificial propagation.

The high state of civilization of the present day is due to the fact that each generation commences very nearly where the past left off. Did each man have to gain all his information from experience, he would have to live a good many centuries in order to be up to the times.

Happily the man who first applied steam to produce work did not let his invention die with him; but passed it on to his fellow-men, and they on to their successors, until at the present day we are surrounded by the thousands of engines, surpassing the most imaginative dreams of our forefathers.

If we profit by example, we are simply using common sense; if we fail to do so, we are to be pitied.

One hundred years ago our woods abounded in game; a few years ago our prairies contained thousands of buffalo. Every one knows to what extent the supply has been reduced.

The experience of European countries has been that all natural growth oyster beds will become over-worked; and to illustrate this, I will cite a few extracts from a report of Prof. Karl Möbius, Professor of Zoölogy at Kiel:

"According to the statement of Mr. Webber, mayor of Falmouth, 700 men, working 300 boats, were profitably employed in oyster fishing in the neighborhood of Falmouth prior to 1866; but since then the beds have become so impoverished that now, in 1876, only about forty men with less than forty boats can find employment, and even with this greatly diminished number of boats, no single boat takes daily more than from 60 to 100 oysters, while formerly in the same time a boat could take from ten to twelve thousand. About the year 1830 an oyster bed was discovered upon the English coast, near Dudgeon Light containing an immense number of oysters, among which were very many old ones.

During the next three or four years, this bed was fished

so perseveringly and disastrously, that since then it has not produced enough oysters to be worth recording. Between the years 1840 and 1850, there were in the harbor of Emsworth so many oysters that one man in a single tide (five hours) could take from fifteen to twenty casks, each containing 1,600 oysters. Later, 70 to 100 sailing vessels from Colchester came into the harbor and fished up so many young and old oysters during the two or three weeks they were there, that in the year 1858, scarcely ten vessels could load there, and in 1868 the beds were so impoverished by this fishing, that a dredge in five hours could not gather more than twenty oysters.

From the beds of the districts of Rochefort, Marennes, and the island of Oléron, on the west coast of France, there were taken in the years 1853–54, ten millions of oysters, and in 1854–5, fifteen millions.

By means of long continued and exhaustive fishing they were rendered so poor, that in 1863–64, only 400,000 oysters were furnished for market.

The very celebrated rich oyster beds of the Bay of Cancale, on the coast of Normandy, have produced, according to official reports, the following number of oysters :

Year.	Number of oysters taken.
1847	71,000,000
1848	60,000,000
1849	52,000,000
1850	50,000,000
1851	47,000,000
1852	20,000,000
1853	49,000,000
1854	20,000,000
1855	20,000,000
1856	18,000,000
1857	19,000,000
1858	24,000,000
1859	16,000,000
1860	8,000,000
1861	9,000,000
1862	3,000,000
1863	2,000,000

Year.	Number of oysters taken.
1864	2,000,000
1865	1,000,000
1866	1,000,000
1867	2,000,000

The French, ever ready to advance in the arts, seem to have been the first to cultivate oysters on any large scale; and, as their experience may be valuable, I will give a brief outline of their progress.

The natural beds of oysters were gradually giving out, the prospect for future supply was down to its lowest ebb, when M. Coste, the father of the shell-fish interests of France, determined to experiment upon the production of oysters artificially. That is to say, to try and collect the spat as it came by natural means upon collectors, though not to attempt artificial fertilization of eggs. He was very sanguine at first and based some of his expectations upon the theoretical calculations of what could be done, knowing that a good size spawner is capable of producing 50,000,000 young.

His experiments were very elaborate and cost a large amount of money. He did not accomplish the astonishing results he anticipated; but he succeeded in revolutionizing the system and bringing about results that increased the supply many fold. The following table taken from the report of M. Brocchi, to the minister of marine in France, will show the increase in ten years in the basin of Arcachon alone:

Year.	Number of oysters exported.	Value in francs.
1871	4,897,500	268,332 50
1872	10,796,740	537,515 00
1873	25,711,750	1,159,397 00
1874	42,542,650	1,745,050 00
1875	112,715,233	2,817,630 00
1876	196,885,450	3,941,309 00
1877	202,392,225	4,456,288 00
1878	176,500,225	4,426,500 63
1879	160,197,275	3,944,241 88
1880	195,477,357	4,254,465 64

From this we see an increase of 1,487 per cent in ten years of the value of the oysters, while the people of the country had an increase of 3,890 per cent in the number of oysters consumed.

The French method consists substantially in suspending tiles in the waters during the spawing season. They found that the young oysters clung very closely to these tiles; so they take the trouble to coat each with plaster, and after the young oysters have set upon it, take them up, separate the plaster from them with knives, and use the tiles again the next spawing season. The plaster holding the set is then planted and the young oysters cultivated.

Our system, as in use in Long Island sound, is upon the same principle, only we are more fortunate, inasmuch as we do not have to resort to so troublesome and expensive a method of collecting the spat. Our refuse oyster shells, deckers, cinders, etc., serve as collectors and produce splendid results. In fact, our favorable conditions on this side have caused a great deal of comment from foreign authors, and our yield appears to them to be something remarkable. They are all unanimous, however, in declaring, from their own experience, that if we do not go into the cultivation more vigorously we will go down in the scale instead of up, and Americans certainly ought to be smart enough to profit by such examples.

The oyster supply for the future must then come from artificial beds, and to aid the cultivation of these was the purpose of the bill passed by the Legislature, and in its results will, I believe, be found the solution of the oyster question, and the remedy for the cause of the decrease in the supply of oysters.

That this is believed to be true by the practical oystermen of the State, is shown by the number of applications already received for franchises in the lands under the waters of the State. Nearly 270 applications have already been received and new ones are coming in every day. The great work consequent to the proper organization of this branch of the duties of the Commissioners of Fisheries and the preliminary routine necessary before anything definite could be done, prevented the granting of fran-

chises as yet, but 100 are in condition to be granted at the January meeting of the commission.

The commissioners have fixed the price for lands now in cultivation and use at fifty cents per acre, and have provided that new lands shall be sold at auction, at a sum not less than one dollar per acre; so that in addition to the great protection and security afforded the planter, a large income will be derived by the State from this source.

The principal work of the investigation done by me during the past year has been in the direction of ascertaining, if possible, the nutritive value of oysters, the effect of floating, and the collection of information regarding oyster food.

I wish to call especial attention to the report of Prof. W. O. Atwater, of Wesleyan University, on the floating of oysters. It will be found in full in the appendix.

Until lately, extremely little has been known of the chemical composition and food values of oysters and other shell-fish, and the larger part of what has been discovered comes from the investigations which have been conducted in the laboratory of Wesleyan University and elsewhere. Besides the information given as to the food values of oysters, much is said of their changes in composition and nutritive value in the process of floating, or as it is sometimes called, fattening, which is very generally practiced in preparing for the market.

It appears that, speaking roughly, a quart of oysters contains, on an average, about the same quantity of actual nutritive substance as a quart of milk, or a pound of very lean beef, or a pound and a half of fresh codfish, or two-thirds of a pound of bread. But, while the weight of actual nutriment in the different quantities of the food materials named is very nearly the same, the quality is widely different. That of the very lean meat or codfish consists mostly of what are called in chemical language "protein" compounds or "flesh formers," the substances which make blood, muscle, tendon, bone, brain and other nitrogenous tissues; that of the bread contains but little of these, and consists chiefly of starch, with a little fat

and other compounds, which serve the body as fuel and supply it with heat and muscular power.

Professor Atwater goes on to say that the nutritive substance of oysters, like that of meat, which is very similar, contains the so-called "flesh forming," and the more specially heat and force-giving, ingredients. In short, oysters come nearer to milk than almost any other common food material as regards both the quantity of nutrients and the food values of each for supplying the body with material to build up its parts, repair its wastes and furnish it with heat and energy. As he states, however, the scientific studies are so incomplete, that although these statements are correct as a whole, we must be careful about insisting too strongly upon the absolute accuracy of the details.

The differences which oystermen observe in the quality of oysters from different localities of different age and grown under different conditions, are made clearer and are to a considerable extent explained by chemical analysis. Taking the oysters in the shell, the proportion of shell contents "meat and liquor" together increases relatively to the whole weight as the animal grows, at least up to a certain limit. In other words a bushel of mature oysters will open more quarts than a bushel of the very young animals; but the differences between different kinds or between specimens of the same kind under different conditions are very wide. Taking the edible portion of the oyster after it has been removed from the shell the differences are much greater than people commonly suppose. This is apparent when we compare either the "flesh," meats or liquids, "liquor" of different specimens or the whole edible portion, meats and liquor "solids" together. The percentage of water in the edible portion of the different specimens of oysters reported in the tables beyond varied from eighty-three and four-tenths per cent to ninety-one and four-tenths per cent, and averaged eighty-seven and three-tenths per cent. This makes the amounts of "water-free substances, *i. e.*, actually nutritive ingredients vary from sixteen and six-tenths per cent to eighth and six-tenths per cent, and average twelve and seven-tenths per cent of the

whole weight of the edible portion (shell contents) of the animals."

Clams, mussels and scollops likewise show variation in composition, but the totals amounts of nutritive material are a little larger than an oyster. Then the specimens of round clams average thirteen and eighth-tenths per cent, the long clams fourteen and one-tenth per cent, the mussels fifteen and eighth-tenths per cent, and the scollops in the flesh, as ordinarily sold, nineteen and seven-tenths per cent of nutritive ingredients.

The canned oysters averaged fourteen and eighth-tenths per cent of nutritive material a little more than fresh oysters, the difference being apparently due to their having a small proportion of liquid. From a number of experiments on the floating of oysters, Prof. Atwater makes the following conclusions:

"The oysters in 'floating' in fresher water, for some hours after they were taken from the beds in salt water, as is commonly done in preparing them for the market, gained from one-eighth to one-fifth in bulk and weight by taking up water, but at the same time lost about one-tenth of their nutritive material. They did this by processes essentially similar to those which go on in our bodies, and by which the digested food passes from the alimentary canal into the blood to be used for nourishment."

This work of Prof. Atwater's is of the greatest possible value and can not be too highly appreciated. There is a popular expression that oysters and other shell-fish are merely luxuries and are worth very little for real nourishment. The importance of investigations which are calculated not only to show the food value but to help the oyster culturist to make his products more valuable is too apparent to need argument.

Whatever else I have done in the way of investigation will be found under appropriate heads, and should be read carefully by all interested in oyster culture.

The details of the work in surveying the oyster territory of the State will be found in the report of the engineer. The work has been conducted through the year very successfully and reflects great credit upon the engineer, Mr.

W. G. Ford, Jr. In fact, had it not been for his untiring energy and marked professional skill, it would have been impossible, even with the assistance of the U. S. Coast and Geodetic Survey to complete the "work contemplated within the limits of the appropriation."

Indeed the State Engineer, Mr. Sweet, advised the Comptroller that it could not be done, and some difficulty was experienced at first in securing the appropriation; but finally through the kind efforts of the deputy comptroller, Mr. Hall, the Comptroller agreed to audit the accounts of the engineer, and the work began. The results of the labor performed are most satisfactory. The whole of Long Island sound was surveyed, natural growth beds being located and accurately defined, the balance of the territory put in such a position as to be easily available for sale by the commissioners.

Nothing remains to be done now except the preparation of the necessary maps, and these the engineer will soon have completed. Mr. Ford has also rendered me valuable assistance in my work as Shell-Fish Commissioner, designating the occupants of artificially planted beds and in settling disputes, notably in the cases of Smithtown and Little Neck bays, as to what constitutes a bed of oysters of natural growth. I can not speak too highly of him in his department.

As to my work as Shell-Fish Commissioner, I can make but a brief report. Beyond the investigation spoken of above as to Little Neck and Smithtown bays, and the designation of occupants of the lands under water in Raritan bay, but little has been done up to this date (November 30).

My action with my colleagues will be found in full in the minutes of the Commissioners of Fisheries, and a report of my other work will be found in the report of the engineer.

A copy of the rules adopted preliminary to the granting of franchises, blank applications, and other forms will be found in the appendix. Under chapter 300, Laws of 1886, I was given supervision of the enforcement of the law, and was authorized to appoint a State oyster protector, who should report to me.

Mr. Joseph W. Mersereau, who was appointed State oyster protector, has given me much satisfaction by his faithful work during the present year. Through his vigilance and activity the evil of refuse dumping has been materially diminished in the vicinity of oyster beds. Oystermen unanimously testify to the improved condition, and there can be no doubt but that the vigorous enforcement of this law has had a salutary effect.

Mr. Mersereau has recently secured indictments against a number of gas companies in New York and Westchester counties, and it is hoped that the cases will be pressed and conviction obtained.

His report will be found very interesting, and I have given it in full. The results shown are very gratifying and I heartily approve Mr. Mersereau's recommendations. More adequate steps should be taken, as he suggests, to guard the vast oyster territory of the State, and larger appropriations should be made.

I think also it is but just that Mr. Mersereau's request for an increase of salary should be granted. He is a man of more than ordinary ability, and is compelled to give his entire time to this work. There should be no false economy by the State in this work, as every cent spent in developing and guarding this great source of food supply is well invested.

With the beds of oysters of natural growth set apart and preserved, the foundation of the system of artificial cultivation upon a certain and definite basis and the prevention of the further pollution of the waters of the State, the oyster industry bids fair to become one of the great and profitable industries of the State.

Respectfully submitted.

EUGENE G. BLACKFORD.

Report of W. G. Ford, Jr., Engineer.

New York, *November* 30, 1887.

Mr. Eugene G. Blackford, *Shell-Fish Commissioner, New York, N. Y.:*

Sir.—I have the honor to submit the following report of the work of the engineering department since November 30, 1886.

To simplify matters, I will divide my subject into two parts—the office work and the field work.

Office Work.

During the winter months the time was taken up by developing the field-notes taken during the previous summer, and in laying out the scheme of work for the next mild season. The triangles on Staten Island were computed trigonometrically, and at the same time spherically. That is to say, the earth was not regarded as flat, but as a curved surface; and allowance was made for the curvature. It is true that the differences are not very large; but the latter method is exact, and the former is not; and the value of the property to be deeded from these triangulation points, and hence dependent upon them, most certainly warrants the expenditure of the additional time and pains required in this style of computation. After the points had been computed and reduced to perpendicular coördinates, they were plotted on polyconic projections of Clark's spheroid of 1866, on the scale of 1:5000. They covered five sheets of antiquarian paper. From these, as bases, all the subsidiary points determined by triple cuts, were put upon the projections and checked in each case. Tracings of the topography having been furnished through the kindness of the Coast Survey, I ran in the shore line at low-water mark, and transferred a good deal of the topography on the western sheets, where the grounds are particularly valuable.

I have plotted all the corners of oyster lots determined in Princess bay, affixed their proper numbers, connected the several lines, and in this way showing the relative position of each lot surveyed,

its area, and its place on the sphere — in other words, its latitude and longitude.

The land on the hard bottom near Ward's point is particularly adapted for the cultivation of shell-fish, and is much sought for and highly prized. Its value is easily appreciated by noticing the very small lots into which it is divided. Most of it is in from one to four or five acre lots, and in some cases less than one acre.

The lines of boundary are shown by stakes; and at low-water the field gives the appearance of a young nursery.

These plots of ground are in irregular shapes, very few being rectangular, and fewer still square. It is a mystery to the uninitiated, how the different little farms can be cultivated by almost as many different owners without encroachment. There is scarcely any poaching from neighbors, however, though marauders from other places are sometimes a little troublesome, and necessitate the employment of watchmen.

The map of these lots resembles to some extent the much quoted Chinese puzzle; but like it, is as easily unraveled when the key is produced — our records on file at the office. For instance: Lot 999 would belong to John Doe and be bounded by K. 14; K. 15; K. 16, and K. 17, representing the N. E., S. E., S. W. and N. W. corners respectively. By turning to page 14 book K. a complete record of the N. E. corner is found from which the point can be mapped geographically, or the mark at the corner be replaced, should it be swept away, and so on.

Should some mischief-maker come along and remove the boundaries, long disputes and possible litigation can be avoided by simply sending a hydrographic engineer to show where the boundaries had been, and where to place new stakes.

Some corners are so happily situated as to be at the intersection of prominent ranges on shore; but when the corners are a little way off shore, this is of rare occurrence. Many devices are resorted to to mark corners in such a manner as to be identified in thick weather and soon become known to all the tongers. For instance, I know of a case in which a man hung an old hoopskirt to one stake, and his land is known as the "hoopskirt property" to this day. But with a view to perfecting our system, I would recommend that each owner bend to his corners little tags of wood or tin (wire fastenings) with the number by which it goes in the office, cut or stamped upon them. This method would aid

very largely in the conviction of thieves prosecuted for stealing. If a man were known to be stealing, any neighbor could go the stakes surrounding the culprit, note their numbers, and find out the owner in this way if he were not familiar with the vicinity, and report to him the theft.

After all the lots had been plotted, the position of the places at which specimens of the bottom had been taken were mapped, marked in red, and numbered thus, "S. 74." Referring to specimen book 74 would be found to be: "Very hard bottom, coarse gravel and sand."

The hydrographic notes furnished by Lieutenant G. C. Hanus, U. S. N., for the western part of the bay, were developed and portrayed on tracing cloth, with reference to meridians and parallels, and also to the topography, so that it could be fitted over the standard sheet and show where the soundings belong without complicating the already well covered sheet below.

Great care is required by the standard maps; difference in temperature and moisture are serious enemies, and hence they are kept in tin cases and not used for ordinary work. In order to follow up the work in the field as I go along, it is necessary to have either these maps or duplicates. These last are called "boat sheets." I have made a complete set of boat sheets, and have them stowed away in a tin case ready for use at any time.

Duplicates of all the records were made in ink, so as to guard against those accidents which experience has taught occur in spite of the utmost care. Much labor and pains were put upon our books of descriptions of signals, and I take pride in presenting them to you. They are composed of three volumes, arranged alphabetically, with space left for the insertion of descriptions of new signals and changes that may occur from time to time in the old. Nearly every signal has, besides its description, angles taken from the center of station, sketches of the locality, or else topographical drawings of the surroundings. They are so complete that any hydrographic engineer could recover the points without the least difficulty. These books are of an importance rarely appreciated until too late. It is the easiest thing in the world to write a poor description of a good signal, but one of the hardest to write a good one — one in which all the effects of decay are contemplated and provided for.

The specimens of water over the natural beds had been stored in quart bottles and preserved for investigation. The contents of each bottle was emptied into a salinometer pot, the density measured and the results tabulated.

During the winter there were several meetings of oystermen, at which the subject of legislation was discussed, with a view to framing some just law for the protection of the shell-fish interests. At all of these meetings I was present, and gave data and details of the oyster lands of the State. Nearly every day some one interested in the production of oysters called at the office to gain technical information. I received all these applicants and provided them with what they wanted so far as lay in my power. The latter part of the winter season was devoted to preparations for the coming summer's work.

Field Work.

I take particular pleasure in presenting the work of the past summer both on account of the very satisfactory results accomplished, and from the fact that we had some of the most trying difficulties to overcome that could possibly fall to the lot of a hydrographic engineer.

In the first place the Legislature did not enact the laws and pass the appropriation affecting us until the latter part of the session, and the bill under which the franchises are to be sold, was not signed by the Governor until after the middle of June; and upon the latter depended, to a great extent, the character of the work to be carried out this year. This made a delay in the start that caused us the loss of a good deal of fine weather which might have been devoted to field work.

By your directions, however, all the preparations were made for whatever turn affairs might take, and the day the bill was signed found us in possession of a government vessel, manned and preparing for sea.

Having learned from experience the ready way in which the Coast Survey responds to all meritorious calls for aid in the advancement of sciences and practical arts in different States, we applied to them for aid. By your direction I proceeded to Washington in May, and requested Mr. F. M. Thorn, the superintendent, to lend us a government vessel for the summer.

After explaining the situation to him thoroughly, he agreed to our proposition, upon the condition that we would provide the vessel with all necessary equipment, keep her in ship-shape manner, and return her in good condition.

The steamer "Arago" was offered us, but the expense of running a steamer was too great for the small appropriation at our disposal. The most economical method was to use a sailing vessel, and the superintendent kindly granted us the schooner "Drift." As soon as possible the necessary official papers were sent us and we took the "Drift" out of the navy yard about the middle of June.

As the vessel had been out of commission for a good many months and had been lying in a basin all that time and was completely unrigged, there was a great deal to do to get her ship shape. First of all we put her in dry dock and had the barnacles scraped off, and the metal repaired wherever needed; and after that, ran down the bay to "fit out."

The vessel was rigged carefully, put in thorough repair and kept in that condition all summer.

Lieut. Commander W. H. Brownson, U. S. N., hydrographic inspector, very kindly visited the vessel and placed at our disposal any of the gear and equipment to be found on the Coast Survey vessels at the navy yard not in commission. I would like to say just here that a great part of the success of my work is due to the very hearty coöperation of Captain Brownson. Without his aid I could not possibly have accomplished nearly as much as I did.

Our field of operations was to be Long Island sound. The object to be accomplished was the completion of the general survey of the shell-fish territory, and of the determination of the limits of the natural growth oyster beds.

The primary work was to form a chain of determined geographical points all along the shore of Long Island bordering on the oyster territory under State jurisdiction. These points were to be marked and made prominent by the erection of wooden tripods above them, so they could be seen from the water. They had to be at short intervals, in order that any point upon the water could be determined by using them in connection with the "three-point problem."

If all this territory were far off shore it would not be necessary to have so many points, but as most of it extends close into shore,

and as that near shore is generally the first located, the necessity of multiplying these points became of vital importance. The Coast Survey, through the courtesy of Mr. B. A. Colona, assistant in charge of office, gave us a great many triangulation points, a large number of which we used. From these, as bases, we determined all the additional points necessary. This relieved me of the necessity of prosecuting a primary triangulation, such as I was compelled to do on a previous occasion.

Sometimes we found Coast Survey tripods standing over these triangulation points; and sometimes all traces of their existence had been extinguished. Whenever we found a Coast Survey point we examined it carefully, verified the marks and repaired the tripods from time to time, to add to their preservation. Complete notes of the condition and changes, and the additional marks put up, were entered in the records and also furnished the Coast Survey office in Washington.

In doing this work, the vessel was moved along from station to station as a base, and the work was done from whale boats. Wherever possible the vessel was left in a harbor, and the triangulation carried forward and back. The shore line covered about 140 miles; but in order to determine the signals along the beach it was often necessary to go two or three miles back into the country. My party tramped over many weary miles in this work, but covered the ground between stations as much as possible by boat.

Finishing our observations at one point, the instruments would be put into the boat and the men would pull as near the next station as possible, clapping on sail every time there was a slant of wind. In this way I have often covered from twenty to thirty miles in one day.

There was only one triangulation point in Little Neck bay, and so the points had to be carried along both shores from points outside. In this bay we were particularly fortunate in finding substantial and conspicuous natural objects for signals; as, for instance, a hole in the top of the famous Saddle Rock.

From here to Oyster bay the signals had to be numerous, owing to the many beds and the availability of the lands close to shore. We had worked to Oyster bay harbor when the greatest disaster of the season befell us; namely, the refusal of the Comptroller to honor our drafts. There is nothing more demoralizing to a party in the field than the knowledge that there is a doubt as to the pay of the men and the settlement of the bills.

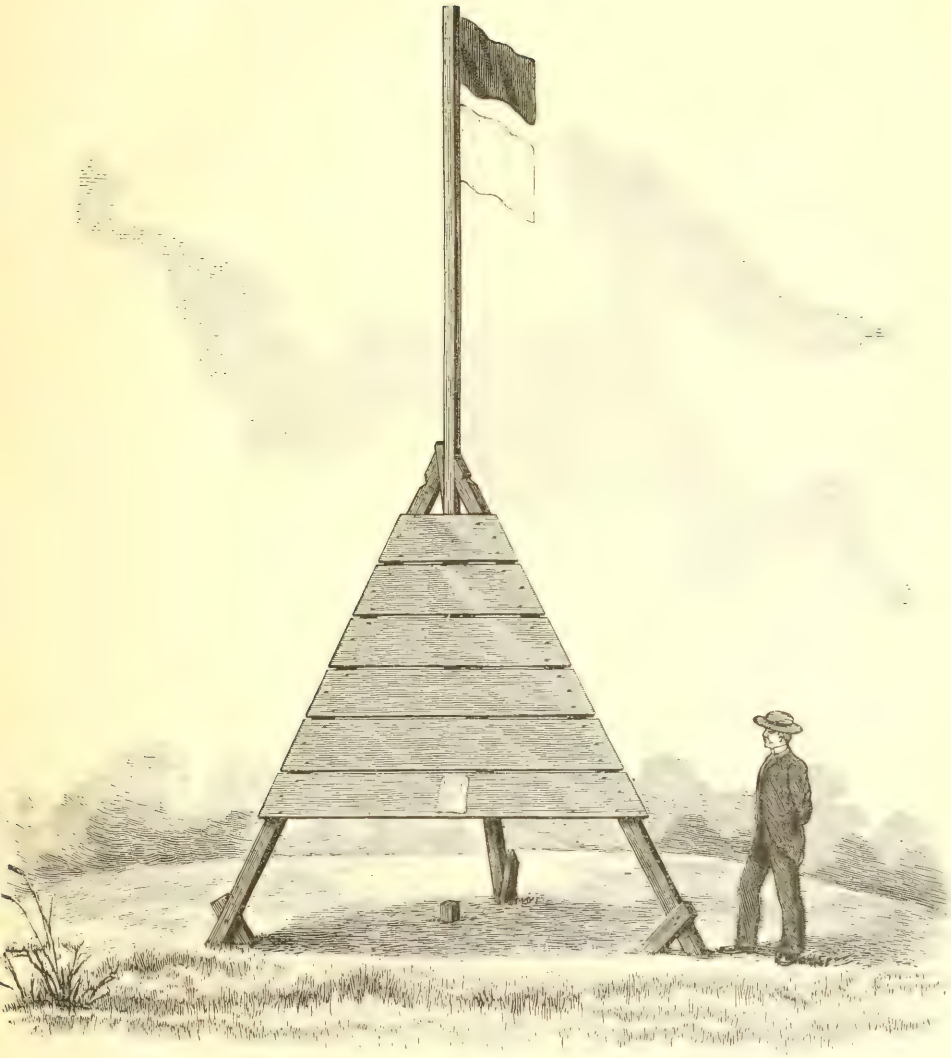
The wording of the law under which the money for the survey was appropriated was such that the Comptroller was required to be satisfied that the work for which the appropriation was made would be completed within the limits of that sum before he could issue any of it. There being no doubt in our minds as to this fact, we naturally went ahead with the work in good faith, and the money advanced by you covered all our expenses.

There were also some $1,100 we had carefully saved out of a former appropriation, with a view to putting it to its greatest advantage this summer; but the Comptroller declared it was no longer available, and would not issue any of it. In the meantime, he declined to accede to our requests upon the ground that he was not convinced we could accomplish such a large amount of work with so little money.

I presented the facts to him and his deputy, and was referred to the State Engineer for his opinion. The latter was loth to believe we could accomplish such results, although I presented him with maps and other data representing good showings of work already done; explained that we had the use of a government vessel free of charge; that I sailed and navigated her myself, and in this way avoided the expense of a sailing master; that I held a pilot license, and could do away with a pilot; that everything was in running order and reduced to a system, and that I would stake my personal reputation upon the accomplishing of the work in the time required. This was backed by letters from some of the best known experts in the country.

I can not blame these gentlemen for adhering to their beliefs; but it was extremely unfortunate that such a thing should happen just at this time; and our results have proved that we were justified in our impatience to push on. But when the work did go on, it was under trying circumstances; crippled to the extent of losing one-sixth of the original moneys, and with three weeks time to make up. Now, that it is over, I look back with amusement at the many devices resorted to in order to save a penny here and there, though extremely trying at the time. It meant being on the jump from half-past 5 in the morning often until after dark; frequently followed by writing by lamp-light, and, perhaps, a turn-out in the middle of the night if it came on to blow.

As we moved to the eastward, the sound being wider, we had to construct our signals on a much larger scale. From Eaton's Neck



on, most of them had to be made of heavy scantling, generally about twenty feet high, and boarded up and whitewashed. It takes about two hours with a full force to construct one of these tripods, if they are carefully centered and substantially made.

There are no harbors on the New York side of the sound between Port Jefferson and Greenport, and we had to anchor out some distance from the shore in order to have plenty of room to cast should a gale come up. Several times we had to get up anchor and run. The weather became unusually cool in September and the sound frequently rough. From the tenth of September until the twenty-eighth, inclusive, we only had one entire good or favorable day, so the work had to be done by jumps. For a long time, even when the wind was north-west (which was most frequently the case), the air was filled with mist or smoke. It gave the general appearance of easterly weather. Even the sun appeared fiery red and the moon deep orange. It was very hard to see on any day but one, and I was often obliged to strain eyes for hours at a time before being able to get the proper sights.

Every one knows what a mean sea can be found on Long Island sound; and when we had stiff winds from the northward it meant a wetting up to waist or neck every time in landing, and great care and exertion to keep from hurting the whaleboats, especially in some of the places where the rocks extend for miles all along the shore and out to the water. On one occasion our starboard whaleboat was in the surf and in imminent danger of being smashed to pieces on the rocks. Although the water was very cold, Mr. Young jumped in and swam with his clothes on to the assistance of the boatkeeper, and the boat was saved.

Nevertheless, we carried our survey all the way to Plum Gut, which is the limit of the oyster territory under our jurisdiction. During the month of September I made harbor in New Haven twice, and took advantage of the opportunity of visiting the shellfish commissioners of Connecticut. Mr. James P. Bogart, engineer of the commission, kindly showed me many things of interest connected with the oyster industry of his State. Particularly noticeable was the equipment of the oyster steamer "Luzerne Ludington." She was fitted with a Westinghouse engine, Korting injectors, speed regulator worked from the pilot-house, two independent dredges and equipments, etc., including hoisting engine and Frisbie friction clutches. She uses very large dredges and has

plenty of power. We visited the oyster shucking room of Capt. Caleb L. Ludington, where young girls were busily engaged opening oysters. Many of them can open eighty quarts a day, and make as much as fifteen or eighteen dollars per week.

New Haven furnishes many of the Connecticut and Massachusetts towns with oysters by the quart or gallon, and even sends some to New York, while her export trade is enormous. There are some 80,000 acres of land on the Connecticut tax list, and the industry in that state, by the judicious guidance of the shell-fishery commission, has been brought forward in a manner to attract attention all over the country. It shows what can be done by system, concentration and moderately liberal appropriations.

In obedience to your instructions I left the "Drift" in Cold Spring Harbor and came to New York to attend the meeting of the Fish Commissioners relating to the shell-fish territory, and to show them over the oyster grounds.

I joined Messrs. Roosevelt, Bowman, Joline, Green and yourself on the oyster steamer "Mystery" September 6th, and as we steamed up East river pointed out the position of natural beds, signals, etc., showing the College Point, Whitestone, Hamelin Flats, Millett's Point, Throg's Neck, Great Neck bed, etc. We explained to the commissioners the general character of the beds, and as we went along showed the location of the Pelham Bay, Stepping Stones, City Island, Hart Island, Gangway Buoy, Barker's Point beds, and finally brought up on Execution bed, upon which we made hauls of a "general cargo," as they expressed it.

After leaving here we passed over successively the Hempstead, Peacock Point, Lloyd's Neck and Eaton's Neck beds, stopping at Cold Spring Harbor on the way to inspect the "Drift;" and finally making an examination of Smithtown bay.

The next day we visited Princess bay, Gravesend bay, and the Arthur Kills.

LITTLE NECK BAY.

In examining this bed last year, it was from a vessel drawing too much water to allow us to run into the bay; and while in doubt as to the character of the inside portion where the water was very shoal, we classified it natural growth until it could be examined in detail. This was left until the last thing of the past season when there was nothing ahead of it to push it or prevent a thorough overhauling.

We anchored some distance off what we considered the outer limit of the bed, and the same afternoon sent word around the bay to the residents who had shown interest in the affair, that the bay was to be examined. I wrote to the attorneys of those appearing by counsel and passed the word amongst the sloops. In short, we invited all we could find to be present during the examination.

The next morning we set out in the whaleboat and dredged toward the fleet of sloops. My idea in regard to such investigations is that men who devote their lives to dredging can make more trustworthy hauls than amateurs, and moreover a "natural growther," being anxious to have the limits of a natural growth bed made ample would undoubtedly do his best in dredging; yet he could not show more than there was; while a man interested on the other side might be prejudiced to such an extent as to cover up something. As soon as we arrived among the sloops, I got some to luff up while I asked if I could get a passage for the day. The first one could not be spared; but the "Osprey" was put at our disposal for all this day and the next; and the owners, Messrs. Fred. and Henry Glasier did everything in their power to help us. I feel much indebted to Messrs. Glasier for their kindness; and would say that I have the highest opinion of their wish to be square in their dealings.

As we entered the bay I counted six sloops at work in the deep water and thirty-one skiffs in the different shoal parts of the bay. It was a busy scene.

I was informed that this was an unusally large number and that these men had all congregated to give me a wrong impression. But this has been refuted by others; and my own observations obtained during several visits in the summer, have led me to believe that my informer was mistaken. The "Osprey" took me to all parts of the bay I wanted to visit and gave me over a hundred dredgings. The result was an exhaustive examination.

From time to time during the two days we dredged here we had many visitors representing the different factions and listened carefully to all they had to say. The disposition of this bay has brought to light some interesting and curious features. For instance, several have made efforts to get franchises for large portions, say one man to get a fifth or fourth of the whole bay. Others have put in claims for small portions. Some are willing to swear the whole bay is a natural bed and others say it is not.

One staked in about a fifth of the bay and some one else came along and staked him in and more too.

Thus it has been that the question was not one to be decided upon at a glance, but only upon careful examination and mature deliberation. The dredge will show better than anything else whether the oysters "exist in paying quantities," but in cases where a natural growth bed has been planted, it is often hard to tell where the "planting" stopped; and in such cases evidence from interested parties is very admissible. When this occurs it is generally claimed that the places planted were grounds upon which the natural bed had been depleted and upon which no one could make a living.

There is a statute law which declares that the territory in Little Neck bay from low-water mark to a line running parallel to it 500 feet off shore shall be called natural growth and shall not be considered available for planting purposes. This leaves very little of the bay that can be considered available, and of what remains the bottom is very soft and will probably require special preparation before the seed is deposited upon it.

The general character of the oysters to be found in the bay extends from seed to those unusally large. The term "saddle rock" is now applied to very large oysters generally; but very few of those we get in restaurants under this name have ever had the honor of having the famous rock as a neighbor; but the "saddle rocks" are not all gone; and in this bay may be found to-day many of this proud family. Then, too, there are often clusters of from five to twenty of these large fellows.

The set during the past year has not been very fine and the evidence points to a not far distant time when this bay will be seriously the worse for wear.

Advance notice was given to all interested in the subject, and a meeting was held on November fifteenth, upon which occasion every one was invited to give his reasons for objecting to the proposed ruling, if he had any.

Several spoke for and against it, and one old man in particular objected very strongly to the report of the engineer. He said he had been working in that bay continually for the past thirty years and thought his evidence should be given proper weight. Upon being asked for his opinion as to the limits of the natural growth, he gave, after his own fashion, a very detailed account of it, and

when he had concluded was very much surprised to learn he had corroborated in almost every particular the engineer's report, which, by-the-way, he had never seen.

Out of courtesy to some of the residents, you directed me to make another examination of a portion of the bay, claimed to be not natural growth. I followed out your instruction to the letter, though it was blowing from a moderate to a fresh gale and the boats had ice in them.

The last examination checked the former one very nicely, and gave the planters the benefit of about fifteen acres more out of 1,500 acres in the whole bay. Another meeting was held, and those present expressed themselves satisfied with the decision of the Shell-Fish Commission.

The northern limit of the bed is a line connecting the outer end of the government wharf at Willet's Point with the outer end of the Clay dock on Great Neck. All to the southward of this is natural growth, except a 750 meter square, having for its northern boundary the parallel N. 40° -47′, and for its western boundary the meridian W. 73° 46′, and not included between low-water line and a line 500 feet off shore from it.

It is unfortunate for the oystermen in this bay that the sandbank in the southern portion is being so extensively worked. The water throughout the bay is so shoal that the scows in being towed in and out stir up a great deal of mud. Even without this, there are times when the water in the southern part of the bay resembles the Juniper water in the Dismal Swamp of Virginia.

SMITHTOWN BAY.

During the summer of 1886 Smithtown bay was examined for natural growth. One spot was found upon which were a large number of oysters. They were buoyed in and gave evidence of planting; but while we were examining it the feed pipe of the boiler burst, and we had to run to New York for repairs. In the meantime it was put down as natural growth.

During the past summer I made a thorough examination of it, running lines of dredging back and forth over all the questionable ground. The only places from which we got satisfactory hauls were where the ground had been strewn with scollop shells, gravel, deckers, etc. To these the oysters had clung, and a great many large single oysters were found clinging to small pebbles. There

was no doubt about the fact that the ground designated as natural last year was a planted bed, and well planted at that. The question then arose as to whether there had ever been natural growth there, and if there had been, whether the planting was done only after it had been thoroughly depleted and abandoned.

A time of hearing was apppointed for November twenty-second, at which time no one appeared to advocate the natural growth side of the question. The only evidence for that side being an affidavit, brought some weeks before by a man who was either afraid or ashamed to put his own name to it, but who spoke against the planters, at the same time declaring he did not wish his friends of the other side to know he was appearing against them. The planters presenting the testimony of the most respectable men in the community, and the decisions of a court a few years ago, that the land was not natural growth, the Shell-Fish Commissioner decided that the bay was open to cultivation.

THE PINES BED.

I have developed during the summer a small natural growth bed on the hard bottom which skirts the shore in the bight, between Oak Neck Point and Center Island reef, just off the "Pine trees" from which it derives its name. It has not been well-known or generally worked, but it contains a few very fine oysters, though not in very paying quantities this year. There is probably no bed in the State which varies more from period to period than this bed.

NATURAL GROWTH BEDS.

The following circular was sent to all the principal newspapers on Long Island, with request to publish it. It was also sent to different supervisors and other prominent men with accompanying letters asking them to place it where it would do the most good:

NOTICE TO OYSTERMEN.

In pursuance with chapter 584 of the Laws of 1887, I am causing the natural growth beds of oysters of this State to be surveyed and delineated.

The law reads: * * * "He shall finish and complete the survey now being made of all the beds of oysters of natural growth located in the waters of the State; and such beds of oysters of natural growth shall be set apart and preserved, and shall not be deemed to be included in the lands for which franchises are to be sold under the provisions of this act," etc.

These natural beds are to be "set apart and preserved," so that anybody can go and tong or dredge upon them, but so that nobody can stake them up and keep every one else off. I would be glad to receive notice from those interested of the existence of any bed or beds known to them in the waters of the State, which are of natural growth.

On the back of this sheet is a map on small scale showing natural growth beds already surveyed.

Very respectfully.

EUGENE G. BLACKFORD,
Shell-Fish Commissioner.

The information given in the replies was very valuable and interesting, and resulted in the development of one more small natural growth bed; but its greatest value was in showing that we had already made a most thorough examination.

As it stands now, all the known natural growth beds under jurisdiction of the State have now been surveyed and are being finally mapped. During the past summer you personally inspected a number of them, and of these I will not treat except in a general way.

The Execution bed is still furnishing large quantities of seed and large oysters; but the refuse material upon it accumulated during the past years is simply shameful. I realize more and more that had you not caused the dumping of garbage to be stopped here, through the watchfulness of Mr. Joseph W. Mersereau, the State oyster protector, all the shell-fish would have been absolutely smothered.

As regards the Hempstead bed, the north-west portion seems to have been the most popular part this summer; and here I have seen, time and time again, a regular cloud of canvas belonging to oystermen. The oyster fleet is a pretty one and can easily be mistaken for a fleet of yachts; which I have done several times. The boats are not fine in the sense used by yachtsmen; but they are in the eyes of a man who follows the sea.

The models are splendid; the sails fit perfectly, and the handling of them by their skippers is beyond comparison. These men are born sailors, know every quality of their boats and use them to their best advantage. An oysterman can give you more "touch and go" points than almost any other sailor. I have seen them cross our bow, they on port tack and we on starboard, both close

hauled, so close that their dinghy would come under our head booms.

One of these oyster sloops had a race with the celebrated cutter "Bedouin," and beat her in a good breeze. They go fast and work like witches; and they are kept scrupulously clean and tidy. A sailor proud of his profession should feel complimented if called an oysterman.

In regard to Little Neck bay and the swash bed off Hoffman Island, I think they have been heavily worked also.

All these beds I have mentioned, in fact, are having too heavy a load to carry; and they will break down, so to speak, if something is not done to help them.

OYSTER GROUND.

The land under water to the northward of Whitestone is generally hard; and the water over it averages about six or seven fathoms, except along Westchester county shores, where the bottom is softer and the water not so deep. A little eastward, and between Willet's Point, and Throg's Neck, the water deepens to from ten to twenty fathoms. None of this is very good oyster ground, except close along the shores; owing to the immense amount of ocean traffic that passes through at this point.

To the eastward of Throg's Neck, however, and between there and the limits of the natural growth beds of Little Neck bay and Elm Point, there is a good deal of land that might be taken up. The bottom is generally soft, though not too soft for cultivation. The depth of water varies from an average of four and a half fathoms in the eastern part of the bight, to about nine fathoms in the western. To the northward and eastward of Stepping Stone light, the water is generally deep and the bottom soft. This is also a highway for passing craft.

To the westward of Barker's Point, and just outside of Manhasset bay is a plot of ground having the greatest depth of seven fathoms; which is a little out of the track of traffic, owing to the position of the shoal extending out to buoy twenty-three, known as the Gangway Rock buoy.

In the bight just to the westward of Sands Point, and to the south-eastward of the steamer track, are lands well suited for cultivation, and having a depth of from three to six fathoms of water. The water to the northward of Sands Point is rather deep for

planting except close along shore, and between Prospect Point and Sands Point out to about three-quarters of a mile.

The ground immediately off Hempstead harbor of course is not available for planting, owing to the natural growth beds there; but to the northward of Matinicock Point the greatest depth of water is nine and a half fathoms all the way across the sound. The turning point of the boundary line between New York and Connecticut is almost due north of Peacock Point. The water between has an average depth of from seven to eight fathoms.

The land included between the meridians which pass through Peacock Point and Oak Neck Point is very well adapted. The eighteen foot curve here is about half a mile from high-water mark. From there to the seven fathom curve is nearly half a mile more. Beyond this the depth varies to nine and a half fathoms. Most of the bottom is soft, but not very soft.

In the bight between Oak Neck Point and the end of Center Island reef, all the ground except that indicated as the Pines Bed is available for planting. The average depth is from four to five fathoms. From this line out to the State line, the water gradually increases in depth to ten and a half fathoms; but very little of it is deeper than eight fathoms. There is some hard bottom off Center Island Point, but it is very rocky; and it is an open question as to whether much could be cultivated to advantage.

Between the end of Center Island reef and Lloyd's Point, the general depth of water is from four to seven fathoms; but there are a few holes with a depth of from ten to eleven fathoms. These however, are well in the southern part of the bight.

The ground directly to the north of Center Island reef is composed generally of soft bottom; and varies from five to eleven fathoms out to the State line. The tide runs here about three-quarters of a mile an hour.

The ground included between the meridians passing though the end of Center Island reef and of Lloyd's Point, the line adjoining these two points, and the State line, is generally soft bottom with a depth of from eight to nine fathoms in the southern portion, and increases to from eleven to thirteen in the northern portion.

The Lloyd's Neck bed is on the meridian passing through Lloyd's Point. The shoals off Lloyd's Neck extend on an average half a mile off shore. A good deal of the bottom is hard for about

two miles off shore. Beyond this out to the State line it is soft. The land off Lloyd's Neck is particularly valuable.

To the northward of the Huntington bay limit line, and out to about one and a half miles, the average depth is from five to seven fathoms. Beyond this it increases to sixteen fathoms near the State line. Between Eaton's Point and the Eaton's Neck bed there is a long shoal extending, and between the shoal and the bed the depth is from three and a half to seven fathoms; the bottom is hard in many places and pretty well covered with rocks. To the northward of Eaton's Neck bed the water runs to a depth of twenty fathoms, and the changes in depth in this vicinity are quite rapid and wide. The current attains a velocity of one and one-half miles per hour. In the bight to the eastward of Eaton's Neck and west of a meridian through the first lowland to the eastward of East Beach, the character of the ground is quite varied. Following the shore from Eaton's Point to the end of East Beach the five-fathom curve is found to be about three-fourths of a mile off shore. The southern portion of this bight is generally soft while the north-western part is hard. On this hard bottom, however, the star-fish seem to thrive particularly well, as a great many of the oystermen in this vicinity have found to their sorrow. Between the three-quarter-mile curve, the State line and the above-mentioned meridians, the depth of water gradually increases to fifteen fathoms at the northern limit, with one deep hole of sixteen fathoms near the middle. The bottom is generally soft but very good.

The shoals from here on to Nissequague river extends anywhere from half to one mile off shore. They are generally composed of hard sand, with a few scattered rocks, and are not adapted for cultivation for the reason that the heavy seas in winter rolling in upon them with accumulated force break with great violence and create such a commotion that the sand on the bottom is stirred up and shifts its position. If oysters were planted on this ground the probabilities are that during the first winter season they would be smothered by sand. A little ways beyond these shoals, however, and off shore, there are fine lands.

Off Crab Meadow the bottom is generally soft and the depth of water runs from seven to sixteen fathoms at the State line. Most of it, however, is within the ten-fathom curve. Off Kidd's Money Hole and beyond the shoals there is a good deal of hard bottom in from five to eight fathoms.

Further off shore the bottom is soft and the depth increases to nineteen fathoms near the State line; but it is within eleven fathoms most of the way out. The shore of Smithtown bay is bounded by shoals out to from five-eighths to seven-eighths of a mile. These shoals are composed of hard sand, and are covered in many places with small and large size rock.

The bottom of this bay is generally soft, though not very soft, and the general average of depth is eight fathoms. The nine-fathom curve will run nearly west from Crane Neck Point. From this line to the State line, the bottom is nearly all soft, and has a varied depth of from nine to nineteen fathoms.

The grounds to the northward of the bight between Crane Neck and Old Field points are generally hard for three-fourths of a mile; and the greatest depth is eight fathoms. Beyond this it is generally soft, and has a variable depth of from ten to twenty fathoms. Between Old Field Point and Mt. Misery Shoal there is a variable depth of from three and one-half to eight fathoms of water. It is generally soft and in the portion of Old Field Point there are a good many rocks. To the northward of this the water is very deep until one reaches the vicinity of Stratford shoal to the southward of which there is some soft and sandy bottom with the least water of about seven fathoms. Between the meridian passing through the entrance to Port Jefferson harbor and the one through Miller's Landing the character of the bottom is varied. Most of it is soft and composed of brown and black mud mixed with sand. The current here attains a velocity of two miles an hour. The average depth off shore is about fifteen to twenty fathoms. The ten-fathom curve is about one and one-half miles off shore. Along the shore to the eastward of this as far as Hallock's Landing, the shoals extend one and one-half miles out; and it is not very good for planting on account of the tendency of the bottom to shift.

A little to the northward of the shoals, there is a patch of hard bottom in from three to eight fathoms of water. This extends about a mile further out. From there to the State line the bottom is generally soft and the depth varies up to twenty-two fathoms.

Between Hallock's Landing and the mouth of Wading river the shoals do not extend more than three-fourths of a mile; and beyond them there are several strips of hard bottom in from five to eight fathoms of water extending about a mile. Beyond these

the water is very deep, running from ten to twenty-two fathoms with a general average of about twenty fathoms.

The Herod's Point shoal extends two miles off shore; and, although the bottom is hard, is not very good for oyster planting. Beyond this the water deepens rapidly, and has an average depth of nineteen fathoms. The current retains a velocity of nearly two miles an hour close to the end of the shoal.

There is a bight between Herod's Point shoal and Roanoke Point shoal, in which there is a good deal of hard bottom, and the depth is not over twelve fathoms. A good deal of it is in less than eight fathoms. This is in the western portion of the bight. To the northward of the line between the buoys on these respective shoals the water deepens rapidly to from fourteen to twenty-three fathoms, with a general average of about eighteen fathoms.

The shoal off Roanoke Point extends one and three-quarters miles from shore. The bottom beyond is generally soft, and averages sixteen fathoms. Just off Old Landing, and to the north-eastward of Roanoke Point, there is some hard bottom in about four fathoms of water. This extends about one and a half miles off shore.

The shoal off Jacob's Point extends about one mile off shore. The water deepens rapidly, with a general average of thirteen fathoms. Almost due north of Jacob's Point, a distance of six and a half miles, there is a patch of hard bottom in fourteen fathoms of water. Off Jacob's hills the shoals do not extend very far, and the depth of water for about two and a half miles does not exceed nine fathoms. Most of the bottom is muddy, but some of it is black sand. Beyond this, and out to State line, the average depth is about thirteen fathoms. The bottom is composed of brown sand in some places, fine gray sand in others, and out near the State line hard sand in about fourteen fathoms of water.

Between Jacob's hills, Duck Pond Point and the lines parallel to these points, distant one and a half miles, the depth of water does not exceed nine fathoms. Close in to shore it is from four and a half to seven fathoms. A good deal of it is hard, most of it being composed of sand and broken shells. Due north of this last line the bottom is quite level, and the depth averages about thirteen fathoms. The bottom is nearly all hard.

The shoals between Duck Pond Point and Horton's Point extend one mile off shore, after which the depth increases rapidly to

thirteen fathoms, and then gradually to twenty-four fathoms; then slowly diminishes to twelve fathoms near the State line.

Between Horton's Point and Inlet Point there is a good deal of hard bottom, with an average depth of from eight to ten fathoms. The hard bottom extends off shore about two and three-quarters miles, and is bounded by the fourteen-fathom curve. The depth of water beyond this is as great as twenty-eight fathoms in some places.

The six-mile reef which has least depth of three and one-quarter fathoms is mostly within the Connecticut waters; but a small portion of the eastern corner extends into our waters and has hard bottom. The currents along here are very strong and it would require a very heavy dredge to work successfully.

Between Inlet Point and Rocky Point there is a narrow strip of hard bottom in shoal water, but extends very little past the line joining these two points. Beyond this the water deepens rapidly and the current is very strong.

Between Rocky Point and Terry's Point and to the southward of Orient shoal, there is a bight of hard bottom with an average depth of four fathoms; but with the exception of that part close in shore, the current is very swift.

Just to the northward of Orient shoal the bottom is composed of hard sand and the general depth is about eleven fathoms. Between Terry's Point and Mulford's Point there is a little of shoal water, extending from a short distance off shore about a quarter of a mile. The current here is very swift. All to the northward of this the bottom is very deep and the current very swift.

Between Mulford's Point and Plum Gut the water is deep even close in shore. Some places here have a depth of thirty-nine fathoms. The only exception to this is close in shore at Petty's bight where there is some land with five fathoms of water over it.

The most available lands for planting are off Little Neck bay, to the northward of Oak Neck, and in the bight to the eastward of Oak Neck Point, at the mouth of Oyster bay, particularly to the north-westward of the mouthof Huntington bay, off Kidd's Money Hole and in Smithtown bay.

There are some splendid gravel beds on the shores of the sound which would furnish very large quantities of cultch. The best ones are to be found just to the eastward of Crane Neck and around Old Field Point, off Mattituck hills and about Rocky Point.

The results from tin used as cultch have not been successful. In the Chesapeake bay, small trees with the branches and twigs left upon them have been found very serviceable for catching the set.

The ice in Long Island sound would prevent, to a great extent, their use in the same way as in southern waters. Nevertheless, a modification of this plan would be, in my estimation, of value. We all know that the young oysters or fry, do not float near the bottom alone, but throughout intermediate depths also.

Experiment has proved that tiles suspended in the water are covered on the under side as well as on the upper.

The cultch now used serves only as a collector for the strata at the bottom. If we had some cheap method of having collectors for other strata, a much larger set would result.

Now, if a lot of dead bushes were weighted with stone and hove overboard, they would present a very large surface for very little cost.

I have noticed that the oystermen are sometimes late in preparing their grounds for the set, and then think the season has not been a good one. I would advise them to rake their grounds thoroughly during the very first part of the spawning season, and not delay it. I have in mind some cultivators who did not commence to rake their grounds until the middle of August last year, and found themselves too late, while some of their neighbors, who commenced the first part of July, had magnificent sets.

There are a good many oysters to be found just inside the mouths of such rivers as the Nissequagua, Stony brook, etc., which are not suitable for table use. They are long, thin, and generally found in thick clusters. They are called by some "Raccoon oysters," and have often been considered valueless. But they make splendid spawners.

If a man is shelling a piece of ground and decides to put some full-grown oysters amongst them for the purpose of securing a fair amount of spawn, he can not do better than use these comparatively valueless clusters of "Raccoon oysters." Besides giving forth a good deal of spawn, they form a barricade for the inner layers against the star-fish. The stars can not reach the ones in the center, and even if those outside are eaten up, the other ones will carry on operations in defiance of all enemies.

Mr. N. I. Qvigstad has acted as recorder and first mate. It is hardly necessary for me to reiterate what I have already said as

to his attention to duty and interest in the work. He has learned the use of the sextant and has given me valuable aid in this way. He deserves credit for the neatness and cleanliness of the vessel during the summer, for his sketches, which will add largely to the completeness of the records, and for his general usefulness to the survey.

I wish to express my thanks for the many ways in which I have been assisted by Mr. Archibald Young, Jr., and Dr. J. E. DeMund, of Bath Beach. These gentlemen went along with me last summer, and helped me in my work, purely out of good nature.

I hope that Mr. Edward Thompson and Mr. John Arthur, of Northport; Judge J. Lawrence Smith and Mr. Darling, of Smithtown; Dr. O. L. Jones, of New York; Mr Godfrey, Port Eaton, and Messrs. Charles H. and Alexander Bell, of Bayside, will accept my thanks for their many courtesies.

We are indebted to Mr. Glasier, of City Island, for the specimens of set, of which the accompanying photograph is an example. These set came from deep water where the oysters do not grow as rapidly as in shoaler places.

The following is a statement of expenditures of the engineer's department for the year ending November 30, 1887:

Salary of engineer and pay of crew	$3,698 04
Maps, drawing material, printing, etc	502 16
Field expenses	645 23
Office expenses	357 82
Miscellaneous	114 60
Total	$5,317 85

I wish to close my remarks with expressions of my appreciation of the way in which you have facilitated my work.

I know that your deep interest in the subject, and the trouble you have taken already would naturally cause you to wish for success, but the time and pains you have spent upon it, not to speak of the hundreds of dollars you advanced to carry on the work at a time when their return by the State seemed doubtful, have put such spirit into my department that I can not but feel grateful.

Very respectfully.

W. G. FORD, JR.,
Engineer.

Report of J. W. Mersereau, State Oyster Protector.

No. 80 Fulton Market,
New York City, *November* 30, 1887.

Eugene G. Blackford, Esq., *Commissioner of Fisheries in charge of Oyster Investigation, New York:*

Dear Sir.—I have the honor to transmit herewith the report of the State oyster protector for the year ending November 30, 1887.

Very respectfully.

JOS. W. MERSEREAU,
State Oyster Protector.

No. 80 Fulton Market,
New York City, *November* 30, 1887.

Eugene G. Blackford, Esq., *Commissioner of Fisheries in charge of Oyster Investigation:*

Dear Sir.—I respectfully submit the following report of my operations as State oyster protector for the year ending November 30, 1887.

Since my last report, in accordance with your directions, I have reported daily at this office except on the dates hereinafter mentioned, viz.: December 25, 1886, January 1, 1887, February 8, 1887, July 4, 1887, and November 8, 1887.

I have been on duty only part of a day on the dates hereinafter mentioned, viz.: January 18 and 19, 1887, February 22, 1887, May 30 and 31, 1887, and November 24, 1887. On all other days from November 30, 1886, to November 30, 1887, inclusive (except Sundays), I have been on duty all day subject to your instructions.

I have conferred with you in respect to the execution of the various duties appertaining to this office, and have acted in accordance with your directions.

I have frequently visited and examined various localities, especially manufacturing districts, and those points from which the pol-

lution of the waters might be expected. In making inspections, I have used steam tugs or such other method of travel as would best serve my purpose to reach the desired locality.

The particular time of the tide, hour of the day, and time of the week, being selected as would be most advantageous to detect the emission of deleterious matter from the respective establishments, and best evade the lynx-eyed watchmen at the several points, part of whose duty seemed to be to observe my arrival and movements. I therefore visited suspected points at irregular intervals, sometimes twice a day, or several days in succession. I would then inspect a distant point without notice to the parties as to my intended visit. In this way I endeavored to render the emission of refuse, hazardous, and found the scheme worked well.

I am pleased to report that during the year past there has not been a repetition of the offense of dumping garbage in the vicinity of the oyster beds in Long Island sound. The salutary effect of the successful prosecutions of this class of offenders in the courts of Westchester county, has given a quietus to the indiscriminate dumping of garbage upon oyster territory in that section,

I am pleased to state that our efforts in above matter were efficiently supported by District Attorney Nelson H. Baker and other officials of Westchester county. I have written to District Attorney George Gallagher, of Richmond county, as to the status of the three (3) cases (indictments of oil refiners) in said county, and he reports the cases to be yet pending.

In justice to the indicted parties I must say that since the indictments were obtained there has been an earnest effort upon the part of oil refiners and other kindred manufacturers, whose works are located on the shores of the Kill von Kull and Staten Island sound, to reduce the volume of obnoxious effluents from their respective establishments to a minimum, by perfecting the methods of arresting the outflow of refuse by the construction of new and additional safeguards, as hereinafter particularly mentioned.

The following extracts are from the report, in 1886, of Walter H. Kent, Ph. D., chemist, to Andrew Otterson, M. D., commissioner of the department of health of the city of Brooklyn, relative to the emission of sludge acid into Newtown creek, and which is pertinent to other localities:

"As bearing on the subject in hand, a word on the method of oil refining, with regard to the origin and nature of sludge acid and other refuse, may not be out of place.

"The method of oil refining is in the main a process of fractional distillation, and the portion distilled off between such and such temperatures are in turn discharged into the tanks provided for naphtha, gasoline, kerosene, etc. In the retorts there remains a tarry substance containing the paraffine, which is finally withdrawn and either sent to the paraffine works or mixed with coal dust and burned as fuel for heating the retorts. The kerosene, as it comes from the stills, needs further treatment to deprive it of its dark color and of the adhering volatile substances which tend to make it dangerous to burn. To deprive it of its dark color it is mixed in the 'agitator' with concentrated sulphuric acid 66 B. (sp. gr. 1.84) and thoroughly agitated by forcing air into the mixture. The strong acid has the property of taking from the kerosene the coloring or tarry matter, which, with the acid, forms a black, heavy liquid, known as sludge acid. It readily separates from the lighter kerosene, and is run off into tanks where the small amount of adhering kerosene further separates, after which it is transferred to the storage tanks. This waste acid has some peculiar properties. The tarry and carbonaceous matters held in solution very soon act as reducing agents on the sulphuric acid, forming sulphurous acid by a reaction like the following:

"$H_2 S O_4$ + tarry substance = $S O_2 + H_2 O$ (from the $H_2 S O_4$) + $H_2 O$ and possibly $C O$ (from the oxidation of carbonaceous matter). Very naturally the extent of this action varies with the temperature. In winter it is claimed to be slight, while in summer it becomes very offensive, undergoing, as the workmen improperly term it 'a process of fermentation;' but which is only an ordinary case of reduction. The suffocating and irritating gas of sulphurous acid is the gas which gives to burning sulphur its characteristic odor. If mixed with a small amount of water or steam, the heat engendered by the action of the water on the sulphuric acid assists in the action of reduction.

"When discharged into water, the sulphuric, acid so far as it comes in contact with the water, is taken up and, of course, forms a clear solution, while the tar, with the large amount of acid it contains, forms a semi-solid mass which mostly falls to the bottom. The tar is insoluble in water and when thoroughly freed from acid forms a wax-like, nearly solid mass.

"The sulphurous acid is also dissolved or absorbed by the water. After withdrawing the last portion of sludge acid from the agitator,

the kerosene is freed from acid so far as possible by washing with large quantities of water; then to secure the removal from the oil of the last traces of acid, it is agitated with a relatively small amount of caustic soda and further washed.

"The amount of acid the wash-water contains depends on the care with which the last portion of sludge acid is withdrawn; but by the present method of working a small amount of acid here finds its way into the creek.

"The question of removing this acid by neutralizing in some properly constructed tank needs, I think, further attention. The wash-water is freed from the small amount of oil it contains by allowing it to pass a system of 'traps' or tanks (see second annual report of the State Board of Health, page 387), where the oil is retained, and from which the wash-water is discharged into the creek.

"Here is the general source of the oil which is often found on the creek. I have obtained samples of the wash-water as it was being discharged into the creek, and generally find that on standing in the laboratory more or less rises to the surface. The effect of oil on the creek is to increase the danger of fire, to kill the grass on the shores, and to give the shores a dark greasy appearance. It is also said that the oakum calking in boats plying on the creek very soon degenerates so as to cause a leaking. This is readily understood from the action of the oil. Oil is a solvent for tar, and as oakum is finely divided tarred rope, the tar is removed by the oil and the structure of the oakum is thereby weakened.

"It having been asserted on the strength of a supposition that the waste acid has run into the creek by underground pipes which terminate and discharge somewhere in the bottom of the water, it was very soon concluded that any amount of inspection by watching along the creek would probably be entirely futile in discovering any offense under cover of such ingenious schemes. It was evident that if I could ascertain the amount of fresh sulphuric acid used for a given time, and obtain a statement of the amount of sludge acid sent to sea or elsewhere for the same period of time, I would be able to calculate the relation between such amounts and ascertain, approximately at least, whether the fresh acid used was accounted for in the amount of sludge acid disposed of. Hence I concluded to extend my efforts in this direction to find what facilities the refineries had for storing and disposing of the sludge

acid, and to do what I could by such facts as could be obtained by open inspection.

"Such a method would lead to results expressed in figures which might indicate whether the acid used was delivered to the boat in the form of sludge acid. That this method involved certain possible errors was readily seen, but it seemed to form a basis for a procedure from which there might be hopes of eliminating the errors to such an extent as to give satisfactory results.

"During this investigation, involving as it has many inspections, I was led to think from the uniform courtesy which I received, the fairness on the part of those whom I met, the facilities at hand for the disposal of the sludge acid and the apparent thoroughness of the work, that there was not ground for serious complaint; and it was not until the results in the above table were obtained that unsatisfactory indications were shown. The elaborate table of statistics above referred to is not here introduced, but suffice it to say that from the various refineries therein enumerated only the following respective percentage was accounted for, viz.: 93.8, 69.5, 71.5, 84.2, 74.3, 78.0, 92.5 and 96.5.

"In seeking an explanation for these low results among the companies concerned, it was ascertained that some have been using the sludge acid for fuel. To do this the acid is partly freed with water and the resulting tar mixed with coal dust and burned under the retorts. The acid, freed by the means of the water, finds its way sooner or later into the creek.

"In a subsequent report Mr. Kent says: "Since my former report I have again inspected those refineries located on Newtown creek. Their condition is apparently the same as represented in my previous report; and as there shown, there is a large percentage of acid still unaccounted for. Whether this will be found in the wash-water from the agitators, or in the portion reduced and vaporized, or disposed of in some way still unknown, further inspection is necessary to show."

In addition to the system in vogue with oil refiners of trapping the wash-water from the agitators (alluded to in the aforesaid report of Mr. Kent), some refiners have constructed large tanks into which the water from the agitators and condensers is pumped and allowed to rest, which quiet affords an opportunity for such oil as may be mingled with soda wash-water to separate. This oil is here collected and pumped back to be utilized. The remaining

water is then discharged into the elaborate system of "traps," and an effort is here again made to arrest the outflow of such oily matter as may not have been caught by the previous process. The "traps" are under the constant surveillance of operatives, who either bail or pump off the accumulation of oil floating upon the surface of each trap; the water escaping, in the meantime, underneath. The earth is completely saturated with oily refuse at an oil refining plant. A system of drainage has been found in some instances to be efficacious in collecting such sepiage and oily matter, and conducting the same to a large well or receiver, which is "trapped," and from which the oily matter is pumped away to be utilized.

Suspicious outlets have been closed at my direction. Notwithstanding the care taken to prevent the outflow of oily matter, nevertheless certain localities would constantly show the presence of oily refuse. Upon examination, it was believed to be due to sepiage. At my request, blanketing has been resorted to, and the refuse in this way collected from the slips and thus prevented from escaping into the stream.

The refineries accumulate a vast amount of ashes and cinders which they use for filling in purposes; the refineries of this section being located upon the banks of streams and in many instances upon marshland, the cinders are utilized in filling in bulk-heads or in raising the elevation of the grounds. The porosity of this filling allows the enormous quantity of oily refuse to percolate freely and ultimately reach the banks of the stream, and pollute the water of the vicinity; if the refuse is not collected by blanketing at this juncture, it being then subject only to the force and direction of the wind and current, it is carried far away on its evil errand.

Sludge acid and kindred refuse has been also, in many instances, used for filling in purposes and being subjected to the varying conditions of frost, heat and rain adds to the accretions of leaks from the many underground pipes. All this accumulation of oily matter naturally follows the underground currents, and is finally emptied at the banks of the stream, and then appears upon the surface of the open water.

The loss of oil from the leakage of underground pipes is a matter of serious importance, not only as to the ultimate pollution of the stream as hereinbefore shown, but as a serious loss to the oil refiners. Some of the refiners at Bayonne are taking up their

underground pipes and intend to have all the oil pipes in their yards above ground so that a leak can be easily observed and corrected. This must, to some extent, tend to improve the condition of the streams.

I have noticed that after heavy, drenching rains the river in the vicinity of the oil refineries presents a revolting spectacle of oily refuse washed from the oil yards. It might not be easy to convince the casual observer, but that the oil refiners had intentionally discharged refuse into the stream.

The system of drainage hereinbefore indicated will operate as a check to the outflow from the cause last mentioned. Frequent inspections of the suspected localities have resulted in the abolition of the former practice of discharging sludge and heavy refuse into the stream in the vicinity of the refineries.

Some of the sludge acid is carried to sea by steamers specially adapted for the purpose of receiving and discharging the same. Some of the refiners manufacture a weak acid from the sludge which they sell to manufacturers of fertilizers; while some refiners sell the sludge direct to the fertilizing companies. In other instances as aforesaid it has been used for filling in about the oil plants. The other residuum of heavy refuse, tar, etc., is used by the paraffine works, gas works, and to some extent for fuel. Thus the accumulation of refuse can be disposed of in various ways without detriment to the public, and especially to the fish and shell-fish industry.

Another prolific source of trouble is the pollution of the waters which comes from the discharge of the contents of the "water ballast tanks" of the oil ships at the wharves, when about to receive their cargo of oil at the refinery.

It has been the custom to load many large vessels with oil for foreign markets. Much more oil is now carried in bulk in tanks (instead of barrels or cans) than formerly. When these tank vessels discharge their cargo abroad, it is customary to pump water into certain lower tanks for ballast for their return to this port. When about to load these vessels at the refineries the water ballast (the contents of the tanks) and the bilge-water is pumped out and discharged into the stream. Owing to leakage from tanks the said ballast water and bilge water contain a certain accumulation of oil which has hitherto been discharged into the stream.

One of the superintendents of the Standard Oil Company said

that that company would arrange so that the oil from tank vessels could be pumped into a receiving tank at the oil yards and utilized instead of being as heretofore discharged into the stream and wasted.

While it may be impossible to so conduct an oil refinery as to prevent the outflow of the slightest trace of oil, yet much has been accomplished and I think better results can be obtained. Some refiners have informed me that although the erection of several tanks (to hold wash-water for rest and oil separation) has cost them $750 each, they are not at a loss thereby, as experience has shown them that they collect many hundreds of barrels of oil per month which heretofore they discharged unknowingly into the stream with the wash-water, not thinking that the percentage of loss was as great in this direction as has been shown to be the fact by collecting the oil from the rest tanks as hereinbefore indicated.

Another source of pollution of the streams with oil exists in the matter of an oil pipe which belongs to the Tidewater Pipe Line Co. This oil pipe extends from New Jersey across the extensive natural oyster beds in Staten Island sound to a point on Staten Island, thence across meadow land, thence to the flats opposite Elizabethport, N. J., thence across the channel between Staten Island and New Jersey, thence across Newark bay to the mainland, thence to Bayonne, N. J. This pipe has broken several times during the past year covering the water of the section with great quantities of crude oil. In one instance the vast quantity of oil from said source covered the main stream (where passenger steamers and vessels of various classes navigate). By some means it became ignited; the river in the vicinity became a sheet of raging flame and a large schooner lying out in the stream was completely enveloped by the flames upon the water and destroyed, being burned to the water's edge. The vessel was valued at $10,000 which amount, I am informed, was recovered from the Pipe Line Co. I am informed that the aforesaid company has authority from the State to construct said pipe line.

The universal testimony of the users of the Kill von Kull and Staten Island sound is to the effect that the condition of the streams during the past year has been much better than for any like period since the establishment of the oil refineries and kindred establishments along the shores of said streams.

Your attention is respectfully asked to copies of several commendatory letters upon the foregoing subject received from various classes of citizens using said streams, which matter is appended to this report.

I have frequently inspected Newtown creek. It also appears to better advantage this year than formerly. While frequent inspection of this section has rendered the reckless discharge of refuse hazardous, it is but just to say that the various oil refineries there located are under the same general control and management, as are the large oil companies located at Bayonne, which influence must be credited to some extent with much of the improvement observed.

I noticed that the glue works located on the Kings county side of Newtown creek, near Maspeth avenue, was discharging much refuse into the creek. The discharge colored the water for a considerable distance from the outlet and also precipitated a heavy deposit. I obtained several samples of the discharge, and also samples of the deposit were taken from the bottom at mouth of outlet. I notified the parties; they subsequently called at this office and agreed at once to begin the construction of large vats in which the waste wash-water is to be allowed to rest and settle; the clear water then to be discharged. There are many public sewers carrying the miscellaneous accumulation due to the populous cities of Brooklyn and Long Island City, which sewers empty their contents into the creek; consequently the creek can not be expected to be as completly free from pollution as it was in the early days of the "oldest inhabitant" when his neighbors were few and the present numerous industries were undreamed of. Most of the available space on either side of the creek (as far as navigation extends) is now occupied by manufactories of various kinds and frequent inspections are required to restrict the emission of refuse.

Gas-works have also been a prolific source of trouble. The refuse emitted therefrom being very similar to the refuse from oil refineries, and not less disastrous to oyster interests. In some instances the volume of the pollution exceeded that which would be observed at an oil refinery.

The slips and river in the vicinity of gas-works have been observed to be covered with a heavy tarry and oily refuse which being subject only to the force and direction of wind and tide, the

pollution is carried to distant points. The gas-works near the head of Gowanus creek were found to be emitting refuse. Samples were obtained, and the parties notified to discontinue the emission of gas refuse into the creek. They said, in reply, that they had constructed safeguards against the emission of refuse, and if any had escaped, it was due to the negligence of employes and that greater care would be taken in future.

The gas-works at foot of Hudson street, East river, Brooklyn, were found to be discharging much foul matter; upon a notice being sent to the parties, they said that they would cause an examination to be made, and arrest the outflow of refuse from their works. I have since frequently inspected the dock front of this company and have noticed nothing of a foul character flowing from the outlet at which I had obtained several samples of refuse previous to said notice.

At the works (two plants) of the Consolidated Gas Company, and at the works of the Equitable Gas-Light Company of New York, I observed that much refuse matter was being discharged into the river.

Both companies were warned to stop the emission of refuse from their gas-works into the stream. The offense continued. I therefore presented complaints to the grand jury of the county of New York, and noted sixty-three (63) samples of refuse which I had obtained, each bottle being particularly marked as to exact locality, date, etc., and with such further inscriptions as were suitable to the case, as "hot discharge," "bottle held at outlet," "profuse discharge," "steaming," "vapor painful to the eyes," "surface at point of contact of effluent," "incrustation of dock at outlet," "deposit taken from bottom at outlet," etc.

The Consolidated Gas Company and the Equitable Gas Light Company were indicted upon aforesaid complaints. Three indictments were obtained; two against the Consolidated and one against the Equitable Company. I have obtained many samples of refuse emitted into Flushing bay by the dye-works at College Point. The water of the bay is at times colored crimson, blue, green, yellow or black, as the case may be. The shell-fish upon the banks of the bay were found to be rotten, poisoned by the sulphuric acid and refuse emitted as aforesaid, which not only kills shell-fish by contact, but also operates in changing the character of the vegetation upon the bottom, thus affecting the supply of food for fish and shell-fish.

Several complaints have been made to this office in respect to the emission of said refuse. I investigated the matter, and learned that the parties did not discharge their refuse from their works directly into the bay by means of a private outlet, but that they used the public sewers, and had permission from the village authorities to do so. I then wrote the president of the village as to the facts of the case, and asked for their aid in eradicating the evil. I have received no response to my letter. Several applications have been received from dredging companies to have some suitable point in the deep water of Long Island sound (within the limits prescribed by chapter 300, Laws of 1886) set apart for depositing dredging of slips. Certain contractors desire a similar privilege extended to them to deposit cellar dirt and other earth. I have written to the Attorney-General of the State as to the matter, and have been by him referred to the district attorney of the particular county to be affected by such deposit of aforesaid material. Upon the advice of such district attorney, I protested against the deposit of the aforesaid material as proposed.

The existing law on the subject directs that aforesaid material shall be deposited above high-water mark, or behind a safe bulkhead, or at a point to be designated at sea.

Oystermen complain that under the cover of night dredgings from slips and other refuse is deposited near and upon oyster grounds to their injury.

Steam dredges are continually operating in and about the slips and water-ways of this section. The vast accumulation of material from this source, together with sand, mud, earth, cellar dirt, stone, ashes, cinders, ballast, or other heavy substances of various descriptions obtained from and about the large cities of this section, aggregates into an enormous volume. The numerous scows laden with above named materials are towed from their base of operation at day or night, as the tide may suit.

It is not an uncommon sight to observe scows laden with dredgings being towed during the day to some convenient point and made up in tows, the cargoes to be dumped at night. The indiscriminate dumping of mud dredgings from slips materially injures the harbor. I have not personally observed such illegal dumping. Boatmen have informed me that while navigating New York bay and Raritan bay at night they have been sufficiently near tows of aforesaid character to hear the operation of dumping. In no

instance did they obtain such evidence as would specifically fix the offense upon any particular party.

In some instances the tug towing the scows at night violated the law by not having lights set. This, of course, was to prevent detection. In some instances it is believed that the offenders proceeded from the slips at Perth or South Amboy, or other points in New Jersey.

The recent establishment of the State boundary line in Raritan bay, and the marking of the same by a line of buoys, will be of assistance in determining the location for future offenses of aforesaid character in that vicinity. It is also of great importance to the fish and shell-fish industries, as it will settle the vexed question as to the limits of the respective jurisdiction of the State of New York and State of New Jersey as to the extent of oyster and clam territory in that section.

The boundary line decided upon redounds to the credit of the commissioners charged with the work. It will give general satisfaction, and can be accepted upon the part of both States upon the full assurance that equal and exact justice has been done to all interests concerned.

The reprehensible practice of dumping in the harbor in disregard of certain bounds and limits could be stopped as effectively as in the matter of dumping at Execution light, Long Island sound, last year, if the proper actions be taken.

I would respectfully renew and amend my suggestion in my last report, "That to abolish the nefarious practice aforesaid, the present success of which is mainly due to its being done under the cover of night, would be to enact a law forbidding the dumping of garbage, dredgings and other refuse matter into the waters of this section, except in the daytime, at certain points to be designated. This would have a signal effect in correcting the evil complained of, and also to impose upon the offender a heavy fine; and allow any citizen to become an informer; and entitle such citizen acting as an informer to an equitable proportion of the fine, after the cost of prosecution be first deducted from the fine imposed. Upon the New Jersey shores of the Hudson river, New York bay, Kill von Kull, Staten Island sound and Raritan bay, are located many oil refineries and kindred establishments emitting refuse into the said waters; dredging from slips, and other refuse from the State of New Jersey, is deposited into the waters of the

State of New York to the injury of the oyster industry and other important interests."

I would, therefore, suggest that a conference be had between the law making powers of both States aforesaid, to the end that each State enact a law of like tenor and purport to remedy the aforesaid evil.

To guard efficiently the vast territory comprising a part of Long Island sound, East river, Hudson river, New York bay, Kill von Kull, channel between Staten Island and New Jersey, Staten Island sound and Raritan bay, is a work of no small character. The small appropriation allowed for this purpose precludes the possibility of such supervision as the importance of the great oyster industry demands.

SUMMARY FOR THE YEAR ENDING SEPTEMBER 30, 1887.

Days on which I reported for duty	308
Days on which I remained on duty all day	302
Days on which I remained on duty only part of a day	6
Days on which I did not report for duty (not including Sundays)	5
Suits pending in Richmond county	3
Suits pending in New York county	3

Inspection still in progress.

SALARY.

Balance available on November 30, 1886	$500 02
Amount appropriated in June, 1887 (chapter 195)	1,000 00
	$1,500 02
Amount received for year ending November 30, 1887	1,000 00
Balance available for ensuing year	$500 02

For Traveling and Incidental Expenses and Assistant.

Balance available on November 30, 1886	$468 15
Amount appropriated in June, 1887 (chapter 195)	750 00
	$1,218 15
Amount disbursed for year ending November 30, 1887,	390 42
Balance available for ensuing year	$827 73

GENERAL.

For Expenses of State Oyster Protector.

Amount appropriated in June, 1887 (chapter 460)	$750 00
Amount disbursed for services of tug-boats and small-boats since June, 1887, being the six months ending November 30, 1887	262 75
Balance available for ensuing year	$487 25

In order to be prepared for any emergency that might arise during the year demanding special work, with its corresponding increase of expenditures, I have been compelled to so economize in the matter of disbursements as to forego certain necessary work; therefore the balances existing as above shown do not by any means indicate that the appropriations heretofore stated are adequate for the work of guarding the vast oyster territory of the State.

I respectfully suggest that inasmuch as my time as above shown has been entirely devoted to the public service, my request hereby made for an increase of salary is not without reason. A sufficient appropriation should also be made to provide for the maintenance or frequent hire of a steam patrol vessel to properly and expeditiously answer the demands of the service.

Very respectfully.

JOS. W. MERSEREAU,
State Oyster Protector.

MARINERS' HARBOR, S. I., *November* 24, 1887.

EUGENE G. BLACKFORD, Esq., *Shell-Fish Commissioner, New York State:*

DEAR SIR.— We, the undersigned oystermen, join in expressing our appreciation of the improvement noticed during the past year in the condition of the Kill von Kull and Staten Island sound. Said improved condition we attribute to the energetic action of yourself and State Oyster Protector Joseph W. Mersereau in enforcing what is known as the sludge acid law. The sludge acid nuisance was becoming unbearable, the heavier portion settles upon and destroys the natural oyster beds, the lighter oily refuse

enters and covers the surface of the oyster floats in which oysters are placed to freshen for market.

If the oysters in being taken from the floats are raised through a surface of oily refuse it adheres to the shells, and in the process of opening the oysters become impregnated with an oily taste which injures their market value.

We earnestly desire a vigorous enforcement of the law against depositing sludge acid and other oily refuse into our waters and trust that you will continue the fight against the pollution of our waters.

BEDELL JONES.	CHARLES VAN NAME.
AMOS MERRELL.	CHARLES M. DECKER.
DOUGLAS THOMPSON.	HENRY FISHER.
EDGAR MERSEREAU.	MOSES VAN NAME.
GEORGE A. SHARRET.	RUSSELL TOMLINSON.
A. W. STINEMIRE.	JOSEPH LA TOURETTE.
EDMOND DECKER.	AARON BUSH.
DAVID LA TOURETTE.	ABRAM MARTINEAU.
EDDIE MARTINEAU.	G. M. SHOTWELL.
JOHN B. KING.	ABRAM KRUSER.

WEST PORT RICHMOND, S. I., *November* 21, 1887.

JOSEPH W. MERSEREAU, Esq., *State Oyster Protector:*

DEAR SIR.—I take pleasure in saying that since Commissioner Blackford and yourself began the enforcement of the law against those who pollute our waters with oil refuse there has been a marked improvement in the condition of the Kill von Kull.

I am daily about my railway and beach and have observed that there has been much less pollution of the river this year than for any like period since the establishment of the oil refineries along the shores of the Kill von Kull and Staten Island sound.

On two or three occasions during the past spring and summer I noticed that the surface of the water in the vicinity was covered with an oily film; I have observed that this was not refuse from the oil refineries, but was due to the breaking of an oil pipe recently laid across Staten Island sound.

The fish and shell-fish industry is not alone injured by the pollution of the waters; it works great injury to boating and yachting and consequently injures my business; as yachtsmen will

not frequent the Kill von Kull as a place of anchorage, nor will they use our ship yards, and railways for repairing, painting, etc., if their vessels are to be subjected to the great volume of pollution heretofore encountered in this vicinity.

Previous to the enforcement of the law against the pollution of our waters, I have been compelled repeatedly to scrape the thick oily refuse from my railway before my men could begin their work upon the vessels which were hauled out upon the ways.

That it has not been necessary to cleanse my ways during the past year I attribute to the enforcement of aforesaid law.

I earnestly hope that the good work will be continued until the evil is entirely eradicated.

Yours truly.

LEWIS S. ST. JOHN.

MARINERS' HARBOR, S. I., *November* 22, 1887.

JOSEPH W. MERSEREAU, Esq., *State Oyster Protector:*

DEAR SIR.—In the prosecution of my coal business, I am required almost daily to pass along and over the Kill von Kull; and am pleased to say that there has been much less oil refuse upon the river during the last year, than during any year since the oil refineries were located on said stream.

I think the improvement in the condition of the river is due to the energetic action of Commissioner Blackford and yourself in compelling the oil refiners to respect the rights of all users of our waters.

Yours very respectfully.

GEO. W. THACKERY.

WEST PORT RICHMOND, *September* 30, 1887.

JOSEPH H. MERSEREAU, Esq., *State Oyster Protector:*

DEAR SIR.—I am engaged in operating a ferry across the Kill von Kull. I am daily upon the river and about the beach, and desire to add my testimony to that of the general public, that for the last year there has been much less oil refuse upon the water in the vicinity than heretofore.

Commissioner Blackford and yourself deserve the thanks of watermen for the great improvement which has taken place in the condition of the river since the enforcement of the law against the pollution of our waters by oil refuse.

Very truly yours.

HENRY KING.

Mariners' Harbor, S. I., *November* 23, 1887.

Joseph W. Mersereau, Esq., *State Oyster Protector:*

Dear Sir.—Since Commissioner Blackford and yourself began the enforcement of the law against the sludge acid nuisance there has been a very perceptible improvement of the condition of the surface of the Kill von Kull and Staten Island sound.

Had the emission of refuse continued or increased, as it very probably would have done if not restricted by law, it would have materially injured if not destroyed several business interests along our shores. I am daily upon my coal wharf or upon and about the river and know whereof I speak.

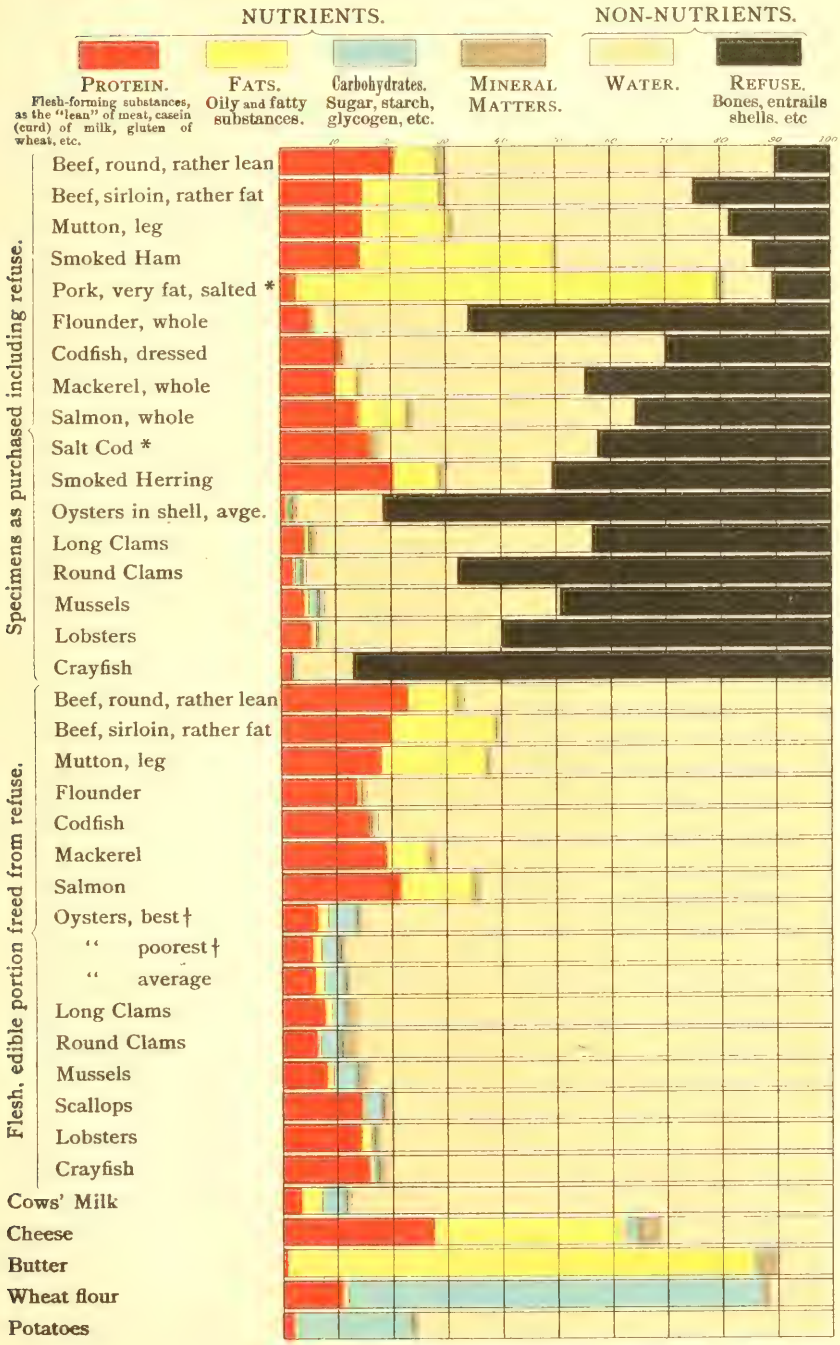
I trust the oil refiners will be compelled to continue the observance of the law against the pollution of the waters with oil refuse.

Yours truly.

MATTHIAS DeHART.

Proportions of Nutritive Ingredients, Water and Refuse in Food Materials.

PERCENTAGES INDICATED BY COLORED SPACES.



* Refuse includes salt. † In respect to quantity of nutrients regardless of flavor.

APPENDIX "A."

OYSTERS AS FOOD.

By W. O. Atwater,
Professor of Chemistry, Wesleyan University.

Very little is popularly known and widely varying views are held with reference to the value of oysters and other shell-fish for food. Although a great deal of scientific research has of late been given to the subject of food and nutrition, these particular kinds of food have been studied but little, and what has been done is slow in getting into print and becoming generally known. The lack of popular knowledge of the subject is, therefore, easy to understand. The object of the present article is to give a brief summary of the results of studies conducted in the laboratory of Wesleyan University under the auspices of the United States Commission of Fish and Fisheries.*

Speaking roughly, a quart of oysters contains, on the average, about the same quantity of actual nutritive substance as a quart of milk, or a pound of very lean beef, or a pound and a half of fresh codfish, or two-thirds of a pound of bread. But while the weight of actual nutriment in the different quantities of food materials named is very nearly the same, the quality is widely different. That of the very lean meat or codfish consists mostly of what are called in chemical language protein compounds, or "flesh formers," the substances which make

* The studies belong to an investigation of the chemical composition and nutritive values of American food fishes and invertebrates, one of the investigations that are carried on with official aid, in this case that of the United States Commission of Fish and Fisheries, but of which the larger part of the pecuniary expense is paid from private sources. It is proper that I should say here that the part of the investigation which has to do with oysters and other shell-fish would not have been undertaken had not the expenses of beginning it been in part defrayed by a personal contribution from Mr. E. G. Blackford, Fish Commissioner of the State of New York. Preliminary accounts of the work have been given in the commissioner's reports of the United States Commission of Fish and Fisheries for 1880 and 1883. (Published in 1883 and 1885.)

blood, muscle, tendon, bone, brain and other nitrogenous tissues. That of the bread contains but little of these, and consists chiefly of starch, with a little fat and other compounds which serve the body as fuel and supply it with heat and muscular power. The nutritive substance of oysters contains considerable of both the "flesh forming" and the more especially heat and force giving ingredients. Oysters come nearer to milk than almost any other common food material as regards both the amounts and the relative proportions of nutrients, and the food values of equal weights of milk and oysters, *i. e.* their values for supplying the body with material to build up its parts, repair its wastes and furnish it with heat and energy, would be pretty nearly the same. But while this statement is reasonably correct, the studies thus far made are not sufficient to assure us of its absolute accuracy.

The differences which oystermen observe in the quality of oysters from different localities, of different age, and grown under different conditions, are made clearer and are to a considerable extent explained by chemical analysis. Taking the oysters in the shell, the proportion of shell contents, "meat" and "liquor" together increases relatively to the whole weight as the animal grows, at least up to a certain limit. In other words a bushel of mature oysters will "open" more quarts than a bushel of the very young animals. But the differences between different kinds, or between specimens of the same kind under different conditions, are very wide.

Taking the edible portion of the oyster, after it has been removed from the shell, the differences are much greater than people commonly suppose. This is apparent when we compare either the flesh, "meats," or liquids, "liquor," of different specimens, or the whole edible portion, meat and liquor, "solids" together. The percentage of water in the edible portion of the different specimens of oysters reported in the tables beyond, varied from 83.4 to 91.4 per cent, and averaged 87.3 per cent. This makes the amounts of "water-free substances," *i. e.* actually nutritive ingredients, vary from 16.6 to 8.6 and averaged 12.7 per cent of the whole weight of the edible portion (shell contents) of the animals. In other words the contents of nutritive material in a quart (two pounds) of shell contents, "solids," varied from $2\frac{3}{4}$ to $5\frac{1}{8}$ ounces. The proportion of nutritive substance was twice as large in the one case as in the other.

The large table at the end of the article (Table IV), gives condensed results of chemical analysis of a considerable number of specimens of oysters, clams and other shell-fish, and Tables I, II and III give various details of composition of these and other food materials.

As the technical terms are somewhat unfamiliar, a few explanations will perhaps be in place here.

If the reader will take the pains to notice the next piece of beef that he has to carve for dinner, he will, of course, notice first of all that along with the meat which is good to eat, there is more or less bone, which, except in so far as it may be used for soup, is of no value for food. The beef, then, may be regarded as consisting of edible portion and refuse. In eggs there is the same distinction between shells and the so-called "meat," and oysters and other shell-fish in like manner, include the shells, which are simply refuse, and the shell contents, which make up the edible portion. The inside of the potato and the wheat flour are the edible portion, and the skin and bran are refuse of potatoes and wheat.

If we take the beef and separate the meat from the bone, cut it into fine particles and keep it for a long time in a hot oven it will be gradually dried, that is to say the water will be driven out of it and the so-called nutritive substance will remain. In the same way milk, eggs, oysters, potatoes and flour are found to consist of water and nutritive material. In estimating the value of these different materials for food we leave the refuse and the water out of account and consider only the nutritive ingredients.

We may take a piece of beef, and after cutting out the bone and drying the meat, put the latter in the fire and burn it. Nearly all will be consumed, but a portion will remain as ashes. An operation of this sort is regularly carried on in the chemical laboratory in the analysis of meat and other food-materials. Portions are dried with proper apparatus, and the percentages of water and water-free substances are determined. Other portions are burned, and the percentages of ash are found out. If we weigh the whole meat, bone and all, to start with, and afterwards weigh bone and other refuse and the meat, we can easily calculate the percentages of refuse and edible portion. If we then determine the percentages of water, water-free substance, and ash in the meat, we have made a fair start in the analysis for determining the food value. The water-free substance contains all of the nutritive materials, or nutrients, but the analysis thus far has told only the percentage of ash, or mineral matters. The proportions of the other ingredients must be found out before we can judge exactly of the food value.

The meat consist of lean and fat. Part of the fat is in large lumps, which can be easily separated from the lean. We often cut out the fat and reject it instead of eating it. But a portion of the fat is in very fine particles diffused throughout the lean. Although a part of

this fat is in particles so fine as to be invisible to the naked eye, it is possible to separate them very completely from the lean by processes of analysis common in the laboratory. After the water and the fat have been removed from the lean meat, the material which remains will contain a little mineral matter, which would be left as ash if it were burned, the rest consists of so-called protein compounds. The protein is the chief constituent of fish and eggs, as well as of lean meat. It occurs likewise in milk and in vegetable foods, such as wheat, corn, potatoes, etc.

Fat is familiar to us in meat from which we get it in the form of tallow and lard, in milk from which it is obtained as butter, in the various oils, such as olive oil, cotton-seed oil, and the oils of wheat and corn. Larger or smaller proportions of fat are found in most food-materials.

Potatoes, wheat and corn contain large proportions of starch. Sugar-cane and sorghum are rich in sugar. Starch and sugar are very similar in chemical composition, and are called carbohydrates. Other carbohydrates are found in animals and plants; such as inosite, or "muscle sugar," in muscle, and glycogen, or "liver sugar," in the liver.

The mineral matter, or ash, which is left behind when animal or vegetable matter is burned, consists of a variety of chemical compounds commonly called salts, and including phosphates, sulphates and chlorides of the metals calcium, magnesium, potassium and sodium. Calcium phosphate, or phosphate of lime, is the chief mineral constituent of bone. Common salt is chloride of sodium.

The number of different chemical compounds in our animal and vegetable food materials is very large, but leaving water out of account it is customary to divide the rest into the classes of which we have spoken, to wit: protein, fats, carbohydrates and mineral matters, and to look upon these as the nutritive ingredients, or nutrients, of food. The proportions of these ingredients are determined by the somewhat complicated methods of chemical analysis followed in the laboratory, but our every day handling of food-materials often involves processes, though crude ones, of analysis.

We let milk stand; the globules of fat rise in cream, still mingled, however, with water, protein, carbohydrates and mineral salts. To separate the other ingredients from the fat, the cream is churned. The more perfect this separation, *i. e.*, the more accurate the analysis, the more wholesome will be the butter. Put a little rennet into the skimmed milk, and the caseine, called in chemical language an albuminoid or protein compound, will be curdled and may be freed from

the bulk of the water, sugar and other ingredients by the cheese-press. To separate milk-sugar, a carbohydrate, from the whey is a simple matter. One may see it done by the Swiss shepherds in their Alpine huts. But farmers find it more profitable to put it in the pig-pen, the occupants of which are endowed with the happy faculty of transforming sugar, starch and other carbohydrates of their food into the fat of pork.

The New England boy who on cold winter mornings goes to the barn to feed the cattle, and solaces himself by taking grain from the wheat bin and chewing it into what he calls "wheat gum," makes, unknowingly, a rough sort of analysis of the wheat. With the crushing of the grain and the action of the saliva in his mouth, the starch, sugar and other carbohydrates are separated. Some of the fat, *i. e.*, oil, is also removed, and finds its way with the carbohydrates into the stomach. The tenacious gluten, which contains the albuminoids or protein, and constitutes what he calls gum, is left. When, in the natural order of events, the cows are cared for and the gum is swallowed, its albuminoids enter upon a round of transformation in the boy's body, in the course of which they are changed to other forms of protein, such as albumen of blood or myosin of muscle; or are converted into fat, or are consumed with the oil and sugar and starch to yield heat to keep his body warm and give him muscular strength for his work or play.

There, is unfortunately, a little confusion of terms in the usages of different writers on these subjects. Thus the words, protein, proteids and albuminoids are all applied to what we have here called the protein compounds. The term albuminoid, album-like, comes from albumen which is best known in the form of white of eggs, a typical albuminoid compound. The term proteids is applied by some writers to albuminoids and by others to very different classes of materials. The fats are sometimes spoken of as hydrocarbons, but this use of the latter term is very incorrect.

These different classes of nutrients in food, to wit, protein, fats, carbohydrates and mineral matters, have different uses in nutrition. Muscle, tendon and bone are formed from the protein compounds. These are sometimes called flesh formers because they make flesh. Their chief use in the body is to make blood and to build up the muscle, tendon, bone, and other tissues which constitute the frame work of the body and repair them as they are being continually worn out by use. Brain and nerve are also formed to a considerable extent from the protein compounds of the food. The protein of the food is also formed into fat in the body and serves as fuel to supply it with

heat and muscle energy. The fats of the food are stored as fat in the body and may be transformed into carbohydrates, but their chief use is for fuel. The carbohydrates are transformed into fat in the body and may be stored as body fat, but their chief use is for fuel. The mineral matters make bone and have various other uses in the body.

When we eat meat, then, its protein serves to make blood, bone, muscle, tendon, brain and nerve. We can also use it to make fat, and it is consumed, *i. e.*, burned as fuel, to yield its heat, to keep our bodies warm and give muscular strength for work. The fat of the meat can not do the work of the protein in forming muscle, tendon and the like, but is much more valuable than protein for fuel. Bread supplies us with protein and fat, and, also, with carbohydrates in the form of starch, dextrin and sugar. The protein and fats serve the same purposes as those of meat. The carbohydrates, which make up the bulk of the nutritive material of bread and potatoes, and of which only minutest quantities occur in the meat, are valuable chiefly as fuel, though they also yield fat.

To recapitulate; the nutritive material of very lean meat and the leaner kinds of fish consists almost entirely of protein. Tallow, lard, oils and butter are fats. Sugar and starch are carbohydrates. All the different food materials contain mineral matters. Animal foods supply, chiefly, protein and fats. Most vegetable foods contain but little of these, their nutrients being chiefly carbohydrates. Beans, pease and other leguminous plants, however, supply considerable quantities of protein. Milk differs from most other animal foods in that it has large quantities of a carbohydrate, "milk-sugar." Oysters approach milk in composition.

For nourishment we need all of the different classes of nutrients and in proper proportions. Thus a day's food for an average man doing moderately hard muscular work may appropriately supply, on the average, about four and one-third ounces of protein, the same quantity of fats, and sixteen ounces of carbohydrates.

The cheapest food is that which supplies the most nutritive material for the least money, the most economical food is that which is cheapest and best adapted to the wants of the user.

The following tabular statement summarizes the main points above elaborated.

Viewed from the stand-point of their uses in the nutrition of man, the constituents of ordinary foods may be succinctly classified as follows:

1. *Edible substance, e. g.*, the flesh of meats and fish, the shell contents of oysters, wheat flour.

3. *Refuse, e. g.*, bones of meat and fish, the shells of oysters, bran of wheat.

The edible substance consists of

1. *Water.*
2. *Nutritive substance or nutrients.*

Principal Nutrients of Food.

Protein.	*Albuminoids: e. g.*, albumen of egg, myosin of muscle (lean of meat), caseine of milk, gluten of wheat. *Gelatinoids: e. g.*, ossem of bone, collagen of tendons (which yielded gelatin).

Fats: e. g., fats of meat, butter, olive oil, oil of maize and wheat.

Carbohydrates: e. g., starch, sugar, cellulois (woody fiber).

Mineral Matters of Ash: e. g., calcium, potassium and sodium, phosphates and chlorides.

Ways in Which the Nutrients are Used in the Body.

The Protein of food	forms the (nitrogenous) basis of blood, muscle, connective tissue, etc. is transformed into fats and carbohydrates. is consumed for fuel.
The Fats of food	are stored as fat. are consumed for fuel.
The Corbohydrates of food	are transformed into fat. are consumed for fuel.

In being consumed for fuel, the nutrients yield enery in the forms of heat, which keeps the body warm, and muscular energy, strength for work. The quantities of energy which different food-materials are capable of yielding and which are taken as the measure of the fuel-value, are determined by certain methods.*

I have not applied these methods of calculation to shell-fish in this article, because the nature of the compounds which make up their nutritive ingredients is not fully understood, and it is not certain that we call protein, fats and carbohydrates in them have the same fuel-value as in meats, fish, etc. For the same reason I have not attempted detailed estimates of the pecuniary economy of shell-fish as compared with other food-materials.†

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*See article on "The Potential Energy of Food" in the *Century Magazine* for July, 1888.

† See article on "Pecuniary Economy of Food" in the same magazine for January, 1888.

The result of analyses of food material can be stated in a variety of ways. That followed in Tables I and III, beyond, may be explained by an example.

The flesh, or edible portion of a specimen of beef sirloin, of medium fatness, was analyzed and found to contain, approximately, water, sixty per cent; protein, nineteen per cent; fats, twenty per cent; mineral matters, one per cent. But when we buy our sirloin steak or roast, by the pound, as we ordinarily do, we get not only the flesh, the edible substance, but with it more or less bone, sinew and other refuse matter. This specimen contained about one-fourth or twenty-five per cent bone, and three-fourths, seventy-five per cent, of flesh. If then, we are to consider the composition of the meat as we buy it, we must take the refuse matters into account. The proportions of the several ingredients in both the edible portion and the whole piece above referred to, are shown in the following table:

	In flesh, edible portion.	In meat, as bought, including refuse.
	Per cent.	Per cent.
Refuse, bones, etc.	None.	25
Water	60	45
Protein	19	14¼
Fat	20	15
Mineral matters	1	0¾
Total	100	100

This very imperfect analysis may be stated in the following form, as is done in the tables beyond: *

CONSTITUENTS OF SAMPLE OF BEEF, SIRLOIN.

FOOD MATERIAL.	In Edible Portion — *i. e.*, flesh freed from bone and other refuse.					In Meat as Purchased — (including both edible portion and refuse).					
			Nutrients.				Edible portion.				
									Nutrients.		
	Water.	Nutrients.	Protein.	Fats.	Mineral matters.	Refuse: bones, etc.	Water.	Nutrients.	Protein.	Fats.	Mineral matters.
	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.
Beef, sirloin, med. fatness	60	40	19	20	1	25	45	30	14.3	15	0.7

* The tables contain also columns for carbohydrates, etc., which occur in milk and in some shell-fish, but are not found in ordinary meats in sufficient amount to warrant their presence in such tables as these.

Table I, herewith, gives the composition of a number of animal foods, mostly from late American analyses. It is only a short time since analyses of American meats, fish, etc., have been undertaken in any considerable number, and those as yet accomplished are far from sufficient for a complete survey of the subject. Indeed, the work already done can be regarded only as a beginning. Still, the figures will give a tolerably fair idea of the average composition of the articles named:

TABLE I.

Proportion of Nutritive Ingredients, Water and Refuse, in Ordinary Food Materials.

FOOD MATERIALS.	Refuse, bones, skin, shells, etc.	Edible Portion.				
			Water—Free Substance. Nutrients.			
		Water.	Protein.	Fats.	Carbohydrates.	Mineral matters.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Specimens as purchased, including both flesh and refuse:						
Beef, round, rather lean	19.0	60.0	20.7	8.1	.....	1.2
Beef, sirloin, rather fat	25.0	15.0	15.0	14.3	.....	0.7
Mutton, leg	18.4	50.4	15.0	15.5	.....	0.7
Smoked ham	14.0	36.3	14.6	34.2	.....	0.9
Pork, very fat, salted	*10.4	9.5	2.8	76.5	.....	0.8
Flounder, whole	66.8	27.2	5.2	0.3	.....	0.5
Codfish, dressed	29.9	58.5	10.6	0.2	.....	0.8
Mackerel, whole	44.6	40.4	10.0	4.3	.....	0.7
Salmon, whole	35.3	40.6	14.3	8.8	.....	1.0
Salt cod	42.1	40.3	16.0	0.4	.....	1.2
Smoked herring	56.9	19.2	20.2	8.8	.....	0.9
Oysters in shell, best†	81.1	15.1	1.5	0.3	1.3	0.4
Oysters in shell, poorest†	88.8	10.2	0.5	0.1	0.2	0.2
Oysters in shell, average†	82.3	15.5	1.1	0.2	0.5	0.4
Long clams	43.6	48.4	4.6	0.6	1.3	1.5
Round clams	68.3	27.3	2.1	0.1	1.4	0.8
Mussels	49.3	42.7	4.4	0.6	2.0	1.0
Lobsters	60.2	32.6	5.8	0.7	0.4	0.3
Cray fish	87.7	10.1	2.0	.....	0.1	0.1
Flesh, edible portion freed from refuse, bone, etc.:						
Beef, round, rather lean	.....	66.7	23.0	9.0	.....	1.3
Beef, sirloin, rather fat	.....	60.0	20.0	19.0	.....	1.0
Mutton leg	.....	61.8	18.3	19.0	.....	0.9
Flounder	.....	84.2	13.8	0.7	.....	1.3
Codfish	.....	82.6	15.8	0.4	.....	1.2
Mackerel	.....	71.6	18.8	8.2	.....	1.4

Salmon	.....	63.6	21.6	13.4	.....	1.4
Oysters, best †	.....	85.2	6.6	1.8	5.6	0.8
Oysters, poorest †	.....	88.4	5.9	1.5	3.3	0.9
Oysters, average †	.....	87.2	6.3	1.6	4.0	0.9
Long clams	.....	85.9	8.2	1.0	2.3	2.6
Round clams	.....	86.2	6.6	0.4	4.1	2.7
Mussels	.....	84.2	8.7	1.1	4.1	1.4
Scallops	.....	80.3	14.8	0.2	3.3	1.4
Lobsters	.....	81.8	14.5	1.8	0.2	1.7
Cray fish	.....	81.2	16.0	0.5	1.0	1.3
Cows' milk	.....	87.4	3.4	3.7	4.8	0.7
Cheese	.....	31.2	27.1	35.5	2.3	3.9
Butter	.....	10.0	1.0	85.0	0.5	3.5
Wheat flour	.....	11.6	11.1	1.1	75.6	0.6
Potatoes	.....	75.5	2.0	0.2	21.3	1.0

* Includes salt. † In respect to quantity of nutrients, leaving flavor out of account.

The colored diagram expresses the facts of Table I in a way which makes them more easily seen at a glance. One of the first things that strikes the eye in looking down the diagram are the black bands, which represent the proportions of refuse, *i. e.* bones of meat, bones, skin and entrails of fish, and shells of shell-fish. The bulk of the weight of the oysters and other shell-fish, as taken from the water, is shell. The percentages of refuse in the meats and fish are very variable; the fat pork has very little refuse, the beef more, while in some kinds of fish, as flounder, the bones, skin and entrails together make up more than half the whole weight.

The percentages of water, indicated by light green bands, are likewise extremely variable; in the edible portions of shell-fish, fish and most meats the water makes up the larger part. The quantities of nutrients, *i. e.* actually nutritive substances, in the different food-materials are represented by the whole of that part of each band at the left of the light green. It is interesting to compare the very large quantity of nutrients of the fatter kinds of meat and in flour with the small quantities in fish, shell-fish and the leaner meats.

The most important of the nutritive ingredients, the protein, is represented by red; the leaner fish, like very lean meat, consist mostly of protein. The very fat pork, the wheat flour and the potatoes contain relatively little. The portions of fat, represented by yellow, are very variable; in the fat pork it is the principal ingredient. Flounder codfish and the shell-fish contain extremely little. The carbohydrates, represented by blue, do not appear in the meats and fish, the quantities being to minute. The flour and potatoes have large proportions and there is some in the shell-fish. The diagram, with the corresponding figures of Table I, tells its story so plainly that further explanations are hardly needed.

Tables II, III and IV give results of analyses of specimens of shell-fish. They are taken from a report now in preparation which will include numerous details not given here.

The specimens, as received for analysis, were generally in the shell; on arrival at the laboratory they were weighed. The shell contents were then taken out and separated into flesh ("meat") and liquid ("liquor"). Each of these was weighed separately, as were the shells also. From these weights the percentages were calculated. Table II gives results:

TABLE II.

Proportion of Flesh, Liquids and Shells in Specimens of Shell-Fish.

KINDS OF SHELL-FISH, LOCALITY, SEASON.	Edible Portion.			Refuse; shells, etc.
	Fish.	Liquids.	Total.	
	Per cent.	Per cent.	Per cent.	Per cent.
Oysters, Stony Creek, April	7.5	11.4	18.9	81.1
Oysters, Stony Creek, November	11.0	7.3	18.3	81.7
Oysters, Stony Creek, March	11.2	9.3	20.5	79.5
Oysters, Fair Haven, April	12.6	5.4	18.0	82.0
Oysters, Fair Haven, November	12.3	12.1	24.4	75.6
Oysters, Fair Haven, March	12.2	4.4	16.6	83.4
Oysters, Blue Points, April	13.4	5.2	18.6	81.4
Oysters, Blue Points, November	6.5	9.7	16.2	83.8
Oysters, Blue Points, February	7.9	7.4	15.4	84.6
Oysters, Shrewsbury, April	12.6	4.9	17.5	82.5
Oysters, Shrewsbury, November	11.3	8.4	19.7	80.3
Oysters, Shrewsbury, February	9.6	9.7	19.3	80.7
Oysters, Potomac rivers, three weeks after transplanting	6.5	5.6	12.1	87.9
Oysters, Potomac rivers, six months after transplanting	10.2	6.5	16.7	83.3
Oysters, James river, five weeks after transplanting	6.5	7.3	13.8	86.2
Oysters, James river, six months after transplanting	11.4	5.8	17.2	82.8
Oysters, specimen with maximum percentage of flesh	13.4	5.2	18.6	81.4
Oysters, specimen with maximum percentage of liquids	11.7	13.2	24.9	75.1
Oysters, specimen with maximum percentage of shells	4.7	6.5	11.2	88.8
Oysters, average of thirty-four specimens	9.8	7.9	17.7	82.3
Long clams, specimen with maximum percentage of flesh	39.4	16.9	56.3	43.7
Long clams, specimen with maximum percentage of liquids	32.9	25.0	57.9	42.1
Long clams, specimen with maximum percentage of shells	29.3	24.6	53.9	46.1
Long clams, average of four specimens	34.5	21.9	56.4	43.6
Round clams	16.8	14.9	31.7	68.3
Mussels	32.7	18.0	50.7	49.3

TABLE III.

Proportions of Water and Nutritive Ingredients in Edible Portion of Specimens of Shell-Fish from Different Localities and at Different Times.

KIND, LOCALITY AND TIME.	Water.	Nutrients.	Nutrients. Protein.	Nutrients. Fats.	Nutrients. Carbo-hydrates.	Nutrients. Mineral matters.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Oysters, Stony Creek, April	90.1	9.9	4.6	0.6	2.0	2.7
Oysters, Stony Creek, November	84.8	15.2	6.9	1.4	4.5	2.4
Oysters, Stony Creek, March	87.2	12.8	6.3	1.0	3.2	2.3
Oysters, Fair Haven, April	85.1	14.9	7.5	1.4	3.5	2.5
Oysters, Fair Haven, November	85.3	14.7	6.2	1.3	5.0	2.2
Oysters, Fair Haven, March	84.6	15.4	7.7	1.3	3.5	2.9
Oysters, Blue Points, April	81.7	18.3	8.2	1.7	6.5	1.9
Oysters, Blue Points, November	88.3	11.7	5.8	0.8	2.9	2.2
Oysters, Blue Points, February	90.2	9.8	5.0	0.9	2.3	1.6
Oysters, Shrewsbury, April	85.4	14.6	6.5	1.6	5.0	1.5
Oysters, Shrewsbury, November	89.2	10.8	4.9	1.0	3.2	1.7
Oysters, Shrewsbury, February	85.2	14.8	6.2	1.5	5.2	1.9
Oysters, Potomac river, three weeks after transplanting*	86.6	13.4	5.9	1.2	3.8	2.5
Oysters, Potomac river, six months after transplanting	87.4	12.6	6.3	1.2	3.7	1.4
Oysters, James river, five weeks after transplanting	90.1	9.9	4.6	0.8	2.3	2.2
Oysters, James river, six months after transplanting	87.0	13.0	8.0	1.3	2.2	1.5
Oysters, specimen with maximum of nutrients	81.7	18.3	8.2	1.7	6.5	1.9
Oysters, specimen with minimum of nutrients	91.5	8.5	4.5	0.6	1.7	1.7
Oysters, average of thirty-four specimens	87.3	12.7	5.9	1.2	3.6	2.0
Long clams, specimen with maximum of nutrients	85.0	15.0	7.6	1.2	3.4	2.8
Long clams, specimen with minimum of nutrients	86.1	13.9	8.4	1.0	2.4	2.1
Long clams, average of four specimens	85.9	14.1	8.2	1.0	2.3	2.6
Round clams	86.2	13.8	6.6	0.4	4.1	2.7
Mussels	84.2	15.8	8.7	1.1	4.1	1.9

* To New Haven harbor.

Thus in the case of the specimen from Stony Creek, taken in April the shells made 81.1 per cent or a little over four-fifths; and the edible portion, flesh and liquids together, 19.9 per cent or a little less than one-fifth of the whole weight. Of this 19.9 per cent. the flesh constituted 7.5, and the liquids 11.4 per cent. In this specimen the proportion of flesh was very small as compared with the liquids. In the specimen of Blue Points, taken at the same time, the proportion of flesh to liquids is just the other way; that of flesh being 13.4, and the liquids 5.2. The variations in the proportions of flesh, liquids, total edible portion, and shells are very striking.

We should not be warranted in assuming that the Blue Points, generally, have so much more flesh and liquid than the others. The figures of Table II are taken from a larger number obtained in a series of analysis of specimens from different localities on the Atlantic coast, from Massachusetts to New Jersey.* One object of the investigation was to get light upon the effect of kind, locality, season and other conditions upon the composition. But though the number of analysis was considerable, enough to cost a large amount of labor, the result can be taken only as a general indication of the range of variation and not as showing the characteristic composition of specimens of a given source, or at a given time. To find, for instance, the average composition of oysters from a given locality, and the differences in composition in different seasons of the year, and in different years, would require an investigation to extend through a year or several years and to include a large number of analyses of specimens especially gathered for the purpose. Such a study of oysters from different localities could not fail to bring interesting and valuable results. Similar studies of clams and other shell-fish would be likewise interesting. Such an investigation might bring out important facts regarding the connection between locality, season, food and age of animals upon the composition.

Meanwhile the figures here given will at least suffice to show that the difference in different specimens from the same locality, and from different localities, are much greater than is commonly supposed. The range of variation in the proportion of flesh, liquids and shell are so clearly shown in Table II that further explanation is hardly necessary.

The details of the proportions of flesh, liquids and shells and of the composition of the flesh, liquids and whole edible portion are given in

*Especial thanks are due to Mr. E. G. Blackford and to Mr. G. H. Shaffer, of New York, for specimens kindly furnished for analysis.

Table IV, which includes all the specimens analyzed. Table III recapitulates the composition of the edible portion of a number of specimens of oysters, clams and mussels; with what was said in connection with Table I it will need but little explanation. It is interesting to note the variations in the composition of the oysters in this table. The percentages of water range from 84.8 to 90.1 per cent in the specimens here cited. In one of those not here given, but included in Table IV, the percentage of water rose to 91.5. The percentage of water-free substance, *i. e.*, total nutrients, in each case, is the difference between the percentage of water and 100. The nutrients accordingly range from 18.3 to 8.5 per cent. In other words, the proportion of nutritive material was more than twice as large in some cases as in others. The largest proportion of nutrients was in a specimen of blue points, taken in April; the smallest is in one from Norfolk, Va., also taken in April. It would seem from the figures in Table IV, that the northern oysters are, on the whole, richer in nutritive material than the southern, but more analyses are needed to show the true average ranges of variation. One reason why the Virginia oysters appear to disadvantage here may be that the latter were younger. It appears that, as the oyster grows older, at least up to a certain time, not only do the proportions of flesh and liquids increase more rapidly than the shells, but the proportion of natural nutrients in the edible portion increases also. That is to say, one hundred pounds of young oysters in the shell would appear from these analyses to contain less of flesh and of liquids than a hundred pounds of older ones; and when both have been shucked a pound of shell contents from the older animals would contain more nutriment than a pound from the younger. I wish, however, to be very careful in making these statements, because the number of examinations is too small to warrant very definite generalizations; indeed, the only figures which bear directly upon this especial point are those for the oysters transplanted from the James and Potomac rivers to New Haven harbor in the spring and taken out in the following fall or winter. These show a notable increase during this period, both in the quantities of shell contents in a given weight of shell and in the amount of actual nutriment in a given weight of shell-contents. Perhaps this change is more a matter of feeding and fattening than of age. However it may be, it is not unnatural that changes of this kind, which take place in other animals, should occur in the oyster. Thus calves and pigs in growing and in fattening increases in both the proportion of meat to bone and in the propor-

tion of nutritive material in the meat. As regards shell-fish, this particular point especially demands more extended study.

The figures of Table IV show a slight difference between the average composition of the edible portion of the oysters taken from the shell in the laboratory and that of those purchased, out of the shells, in the form commonly called "solids" in the markets. Whether this difference is accidental or due to the fact that as they are ordinarily shucked for sale, less of the liquids is saved than was done in preparing our specimens for analysis, it is impossible to say.

Table IV is somewhat complex, and calls for further explanation. The specimens of oysters are arranged according to locality, from Buzzards bay, Mass., to the James river, Va. The proportions of water, protein, fat and mineral matters in the flesh, and in the liquids, are given separately. The proportions of carbohydrates are not stated, since they are not directly determined by the analysis, but are estimated by subtracting the sum of the protein, fat and ash from the total water-free substance, which latter is determined along with the percentage of water, and is the difference between the latter and one hundred. Details of the methods of analysis may be found in an article entitled "Contributions to the Knowledge of the Chemical Composition and Nutritive Values of American Food Fishes and Invertebrates," in the report of the United States Commissioner of Fisheries for the year 1883, from which this table is taken.

The last two columns of the table, it will be observed, give the percentages of total edible portions and of total nutrients in the edible portion of each specimen as received for analysis. Where the specimen consisted simply of the edible portion and in the case of the "solids" of oysters, canned oysters, etc., the percentage of total edible portion is, of course, 100.

I have already stated that some of the conclusions as to the values of fats, which are ordinarily drawn from the chemical composition of meats and fish are not ventured upon here because the precise nature of the nutritive ingredients of oysters and other shell-fish is not definitely understood.

Perhaps further experimental study will show that what we call the protein of the oyster is very nearly the same as that of meat or milk; that what we reckon as carbohydrates of the shell-fish, have about the same nutritive value as the carbohydrates of other foods — milk, sugar and starch, for instance. Meanwhile, what is known implies that differences are probably not very great, though they may be considerable.

The composition of the liquid portions demands a few words of explanation. The amount of nutriment is very small indeed, the principal constituents being water and salts of sea water. How much food value these minute quantities of nutriment have, it is impossible to say. Perhaps a given weight of what is called protein in the liquids of oysters may be not far inferior to the same quantity in the flesh; but this is a matter of doubt.

Taking all in all, the variations in composition of oysters are very wide. The same would very likely be found to be the case with clams and other shell-fish, if a large enough number of analyses were made to show the range of variation; but probably the averages of the analyses here given represent pretty nearly the average composition of the shell-fish as they are ordinarily found in the water and in the markets.

The most of the specimens of oysters and other shell-fish here reported upon were received without statement as to whether they had been "floated" or not; but we suppose that, except when otherwise stated, they had usually been floated, and the specimens were such as are ordinarily sold. The effect of floating on the composition is described in another place in this report. Briefly stated, floating increases the proportions of water and diminishes the proportions of nutritive ingredients and especially those of mineral salts. Floated oysters will therefore have on the average more water and less nutritive material than those not floated. The same is true of clams, mussels, etc.

It is then safe to say that while the variation in the composition of oysters, clams and the like are considerable, just as they are in different kinds of meat, such as beef, mutton and pork, yet the proportions which are expressed in the figures of Table I, and graphically set forth in the colored diagram, make a reasonably fair exhibit of the average composition of these food materials in the condition in which we ordinarily buy them, and hence represent pretty nearly their relative nutritive values. While we must wait for further research before we can with perfect confidence accept these figures as the actual measure of the nutritive effects, we may say in the general way, that the relative food values are indicated very nearly by the chemical compositions as here given.*

As said above, the cheapest food is that which furnishes the actually nutritive material at the lowest cost. The most economical food is

*See article on "Pecuniary Economy of Food" in *Century Magazine* for January, 1888, above cited.

that which is cheapest and best adapted to the wants of the user. Various methods have been proposed for estimating the relative cheapness or dearness of food materials. For instance the cost of actually nutritive ingredients in a given food material may be computed by comparing the amounts of the several nutrients, protein, fats and carbohydrates it contains, with its market price, one pound of protein being assumed to cost, on the average, five times as much, and a pound of fats three times as much as a pound of carbohydrates. The computed costs of the same nutrient, *e. g.*, protein, in different foods, thus affords a basis for comparing the relative expensiveness of the foods, as in the figures below.*

COMPARATIVE COSTS OF PROTEIN IN FOOD MATERIALS.

FOOD MATERIALS.	Ordinary price per pound.	Cost of protein per pound.
Beef, sirloin, medium fatness	25	106
Beef, sirloin, at lower price	20	85
Beef, round, rather lean	16	63
Mutton, leg	22	91
Milk, seven cents per quart	3.5	53
Salmon, early in season	100	511
Salmon, when plenty	30	153
Mackerel	10	79
Salt cod	7	43
Oysters, twenty-five cents per quart	12.5	168
Oysters, fifty cents per quart, choice	25	335
Lobsters	12	209
Wheat flour	3	11

Shell-fish are delicacies rather than staple foods. The above figures illustrate the fact that in this, as in other delicacies, makes them uneconomical from the strictly pecuniary standpoint, yet they have an important use. The conditions of our advanced civilization make variety in diet desirable, and to a greater or less extent essential, and

* This method of computation is German; assumed relative costs of the nutrients are based upon market prices in Germany. The protein is selected for the estimate because it is physiologically the most important of the nutrients. For other and more accurate, though more complex, methods see seventeenth annual report of Massachusetts Bureau of Statistics of Labor, 1886, p. 253.

oftentimes flavor has a value which can not be counted in dollars and cents.

The nutritive value of the shell-fish as of other foods, depends to a considerable extent upon their digestibility, but so little is positively known of the digestibility of shell-fish as compared with meats and other animal foods, that it has not seemed fitting to say a great deal about it here. Perhaps, indeed, the most that can be said is that, while there are people with whom such substances do not always agree, yet oysters belong to the more easily digestible class of foods.

TABLE IV.—*Percentages of Water and Nutritive Ingredients in Specimens of American Invertebrates Used for Food.*

Laboratory number of specimen.	NAME AND LOCALITY OF SPECIMEN.	Specimen received.	Edible Portion. In flesh. Water.	Protein.	Fat.	Ash.	In liquids. Water.	Protein.	Fat.	Ash.	In edible portion. Flesh plus liquids. Water.	Water-free substance.	Protein. Nitrogen 6.25	Fat. Ether extract.	Ash.	Carbohydrates.	In Whole Sample.* Total edible portion.	Total water-free substance, actual nutrients.
	OYSTERS, *Ostrea virginiana* (in shell).		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
68	Buzzard's Bay, Mass.	May	84.21	7.75	1.57	1.48	95.49	1.26	0.00	1.63	88.80	11.20	5.30	0.99	1.54	3.37	20.01	2.22
70	Providence River, R. I.	May	79.01	10.30	2.58	2.13	95.05	1.48	0.00	2.41	84.79	15.21	7.12	1.65	2.23	4.21	17.00	2.59
103	Clinton, Conn.	Nov.	89.91	9.67	1.86	2.29	96.02	1.10	0.02	2.21	88.21	11.09	5.13	0.88	2.24	2.94	21.87	2.76
55	Stony Creek, Conn.	April	81.02	10.16	1.30	2.76	96.12	0.83	0.01	2.72	90.11	9.89	4.64	0.64	2.73	1.85	18.90	1.89
75	Stony Creek, Conn.	May	82.09	9.81	1.48	2.85	96.32	0.63	0.05	2.61	90.89	9.11	4.19	0.60	2.59	1.73	19.15	1.75
105	Stony Creek, Conn.	Nov.	77.82	10.60	2.32	2.51	95.40	1.36	0.01	2.31	84.83	15.17	6.94	1.39	2.43	4.40	18.[illegible]	2.76
203	Stony Creek, Conn.	Mar.	80.42	10.38	1.85	2.22	95.50	1.42	0.03	2.50	87.19	12.81	6.31	1.02	2.34	3.14	20.50	2.62
	Average of four samples		80.34	10.33	1.81	2.51	95.79	1.06	0.02	2.54	88.24	11.76	5.52	0.91	2.52	2.80	19.20	2.26
54	Fair Haven, Conn.	April	81.30	9.89	2.05	2.26	94.66	2.06	0.02	3.19	85.42	14.88	7.53	1.41	2.50	3.41	18.06	2.69
93	Fair Haven, Conn.	Nov.	76.24	10.96	2.37	2.01	94.43	2.14	0.02	2.43	85.25	14.75	6.21	1.26	2.22	5.06	21.31	3.59
210	Fair Haven, Conn.	Mar.	80.80	9.80	2.05	1.85	95.12	1.94	0.03	2.21	84.64	15.36	7.75	1.78	2.92	3.81	16.59	2.55
	Average of three samples		79.44	10.25	2.19	2.02	94.52	2.06	0.02	2.61	85.00	15.00	7.17	1.33	2.54	4.08	19.65	2.95
118	Norwalk, Conn.	Dec.	81.33	9.52	1.51	2.10	96.46	0.75	0.01	2.32	90.04	9.90	4.50	0.65	2.23	2.52	17.85	1.78
151	Norwalk, Conn.	Feb.	80.50	9.97	1.89	2.15	96.32	0.76	0.02	2.50	89.60	10.40	4.69	0.82	2.35	2.54	17.05	1.77
	Average of two samples		80.92	9.75	1.70	2.13	96.39	0.77	0.02	2.41	89.82	10.18	4.59	0.73	2.29	2.51	17.45	1.76
56	Blue Point, N. Y.	April	76.77	10.06	2.30	1.93	94.33	2.31	0.09	1.91	81.70	18.30	8.22	1.72	1.92	6.46	18.62	3.41
107	Blue Point, N. Y.	Nov.	75.55	13.31	2.02	2.58	96.89	0.75	0.01	1.90	88.30	11.70	5.81	0.82	2.17	2.90	16.17	1.95

* *i. e.*, In sample as received for analysis; in the majority of the cases the whole animal, including both edible portion and shell.

TABLE IV.—*(Continued).*

Laboratory number of specimen.	NAME AND LOCALITY OF SPECIMEN.	Specimen received.	Edible portion. In flesh. Water.	Edible portion. In flesh. Protein.	Edible portion. In flesh. Fat.	Edible portion. In flesh. Ash.	Edible portion. In liquids. Water.	Edible portion. In liquids. Protein.	Edible portion. In liquids. Fat.	Edible portion. In liquids. Ash.	Edible portion. In edible portion. Flesh plus liquids. Water.	Edible portion. In edible portion. Flesh plus liquids. Water-free substance.	Edible portion. In edible portion. Flesh plus liquids. Protein. Nitrogen × 6.25.	Edible portion. In edible portion. Flesh plus liquids. Fat. Ether extract.	Edible portion. In edible portion. Flesh plus liquids. Ash.	Edible portion. In edible portion. Flesh plus liquids. Carbohydrates.	In Whole Sample.* Total edible portion.	In Whole Sample.* Total water-free substance, actual nutrients.
	OYSTERS, *Ostrea virginiana* (in shell)—*(Continued).*		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
182	Blue Point, N. Y.	Feb.	83.97	8.84	1.62	1.59	96.85	0.32	0.03	1.70	90.15	9.85	5.00	0.85	1.64	2.36	15.42	1.52
	Average of three samples		78.76	10.73	1.98	2.03	95.05	0.31	0.04	1.88	86.75	13.28	6.54	1.13	1.91	3.91	16.74	2.33
58	Rockaway, N. Y.	April	81.27	9.18	2.13	1.67	95.06	1.60	0.04	2.26	87.06	12.94	6.00	1.25	1.92	3.85	18.40	2.40
112	Rockaway, N. Y.	Nov.	77.66	10.53	2.72	2.02	94.79	1.76	0.01	2.50	84.31	15.69	7.06	1.66	2.23	4.74	19.84	3.13
	Average of two samples		79.46	9.85	2.43	1.85	94.93	1.68	0.03	2.38	85.65	14.35	6.53	1.46	2.07	4.29	19.12	2.75
60	Long Island Sound, N. Y.	April	84.47	8.14	1.58	1.41	95.85	1.40	0.06	2.65	89.67	10.33	5.24	0.98	1.17	3.03	16.23	1.69
92	Long Island Sound, N. Y.	Nov.	78.51	11.61	1.84	2.39	95.81	2.29	0.02	3.16	83.64	16.36	8.50	1.23	2.73	3.90	14.62	2.39
109	Long Island Sound, N. Y.	Nov.	82.79	8.41	1.74	1.71	96.64	1.09	0.01	1.87	90.15	9.85	4.56	0.82	1.79	2.68	17.59	1.73
	Average of three samples		81.92	9.39	1.75	1.88	95.60	1.56	0.04	1.96	87.79	12.21	6.10	1.01	1.89	3.20	16.15	1.97
180	Oyster Bay, N. Y.	Feb.	77.90	10.61	2.35	2.19	95.31	1.46	0.01	2.37	84.34	15.66	7.19	1.48	2.26	4.73	17.27	2.70
57	East River, N. Y.	April	79.92	10.44	2.16	1.74	95.44	1.63	0.02	1.57	87.57	12.43	6.31	1.10	1.87	3.15	20.28	2.52
108	East River, N. Y.	Nov.	75.22	10.07	2.87	1.87	94.87	1.81	0.09	2.33	83.35	16.65	6.39	1.72	2.06	6.48	20.31	3.38
	Average of two samples		77.57	10.25	2.52	1.81	95.16	1.74	0.06	1.95	85.46	14.54	6.35	1.41	1.97	4.82	20.30	2.87
61	Shrewsbury, N. J.	April	81.65	8.20	2.20	1.33	95.07	2.06	0.04	1.83	85.37	14.63	6.48	1.60	1.47	5.08	17.52	2.56
106	Shrewsbury, N. J.	May	77.58	9.68	2.66	1.88	95.35	1.88	0.04	1.96	85.17	14.83	6.24	1.54	1.91	5.14	19.67	2.93

181	Shrewsbury, N. J.	Nov.	81.73	9.13	2.00	1.68	96.52	1.38	0.01	1.72	89.16	10.84	4.87	1.00	1.70	3.27	19.23	2.08
	Average of three samples		80.32	9.00	2.29	1.63	95.65	1.76	0.03	1.83	86.57	13.43	5.88	1.38	1.69	4.49	18.81	2.53
59	Norfolk, Va.	April	83.86	9.32	1.45	1.82	96.83	1.05	0.01	1.64	91.45	8.55	4.50	0.61	1.71	1.73	11.18	0.95
73	Potomac River, Va. (transplanted) †	May	78.87	9.81	2.27	2.54	95.51	1.42	0.01	2.47	86.60	13.40	5.92	1.22	2.51	3.75	12.15	1.63
84	Potomac River, Va. (transplanted) †	Nov.	82.06	9.06	1.93	1.58	95.69	2.05	0.01	1.19	87.36	12.64	6.25	1.18	1.43	3.78	16.66	2.11
85	Potomac River, Va. (transplanted) †	Nov.	77.90	10.31	2.33	2.17	94.99	1.81	0.02	2.47	86.14	13.86	6.19	1.21	2.31	4.15	16.13	2.23
	Average of three samples		79.61	9.74	2.18	2.10	95.40	1.76	0.01	2.04	86.70	13.30	6.12	1.20	2.08	3.89	14.98	2.00
72	Rappahannock River, Va. (transplanted)	May	82.64	8.49	1.90	1.58	97.24	1.01	0.01	1.38	89.77	10.23	4.88	0.99	1.52	2.73	15.17	1.53
71	James River, Va. (transplanted) †	May	83.49	8.26	1.78	1.71	95.91	1.17	0.01	2.56	90.05	9.95	4.63	0.84	2.16	2.48	13.79	1.41
82	James River, Va. (transplanted) †	Nov.	77.99	10.63	2.61	2.21	94.74	1.95	0.05	2.54	84.15	15.85	7.00	1.67	2.33	4.85	15.00	2.38
83	James River, Va. (transplanted) †	Nov.	82.77	8.75	1.91	1.55	95.22	2.14	0.13	1.42	86.95	13.05	8.00	1.31	1.51	2.23	17.17	2.19
	Average of three samples		81.42	9.23	2.10	1.82	95.29	1.76	0.07	2.17	87.05	12.95	6.54	1.27	2.00	3.19	15.32	1.98
	Average of thirty-four samples (average of averages)		80.52	9.04	2.04	1.96	95.76	1.42	0.03	2.09	87.30	12.70	5.95	1.15	2.03	3.55	17.70	2.32

* *i. e.*, In sample as received for analysis; in the majority of the cases the whole animal, including both edible portion and shell.
† To New Haven, Conn.

TABLE IV—*(Continued).*

Laboratory number of specimen.	NAME AND LOCALITY OF SPECIMEN.	Specimen received.	Edible portion. In flesh. Water.	Protein. Nitrogen × 6.25.	Fat. Ether extract.	Ash.	In liquids. Water.	Protein. Nitrogen × 6.25.	Fat. Ether extract.	Ash.	In edible portion. (Flesh plus liquids.) Water.	Protein. Nitrogen × 6.25.	Fat. Ether extract.	Ash.	Carbonates.	In whole sample. Total edible portion.	Total water-free substance, actual nutrients.
			Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
	OYSTERS, "SOLIDS" (out of shell).*																
89	Fair Haven, Conn	Nov.	84.04	7.12	1.96	0.86	96.19	1.60	0.02	0.55	85.21	6.60	1.77	0.83	5.50	100.00	14.79
204	Fair Haven, Conn	Mar.	.....	.....	....	....	.....	....	....	....	88.44	5.91	1.54	0.89	3.22	100.00	11.56
104	Virginia (transplanted)†	Nov.	85.50	7.51	1.83	1.12	96.43	1.43	0.02	0.77	87.23	6.38	1.54	1.06	3.79	100.00	12.77
202	Virginia (transplanted)†	Mar.	.....	....	....	....	.....	...	....	....	87.90	6.44	1.57	0.77	3.63	100.00	12.10
	Average of four samples "solids"	.....	.....	.....	....	....	.....	....	....	....	87.19	6.33	1.60	0.89	4.07	100.00	12.81
	OYSTERS, "COVE" (canned).																
74	Chesapeake bay	May	78.53	14.00	3.78	1.60	93.57	1.77	0.27	1.21	86.01	7.89	2.04	1.42	2.51	100.00	13.99
97	Chesapeake bay	Nov.	76.75	13.25	4.35	1.63	93.35	1.40	0.09	0.91	85.14	7.25	2.19	1.27	4.25	100.00	14.96
120	Chesapeake bay	Nov.	77.25	13.44	4.24	1.45	90.57	1.88	0.12	1.10	84.60	7.00	1.96	1.26	5.18	100.00	15.40
	Average of three samples	.....	77.51	13.46	4.12	1.56	92.50	1.70	0.16	1.08	85.25	7.38	2.06	1.32	3.98	100.00	14.78
	SCALLOPS, *Pecten irradians*.																
56	Shelter Island, New York	Mar.	.....	.....	....	....	.....	....	....	....	77.79	15.05	0.03	1.48	5.65	100.00	22.21
63	Shelter Island, New York	April.	.....	.....	....	....	.....	....	....	....	82.84	14.44	0.30	1.29	1.13	100.00	17.16
	Average of two samples	.....	.....	.....	....	....	.....	....	....	...	80.32	14.75	0.17	1.38	3.38	100.00	19.68
	LONG CLAMS, *Mya arenaria* (in shell).																
69	Boston, Mass	May.	77.96	14.55	1.79	2.76	95.73	0.49	0.01	3.29	86.11	8.13	0.98	3.00	1.78	53.90	7.50

102	Clinton, Conn.	Nov.	78.57	14.86	1.78	2.49	96.92	0.69	....	2.81	86.11	8.69	1.01	2.63	1.56	57.92	8.05
201	Clinton, Conn.	Mar.	79.94	12.62	1.69	5.11	96.77	0.69	0.01	2.05	85.00	7.60	1.18	2.79	3.43	56.30	8.45
	Average of 2 samples	.....	79.26	13.74	1.74	2.80	96.90	0.66	0.01	2.43	85.56	8.15	1.09	2.71	2.49	57.11	8.25
65	Long Island, New York	April,	81.05	12.52	1.52	1.56	94.76	1.30	0.03	2.93	86.05	8.40	0.97	2.06	2.52	57.64	8.04
	Average of 4 samples (average of averages)	.....	79.42	13.63	1.68	2.37	95.63	0.82	0.02	2.88	85.91	8.23	1.01	2.59	2.29	56.44	8.17
	LONG CLAMS (canned).																
122	Penobscot Bay, Maine	Nov.	74.64	17.94	2.52	3.18	91.92	2.44	0.04	1.72	84.54	9.03	1.27	2.34	2.79	100.00	15.46
	ROUND CLAMS, *Venus mercenaria* (in shell).																
66	Little Neck, New York	April.	78.24	11.59	0.74	2.22	95.12	0.88	0.02	3.17	86.29	6.56	0.40	2.67	4.17	31.71	4.38
	ROUND CLAMS (canned).																
125	Islip, Long Island, New York	Nov.	75.56	16.76	1.27	2.83	96.52	4.07	0.26	3.26	82.91	9.54	0.68	3.74	3.13	100.00	17.09
	MUSSELS, *Mytilus edulis* (in shell).																
139	Stony Creek, Conn.	Dec.	78.67	12.51	1.67	1.73	94.23	1.77	0.13	2.25	84.16	8.69	1.12	1.91	4.12	50.66	3.02
	LOBSTER, *Homerus Americanus* (in shell).																
50	Maine	Mar.	.....	.....	....	....	.....	....	....	....	84.30	11.63	1.82	1.63	0.62	52.52	8.24
62	Maine	April,	.....	.....	....	....	.....	....	....	....	81.77	14.00	1.55	1.71	0.92	36.24	6.60
239	Maine	April,	.....	.....	....	....	.....	....	....	....	79.17	17.24	1.45	1.62	0.52	.....	....
69	Massachusetts	May.	.....	.....	....	....	.....	....	....	....	82.11	15.03	2.54	1.87	....	30.56	5.47
	Average 4 samples	.....	.....	.....	....	....	.....	....	....	...	81.84	14.49	1.84	1.71	....	39.77	6.80
	LOBSTER (canned).																
76	Maine	May.	.....	.....	....	....	.....	....	....	....	79.36	16.75	0.46	2.78	0.65	100.00	20.64
121	Maine	Nov.	.....	.....	....	....	.....	....	....	....	76.45	19.52	1.68	2.15	0.50	100.00	23.85
	Average 2 samples	.....	.....	.....	....	....	.....	....	....	....	77.75	18.13	1.07	2.47	0.58	100.00	22.25
	CRAY FISH (in shell).																
64	Potomac river, Virginia	April.	.....	.....	....	....	.....	....	....	....	81.22	16.00	0.46	1.31	1.01	12.30	2.31
	CRAB, *Ballinectes hastatus* (in shell).																
101	New Jersey	Nov.	.....	.....	....	....	.....	....	....	....	77.07	16.64	1.96	3.13	1.20	44.16	10.12

* *i. e.*, shell-contents, including flesh and liquids. † To New Haven, Conn.

TABLE IV — *(Concluded).*

Laboratory number of specimen.	NAME AND LOCALITY OF SPECIMEN.	Specimen received.	Edible Portion.														In Whole Sample.	
			In flesh.				In liquids.				In edible portion. (Flesh plus liquids.)							
			Water.	Protein. Nitrogen 6.25.	Fat. Ether extract.	Ash.	Water.	Protein. Nitrogen 6.25.	Fat. Ether extract.	Ash.	Water.	Nitrogen.	Protein. Nitrogen × 6.25.	Fat. Ether extract.	Ash.	Extractives.	Total edible portion.	Total water-free substance, actual nutrients.
			Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
	CRABS (canned).																	
124	Hampton, Va	Nov.	....	....	....	....	....	....	....	....	80.98	19.02	15.62	0.79	1.78	0.83	100.00	19.02
274	Hampton, Va	April	....	....	....	....	....	....	....	....	78.95	21.05	15.98	2.30	2.10	0.67	100.00	21.05
	Average of two samples		....	....	....	....	....	....	....	....	79.97	20.03	15.80	1.54	1.94	0.75	100.00	20.04
	SHRIMP (canned).																	
123	Gulf of Mexico	Nov.	....	....	....	....	....	....	....	....	70.80	29.20	25.38	1.00	2.58	0.24	100.00	29.20

APPENDIX "B."

FATTENING OF OYSTERS.

CHEMICAL CHANGES PRODUCED IN FLOATING.

By Professor W. O. Atwater.

It is a common practice of oyster dealers, instead of selling the oysters in the condition in which they are taken from the beds in salt water, to first place them for a time, forty-eight hours, more or less, in fresh or brackish water, in order, as the oystermen say, to "fatten" them, the operation being called "floating" or "laying out." By this process the body of the oyster acquires such a plumpness and rotundity, and its bulk and weight are so increased as to materially increase its selling value.

The belief is common among oystermen that this "fattening" is due to an actual gain of flesh and fat, and that the nutritive value of the oyster is increased.

A moment's consideration of the chemistry and physiology of the subject will make it clear, not only that such an increase of tissue substance in so short a time and with such scanty food supply is out of question, but that the increase in volume and weight of the bodies of the oysters is just what would be expected from the osmose or dialysis which would naturally take place between the contents of the bodies of the oysters as taken from salt-water, and the fresh or brackish water in which they are floated.

If we fill a bladder with salt-water and then put it into fresh-water the salt-water will gradually work its way out through the pores of the bladder, and, at the same time, the fresher water will enter the bladder; and, further, the fresh-water will go in much more rapidly than the salt-water goes out. The result will be that the amount of water in the bladder will be increased. It will swell by taking up more water than it loses, while at the same time it loses a portion of the salt.

It does this in obedience to a physical law, to which the terms osmose and dialysis are applied. In accordance with this law, if a

membraneous sac holding salts in solution is immersed in a more dilute solution or impure water, the more concentrated solution will pass out and at the same time the water or more dilute solution will pass in and more rapidly. The escape of the concentrated and entrance of the dilute solution will be, in general, the more rapid the greater the difference in concentration and the higher the temperature of the two solutions. After the osmose has proceeded for a time, the two solutions will become equally diluted. When this equilibrium between the two is reached the osmose will stop. If the sac which has become distended is elastic, it will, after osmose have ceased, tend to come back to its normal size, the extra quantity of solution which it has received being driven out again.

We should expect these principles to apply to the oyster. Roughly speaking, the body of the animal may be regarded as a collection of membraneous sacs. It seems entirely reasonable to suppose that the intercellular spaces, and probably the cells of the body would be impregnated with the salts of the sea-water in which the animal lives, and this supposition is confirmed by the large quantity of mineral salts which the body is found by analysis to contain, and which amounts, in some cases, to over fourteen per cent of the water-free substance of the body.

It seems equally reasonable to assume that osmose would take place through both the outer coating of the body and the cell walls. In the salt-water the solution of salts within the body may be assumed to be in equilibrium with the surrounding medium. When the animal is brought into fresh or brackish water, *i. e.*, into a more dilute solution, the salts in the more concentrated solution within the body would tend to pass in and produce just such a distension as actually takes place in the floating. If this assumption is correct, we should expect that the osmose would be the more rapid the less the amount of salts in the surrounding water; that it would proceed more rapidly in warm, and more slowly in cold water; that it would take place whether the body of the animal is left in the shell or is previously removed from it; that the quantity of salts would be greatly reduced in floating, and that if it were left in the water after the maximum distension had been reached, the imbibed water would pass out again and the oyster would be reduced to its original size. Just such is actually the case. Oystermen find that the oyters "fatten" much more quickly in fresh than in brackish water; warmth is so favorable to the process that it is said to be sometimes found profitable to warm artificially the water in which the oysters are floated; although oysters are generally floated in the shell, the same effect is very com-

monly obtained by adding fresh water to the oysters after they have been taken out of the shell; indeed, I am told that this is a by no means unusual practice of retail dealers. Oysters lose much of their salty flavor in floating, and it is a common experience of oystermen that if the "fattened" oysters are left too long on the floats they become "lean" again.

This exact agreement and theory and fact might seem to warrant the conclusion that the actual changes is the so-called fattening of oysters in floating, are essentially gain of water and loss of salts. The absolute proof, however, is to be sought in chemical analysis. In the course of an investigation conducted under the auspices of the United States Fish Commission, and which included examinations of a number of oysters, and other shell-fish, I have improved the opportunity to test this matter by some analysis of oysters before and after floating. The results of the investigations are to be given in one of the publications of the commission. From this the following statements are selected as perhaps not without interest to the fisheries association. It is not improper that I should add here, that a portion of the expenses of the investigation was borne by one of the prominent officers of the association, Mr. E. G. Blackford.

The account just mentioned of the experiments is preceded by some citations regarding the practice of floating oysters which I insert here, adding that I should be greatly obliged for any further information upon the subject.

The following very opposite statements are by Prof. Persifor Frazer, Jr., who attributes the changes mentioned to dialytic action:

"The oysters brought to our large markets on the Atlantic seaboard are generally first subjected to a process of 'laying out,' which consists in placing them for a short time in fresher water than that from which they have been taken.

"Persons who are fond of this animal as an article of food, know how much the 'fresh' exceed the 'salts' in size and in consistency. The 'Morris Coves,' of this city, (Philadelphia), while very insipid, are the plumpest bivalves brought to market. On the other hand, the 'Abscoms' and the 'Brigantines' while of a better flavor (to those who prefer salt oysters), are invariably lean, compared to their transplanted rivals, as also are the 'Cape Mays' though, for some reason, not to the same extent.

"The most experienced oyster dealers inform me that the time for allowing the salt oysters taken from the sea coast to lie out varies, but is seldom over two or three days. At the end of this time the maxi-

mum plumpness is attained, and beyond this the oyster becomes lean again, besides having lost in flavor."

The subjoined statements by Professor J. A. Ryder are interesting in this connection. They are taken from a letter to Professor Baird, United States Commissioner of Fish and Fisheries, on "Floats for the so-called fattening of oysters:"

"The simplest and most practical structures of the kind which I have seen are the storage and fattening floats used by Mr. Conger, of Franklin City, Md., and now in use by all the shipper and planters in the vicinity of Chincoteague bay. I have been informed that similar structures, or rather structures serving similar purposes, are in use on the oyster beds along the shore of State Island, New York.

"It is probably a fact that in all these contrivances they take advantage of the effect produced by fresher water upon oysters which have been taken from slightly salt water. The planters of Chincoteague call this 'plumping the oysters for market.' It does not mean that the oysters are augumented in volume by the addition of substantial matter, such as occurs during the actual appropriation of food, but only that the vascular spaces and vessels in the animals are filled with a larger amount of water, due to endosmose. It is a dealer's trick to give his produce a better appearance in the market, and as such I do not think it deserves encouragement, but rather exposure.

"Mr. Conger has actually resorted to warming fresh water to 60 F. in winter, by steam pipes running underneath the wooden enclosure surrounding the 'fattening' or 'plumping' float. One good 'drink,' as he expressed himself to me, renders the animal fit for sale and of better appearance.

"Conger's floats are simply a pair of windlasses, supported by two pair of piles driven into the bottom. Chains or ropes which wind upon the windlass pass down to a pair of cross pieces, upon which the float rests, which has a perforated or flat slat bottom, and a rim eighteen inches to two feet high. These floats, I should think, are about eight feet wide and sixteen feet long, perhaps twenty. These structures are usually built alongside the wharves of the packing and shipping houses, and are really a great convenience in conducting the work. * * * *".

Elsewhere Prof. Ryder speaks of the floats thus:

"The diaphragm itself was constructed on boards perforated with auger holes and lined on the inside with gunny-cloth or sacking, and the space between the perforated boards was filled with sharp, clean sand. The space between the boards was about two inches; through

this the tide ebbed and flowed, giving a rise and fall of from four to six inches during the interval between successive tides."

Mr. F. T. Lane, of New Haven, Conn., writes as follows about the method of floating practiced by himself, and, as I understand, by other New Haven growers:

"We do not always leave them two days in the boats — as a rule only one day. We put them into brackish water and take them out at low water or in the last of the falling tide, as then the water is the freshest and the oysters are at their best. As it is not convenient for us to put them into the floats and take them out the same day we do not want the water too fresh. On one occasion, wishing to know what the result would be of putting the oysters into water that was quite fresh, I had one of my floats taken up the river half a mile further than where we commonly use them and 100 bushels of oysters put into it at high water and taken out at low water. They were in the water from six to seven hours and came out very nice, fully as good as those floated twenty-four hours in the brackish water. It was a warm day and the water was warm. Under these conditions they will drink very quickly. I have seen them open their shells in ten minutes after they were put into the water."

For the following valuable information I am indebted to Mr. R. G. Pike, chairman of the Board of Shell-Fish Commissioners of Connecticut:

"Connecticut oysters, when brought from their beds in the salt waters of Long Island sound, are seldom sent to market before they have been subjected to more or less manipulation. As soon as possible after being gathered, they are deposited in shallow tide rivers where the water is more or less brackish, and are left there from one to four days, the time varying according to the temperature of the season, the saltness of the oyster, and the freshening quality of the water. Generally two tides are sufficient for the two 'good drinks' which the oystermen say they should always have.

"This 'floating,' as it is called, results in cleaning out and freshening the oysters, and increases their bulk; or, as many oystermen confidently assert, 'fattening' them. If the weather is warm, they will take a 'drink' immediately if not disturbed; but if the weather is cold they will wait sometimes ten or twelve hours before opening their valves. Good fat oysters generally yield five quarts of solid meat to the bushel; but after floating two tides or more they will measure six quarts to the bushel. After they have been properly floated they are taken from the shell — and as soon as the liquid is all strained off, they are washed in cold water — and are then packed for market. In warm weather they are put into the water with ice, and are also

packed with ice for shipping. Water increases their bulk by absorption and by mixing with the liquor on the surface of the oysters. The salter the oyster the more water it absorbs. In twelve hours one gallon of oysters, with their juices strained out, will take in a pint of water; but when very salt and dry they have been known to absorb a pint in three hours.

"Water always thickens the natural juices that adhere to the surface of the oyster, and makes them slimy. If too much water is added the oyster loses its plumpness and firmness and becomes watery and flabby.

"Oysters that have been floated bear transportation in the shell much better than when shipped directly from their beds. Oysters, too, that are taken from their shells and packed in all their native juices spoil much sooner than when their juices are strained out and the meats are washed in fresh cold water.

"Long clams are not floated, but round clams are. But both, when shucked, are washed in fresh water. This cleanses them of mud, sand and excess of salt, increases their bulk and improves their flavor. After washing they will keep much longer without risk of spoiling. If the salt is left in them, as they come from their native beds, their liquor will ferment and they will quickly spoil.

"The above facts are gathered from the most intelligent men in the shell-fish business in Connecticut, men who have had many years experience in gathering oysters and clams and preparing them for home and foreign consumption. They are all agreed that by judicious floating in the shell, and by washing and soaking when out of the shell, the oyster and the clam increase in bulk and improve in quality and flavor. We will not presume to say that this increased bulk is anything more than a mechanical distension of the organs and the cellular tissues of the oyster by water, or that its improved flavor is not due simply to a loss of bitter sea salt dissolved out by the water. Many intelligent cultivators are confident that the increase in bulk is a growth of fat; while just as many of equal intelligence, declare that it is mere 'bloat' or distension, akin to that of a dry sponge when plunged into the water. The exact nature of the change the chemist alone can determine."

The following experiments were made with oysters supplied by Mr. F. T. Lane, of New Haven, Connecticut, a communication from whom was just quoted, and for whose courteous aid as well in furnishing the specimens as in giving useful information, I take this occasion to express thanks.

The oysters have been brought from the James and Potomac rivers and "planted" in the beds in New Haven harbor (Long Island

sound) in April, 1881, and were taken for analysis in the following November.

Two experiments were made. The plan of each experiment consisted in analyzing two lots of oysters, of which both had been taken from the same bed at the same time, but one had been "floated" while the other had not. The first specimen was selected from a boat-load as they were taken from the salt water and the second from the same lot after they had been floated in the usual way in brackish water for forty-eight hours. For each of the two experiments, Mr. Lane selected from a boat-load of oysters as they were taken from the salt water, a number, about three dozen, which fairly represented the whole boat-load. The remainder were taken to the brackish water of a stream emptying into the bay and kept upon the floats for forty-eight-hours, this being the usual practice in the floating of oysters in this region. At the end of that time the oysters were taken from the floats and a number fairly representing the whole were selected as before. Two lots, one floated and the other not floated, were thus taken from each of two different beds. The four lots were brought to our laboratory for analysis.

The specimens as received at the laboratory were weighed. Thereupon the shell-contents were taken out and the shells and shell-contents both weighed. The solid and liquid portions of the shell-contents, *i. e.*, the flesh or "solid" and "liquor" or liquids, were weighed separately, and analyzed. We thus had for each lot the weights of flesh and liquids, which together made the weight of the total shell-contents, and the weight of the shells, which with that of the shell-contents made the weight of the whole specimens. We also had from the analysis, the percentage of water, nutritive ingredients, salts, etc., in the flesh and in the liquids. From these data the calculations were made to the changes which took place in floating. For the details, which are somewhat extended, I may refer to the publications mentioned above. It will suffice here to give only the main results.

The body of the animal may be regarded as made up of water and so-called water-free substance. The water-free substance contains the nutritive ingredients or "nutrients." They may be divided into four classes: (1) Protein compounds, the so-called "flesh-formers," which contain nitrogen; (2) fatty substances, classed as fats; (3) carbohydrates; (4) mineral salts. These constituents of the flesh of oysters have been but little studied. It is customary to assume them to be similar to the corresponding compounds of other food materials, but very probably the differences, if known, might prove to be important. The mineral matters especially, which are very large in amount,

appear to include considerable ot the salts of the sea water. Of the nature of the ingredients of the liquids but little is known. They consist mainly of water and salts, and the amounts of their ingredients which are here reckoned as protein, fats and carbohydrates, are very small, so that whatever error there may be in classing them with the ordinary nutrients of food it will not very seriously affect the estimates of nutritive values.

GENERAL RESULTS OF THE EXPERIMENTS.

During the sojourn in brackish water both the flesh (body) and the liquid portion of the shell-contents of the oysters suffered more or less alteration in composition. In order to show clearly what the principal changes as shown by the chemical analysis were, some statistics may perhaps be permissible here.

CHANGES IN THE COMPOSITION OF THE (BODY OF THE) OYSTERS IN FLOATING.

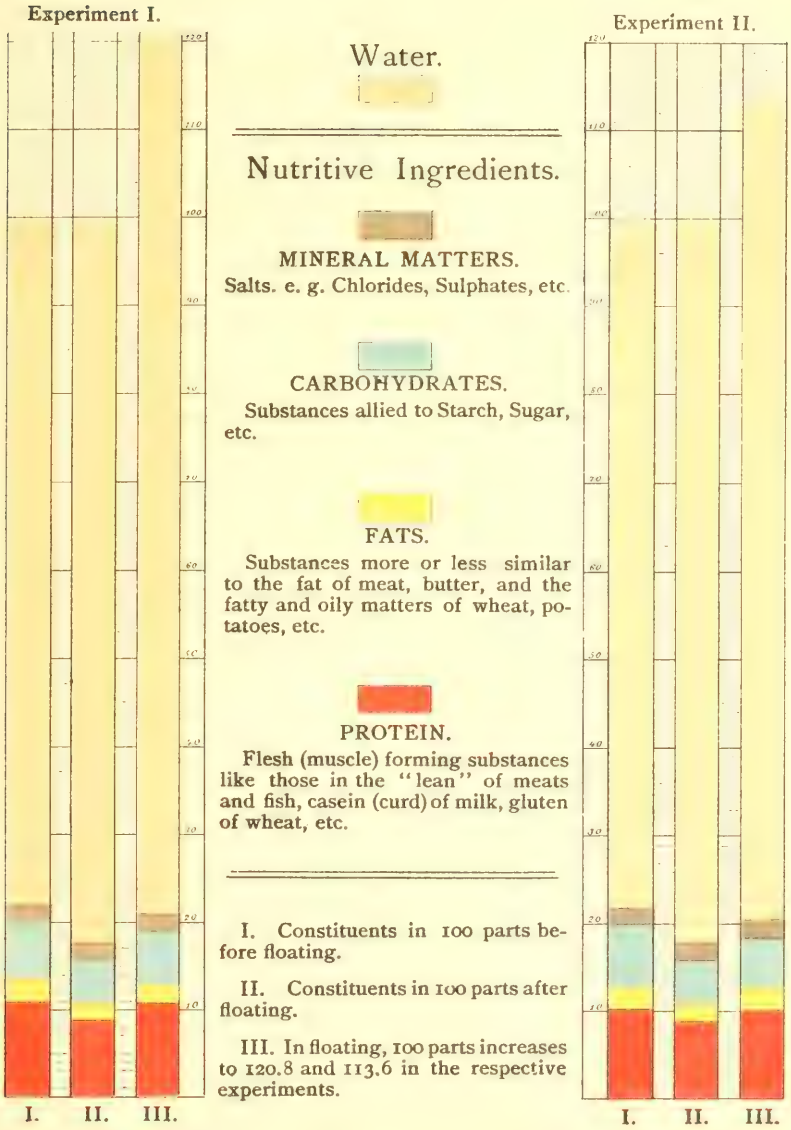
1. The changes in the constituents of the body were mainly such as would be caused by osmose, though there were indications of secretion of nitrogenous matters, and especially of fats, which are not so easily explained by osmose. This I will speak of later.

2. The amounts of gain and loss of constituents which the bodies of the oysters experienced may be estimated either by comparing the percentages found by analysis before and after dialysis, or by comparing the absolute weight of a given quantity of flesh and the weights of each of its ingredients before, with the weights of the same flesh and of its ingredients after dialysis. For the estimate by the first method we have simply to compare the results of the analysis of the floated and the non-floated specimens. Taking the averages of the two experiments, it appears that:

The percentages of	Before Dialysis.		After. Dialysis.
Water rose from	77.9	to	82.4
Water-free substance fell from	22.1	to	82.4
Total flesh	100.0		100.0
Protein	10.5	to	8.9
Fat fell from	2.5	to	1.9
Carbohydrates, etc., fell from	6.9	to	5.2
Mineral salts fell from	2.2	to	1.6
Total water-free substance of flesh	22.1		17.6

There was, accordingly, a gain in the percentage of water and a loss of that in each of the ingredients of the water-free substance. This accords exactly with the supposition that during the floating the flesh gained water and lost salts and other ingredients.

Changes in Composition of Flesh of Oysters in Floating.



It will be more to the point to note the absolute increase and decrease in amounts of flesh and its constituents — in other words, the actual gain or loss of each, in the floating. Estimates by this method have been made and explained in the detailed accounts referred to. They make it appear that 100 grams of the flesh as it came from the salt water was increased by floating, in one specimen to 120.9 and in the other to 113.4 grams. This is equivalent to saying that the two specimens of flesh gained in the floating, respectively, 20.9 and 13.4 per cent, or on the average 17.3 per cent of their original weight. By the same estimates the water-free substance in the 100 grams of flesh before the floating weighed on the average 22.1 grams, while that of the same flesh after floating weighed 20.6 grams, making a loss of 1.5 grams or 6.6 per cent of the 22.1 grams, which the water-free substance weighed before dialysis. The main results of the two experiments thus computed may be stated as follows:

In the "floating" of 100 grams of flesh (body) of the oysters:

The weight of	Before Dialysis.		After Dialysis.
Water rose from	77.9 grams	to	96.6 grams.
Water-free substance fell from	22.1 grams	to	20.6 grams.
Whole flesh rose from	100.0 grams	to	117.2 grams.
Protein was assumed to remain the same	10.5 grams	to	10.5 grams.
Fat (ether extract) fell from	2.5 grams	to	2.3 grams.
Carbohydrates, etc., fell from	6.9 grams	to	6.0 grams.
Mineral salts (ash) fell from	2.2 grams	to	1.8 grams.
	22.1		20.6

Estimating the increase or decrease of weight of each constituent in per cent of its weight before floating:

	Per cent of original weight.
The water gained	23.9
The free-water substance loses	6.6
The whole flesh (body) gained	17.3

The protein was assumed to neither gain or lose.

The fat loses	8.8
The carbohydrates, etc., loses	12.5
The mineral salt loses	15.5

In brief, according to these computations, the flesh lost between one-sixth and one-seventh of its mineral salts, one-eighth of its corbohydrates, and one-twelfth of its fat, but gained enough water to make up this loss and to increase its whole weight, by an amount equal to from one-seventh to one-fifth of the original weight.

These estimates are based on the assumption that the amount of protein in the flesh remained unchanged during the floating. It seems probable, however, that the flesh may have lost a small amount of nitrogenous material. If this was the case the actual gain of flesh and of water must have been less and the loss of fats, carbohydrates and mineral salts greater than the estimates made them. But there appears to be every reason to believe that the error must be very small, and since it would affect all the ingredients in the same ratio, the main result, namely, that there was a large gain of water and a considerable loss not only of mineral salts, but of fats and carbohydrates as well, can not be questioned.

CHANGES IN THE COMPOSITION OF THE LIQUID PORTION (LIQUOR).

3. The liquids might be expected to receive material from the flesh. and to yield material to the surrounding water. The materials coming from the flesh would be such as the latter parted with by either osmose or secretion. Those yielded to the water would either escape by diffusion or be washed away when the shells were open wide enough to allow. What share each of these agencies had in effecting the changes that actually occurred in the liquids, the experiments do not and, in the nature of the case, can not tell. Comparing the percentage composition of the liquids before and after floating, as shown by the averages of the analysis in the two experiments, it appears that :

The percentages of	Before. Dialysis.		After. Dialysis.
Water rose from	94.9	to	95.5
Water-free substance fell from	5.1	to	4.5
Total	100.0	to	100.0
Protein rose from	1.9	to	2.1
Carbohydrates, etc., rose from	0.7	to	1.1
Mineral salts fell from	2.5	to	1.3

The increase in the percentage of water, and the decrease in that of mineral salts are very marked. The quantities of fats (ether extract) are too small to be taken into account. The increase of nitrogen and that of carbohydrates, though absolutely small, are nevertheless outside the limits of error of analysis, and must, like those of the salts, represent actual changes in the composition of the liquids.

The experiments give no reliable data for the determinations of the absolute increase and decrease of the liquids and their constituents, so that it is impossible to say with entire certainty whether there was or was not an actual gain of protein or fats or carbohydrates. It

would seem extremely probable, however, that the liquids received and retained small quanties of these materials from the flesh (bodies) of the animals.

CHANGES IN THE COMPOSITION OF THE WHOLE SHELL-CONTENTS, FLESH AND LIQUIDS.

4. Comparing the average percentage composition of the total shell-contents, before and after floating in the two experiments, it appears that:

The percentages of	Before. Dialysis.		After. Dialysis.
Water rose from	85.2	to	87.1
Water-free substance fell from	14.8	to	12.9
Total	100.0	to	100.0
Protein (N. X. 6.25) fell from	6.8	to	6.5
Fats (ether extract) fell from	1.4	to	1.2
Carbohydrates, etc., fell from	4.3	to	3.7
Mineral salts (ash) fell from	2.3	to	1.5
Total water-free substance	14.8	to	12.9

After so much detail I ought, perhaps, to simply summarize the results in a few words and close. But one or two brief matters call for a notice.

If the changes in composition of the oysters in floating were due to osmose or dialysis alone, we should expect simply a gain of water and loss of salts (and perhaps of carbohydrates). But the flesh seems to have lost a little carbohydrates and fats and probably protein also, along with the salts, while it was absorbing water. A way in which this may have come about is suggested by my colleague, Prof. H. W. Conn, who calls attention to the fact that some mollusks, when irritated produce an extremely abundent secretion of mucus or "slime," so much, indeed, as to sometimes render a small quantity of water in which the animals may be confined, quite sensibly gelatinous. He suggests that the change to fresh water may, indeed, induce such a secretion of mucous and perhaps of carbohydrates and fats as well, which would account for the increase of these substances in the liquids. The observation of oyster dealers that water always thickens the natural juices that adhere to the surface of the oyster and makes it slimy, accords with Prof. Conn's statement.

If such secretion did take place, the flesh must probably have lost a little protion during the floating. The estimates of absolute gain and loss of weight of flesh and ingredients (see detailed accounts of the

experiments) are based upon the assumption that the quantity of protein was unaltered in floating. If protein was given off, therefore, the estimates are wrong. But the quantity of protein secreted and the consequent error must be, at most, very slight. If there is an error its effect would be to make the quantities of nutrients after floating appear larger than they really were. In other words, if the error was corrected it would make the loss of nutritive material in floating greater than it appears to be in the figures above given. As explained in the detailed report above referred to. I have assumed that the changes due to the ordinary processes of metabolism would be to small too materially affect the results.

The experiments might have been so conducted as to decide this question. It would have been necessary to simply take a large number in each lot before and after floating and be certain that the number, weight and bulk were the same in the floated and not-floated lot of each experiment. For instance, we might, in each experiment, carefully select two lots of, say a bushel, each, as taken from the beds, have the number of oysters the same in each bushel as an additional assurance that the two lots were alike, float one bushel and weigh and analyze both. A few experiments of this sort made under different conditions of time, temperature, kind and age of oysters, etc., would give reliable and valuable data. Unfortunately the means at my disposal did not permit so thorough experiments. I am persuaded, however, that the results of such series of trials, if they could be made — and I wish they might be — would be very similar to those of the trials here reported.

It is very interesting to note that these processes which we have been considering in the body of oysters are apparently very similar to processes which go on in our own bodies, namely those by which our food, after it is digested, finds its way through the walls of the stomach and other parts of the alimentary canal into the blood, to be used for nourishment. Physiologists tell us that the passage of the digested materials through the walls of the canal is in part merely a physical action, due to osmose, but that it is in part merely dependent upon a special function of the organs. In like manner the changes in the composition of the oyster, if the above explanation be correct, are caused partly by osmose, and partly by special secretive action, the cell walls and outer-coating of the body of the oyster corresponding to the walls of the alimentary canal of the human body.

CONCLUSION.

The main points presented in this paper may be very briefly summarized thus:

In the floating of oysters for the market, a practice which is very general and is also used for other shell-fish, the animals are either taken direct from the beds in salt water and kept for a time in fresher (brackish) water before opening, or water added to the shell-contents after they are taken out of the shell.

When thus treated, the body of the animal takes up water and parts with some of its salts; and small quantities of the nutritive ingredients escape at the same time. The oysters thus become more plump and increase considerably in bulk and weight. But the quantity of nutritive material, so far from increasing, suffers a slight loss.

In the experiments here reported, the increase in bulk and weight amounted to from one-eighth to one-fifth of the original amounts. This proportion of increase is about the same as is said to occur in the ordinary practice of floating or "fattening" for the market. According to this, five quarts of oysters in their natural condition would take up water enough in "floating" to increase their bulk to nearly or quite six quarts, but the six quarts of floated oysters would contain a trifle less of actual nutrients than the five quarts not floated.

The gain of water and loss of salts is evidently due to osmose. The more concentrated solution of salts in the body of the animal as taken from salt water, passes into the more dilute solution (fresher water) in which it is immersed, while a larger amount of the fresher water at the same time enters the body. But part of the exchange and especially that by which other materials, namely fat, carbohydrates, protein, etc., are given off in small quantities, is more probably due to a special secretory action. There is thus a very interesting parallelism between these processes of secretion and osmose (dialysis) in the oyster and those in the bodies of higher animals, including man, by which the digested food is carried through the walls of the alimentary canal into the blood.

The flavor of oysters is improved by the removal of the salts in floating, and they are said to bear transportation and to keep better. When, therefore, the oysterman takes "good fat oysters," which "yield five quarts of solid meat to the bushel," and floats them so that "they will yield six quarts to the bushel," and thus has an extra quart of the largest and highest priced oysters to sell, he offers his customers no more nutritive material — indeed, a very little less — than he would have in the five quarts if he had not floated them. But many people prefer the flavor of the floated oysters, and since they buy them

more for the flavor than for the nutriment, doubtless very few customers would complain if they understood all the facts. And considering that the practice is very general and the prices are regulated by free competition, the watering of oysters by floating in the shell, perhaps, ought not to be called fraudulent. But rather than pronounce upon this and other questions suggested by the above considerations I, however, should prefer to leave them to the association for discussion.

In the common practice of preparing oysters for the market by placing them for a time in brackish or fresh water, called "floating," "plumping" or "fattening," a considerable amount of water passes by osmose into the body of the animal, thus increases its size and weight. At the same time more or less of the solid constituents pass out, so that instead of a gain there is an actual loss of nutritive ingredients.

The diagram opposite illustrates the changes found, by experiment, in two lots of oysters. In (1) are shown the constituents in 100 parts, by weight of the flesh of oysters before floating. In (2) the composition of 100 parts of the same after floating, while (3) shows the whole weight and the weights of the several constituents, after floating, of the oyster which before floating weighed 100. The protein, fats, carbohydrates and part of the mineral matters are the nutritive ingredients.

The remainder of the mineral matters consists of the salts of the sea-water, which permeate the flesh, and of which part, with a small amount of the nutrients, escapes in the floating. Thus 100 parts of the flesh were computed to increase to 120.8 parts in experiment 1, and to 113.6 parts in experiment 2, but in both cases there was, with the gain of water, a slight loss, not only of mineral salts (chiefly those of the sea-water which permeated the flesh), but also of the nutritive ingredients, fats and carbohydrates. The floating of the oysters is, therefore, not a process of fattening, but of watering.

APPENDIX "C."

Shell-Fish Law of 1887.

CHAPTER 584.

An Act to promote and protect the cultivation of shell-fish, within the waters of this State, for the appointment of an additional commissioner of fisheries; to authorize the grant of franchises for the use of certain lands under water belonging to the State and to make an appropriation therefor.

Passed June 16th, 1887; three-fifths being present.

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

Section 1. The Commissioner of Fisheries, appointed under chapter three hundred and nine, laws of eighteen hundred and seventy-nine, and his successor in office, shall be known as the Shell-Fish Commissioner, and shall finish and complete the survey now being made under his direction of all the lands under the waters of the State suitable for use for the planting and cultivation of shell-fish, and shall make a map thereof as heretofore provided. He shall finish and complete the survey now being made of all the beds of oysters of natural growth located in the waters of the State, and such beds of oysters of natural growth shall be set apart and preserved, and shall not be deemed to be included in the lands for which franchises are to be sold under the provisions of this act. Said commissioner shall ascertain the occupants of all lands claimed to be in the possession or occupation of any person or persons, and no grant of lands so occupied or possessed shall be made, except to the actual occupant or possessor thereof; provided said occupant or possessor, within one year from the passage of this act, shall make application for, and purchase the same.

§ 2. For the further purposes of this act, the Governor is hereby authorized to appoint an additional commissioner of fisheries, who shall be a man of experience in oyster culture, and who shall be a resipent of Richmond, Queens, Kings or Suffolk counties.

§ 3. Immediately after the passage of this act the Commissioners of Fisheries shall meet at some place, to be designated by them, in the city of New York, for the purpose of making such rules and regulations as shall be deemed necessary as preliminary to hearing and granting applications for perpetual franchises for the purpose of shell-fish cultivation on the lands under the waters of this State mentioned in section one of this act, suitable for planting and cultivation of shell-fish. After such rules and regulations shall have been agreed upon and for-

mulated, the said commissioners of fisheries shall proceed to grant franchise for the purpose of shell-fish cultivation, as hereinafter provided. But no such franchise shall be granted until one month's notice of the application for a franchise or franchises shall have been given by posting in a conspicuous place, in the office of the Shell-Fish Commissioner, and in the office of the town clerk of the town nearest to the lands applied for.

§ 4. No grant shall be made to any person or persons who have not resided in this State at least one year preceding the date of application, and no grant shall be made to any person, firm or corporation in excess of two hundred and fifty acres, and no person, firm or corporation shall be allowed to hold, at any one time, more than two hundred and fifty acres.

§ 5. When the conditions precedent to the granting of franchises, mentioned in the foregoing sections, have been complied with, the Commissioners of Fisheries are hereby empowered, in the name and behalf of the people of the State of New York, to grant, by written instruments under their hands and seals, perpetual franchises for the purposes of shell-fish cultivation in the lands applied for under the waters of the State, for the consideration of not less than one dollar per acre, if the lands are unoccupied or unused, and not less than twenty-five cents per acre if the lands are in present use and occupation, and the right to use and occupy said grounds for said purposes shall be and remain in the said grantee, his legal representatives or successors forever; provided only that the said grantee, his legal representatives or successors shall actually use and occupy the same for the purpose of shell-fish cultivation, and for no other purpose whatever. And the moneys received for the sale of such franchises shall be paid forthwith into the treasury of this State.

§ 6. The franchises thus granted shall be deemed to be personal property, and courts of law and of equity shall have power, authority and jurisdiction to determine and enforce the rights of persons, firms or corporations thereto as though such franchises were actually, personal property owned and possessed by such persons, firms or corporations, and such franchises may be sold, transferred, assigned or conveyed the same as other personal property. Immediately after the receipt of the aforesaid instrument of conveyance, the grantee shall at once cause the grounds therein conveyed to be plainly marked out by stakes, buoys or monuments, which stakes, buoys or monuments shall be continued by said grantee his legal representatives or successors.

§ 7. The said commissioners are hereby authorized to appoint and employ a clerk whose compensation shall not exceed fifteen hundred dollars per annum, which compensation and the necessary expenses for carrying out the provisions of this act shall be paid by the Treasurer upon the warrant of the Comptroller, to the order of the said commissioners, upon vouchers to be approved by the Comptroller. The said clerk shall give a bond, to be approved by the Comptroller, in the penal sum of five thousand dollars, for the faithful performance of his duties.

§ 8. The provisions of this act shall not be deemed to limit or interfere with the powers of the Commissioners of the Land Office, to grant to owners of uplands adjacent to such fisheries any of the lands under the waters of this State as is now provided by law. But in case any grant shall be made by the Commissioners of the Land Office of any land actually occupied and in use under the provisions of this act for the cultivation of shell-fish, such grant by said Commissioners of the Land Office shall be subject to the right of the occupant to occupy such grounds for two years thereafter, for the cultivation and removal of the shell-fish there planted.

§ 9. This act shall not apply to nor be held to effect in any way lands under water owned, controlled or claimed under colonial patents or legislative grants by any town or towns, person or persons, in the counties of Suffolk, Queens, Kings and Richmond; lands under the waters of Gardiner's and Peconic bays, ceded by the State to the county of Suffolk, pursuant to chapter three hundred and eighty-five of the laws of eighteen hundred and eighty-five, lands under water in Jamaica bay, lands in the jurisdiction of the towns of Hempstead and Jamaica or in the county of Westchester.

§ 10. The sum of three thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of any moneys in the treasury not otherwise appropriated, payable by the Treasurer on the warrant of the Comptroller to the order of the said commissioners for carrying out the provisions of this act, upon vouchers to be approved by the Comptroller.

§ 11. This act shall take effect immediately.

APPENDIX "D."

LAW CREATING OFFICE OF OYSTER PROTECTOR.

CHAPTER 300.

AN ACT for the protection of the natural oyster beds located in the waters of the State of New York.

PASSED May 10, 1886; three-fifths being present.

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

SECTION 1. It shall not be lawful for any person or persons, corporation or corporations, to place, or cause to be placed, in any manner whatsoever, in any waters within the jurisdiction of the State, any sludge acid or other refuse matter, resulting from the manufacture, or process of manufacture, or treatment of crude or refined material from any oil refinery or oil works, any sugar refinery or sugar works, or from any gas house, or building or buildings used for the making of gas, or to deposit in said waters any substance injurious to oyster culture, provided, however, that nothing in this section shall be held to apply to any refuse from the manufacture or handling of crude or refined oil and guano made from menhaden or other oil-bearing fish.

§ 2. It shall not be lawful to throw or cause to be thrown from any boat, scow or vessel whatsoever, into the waters of Long Island sound or into the bays and harbors opening into the same, west of a line drawn from Eaton's Neck, due north to the boundary line between New York State, and the State of Connecticut, any cinders, ashes, refuse or garbage.

§ 3. Any person or corporations violating the provisions of either of the foregoing sections of this act shall be adjudged guilty of a misdemeanor.

§ 4. Provides for the appointment of an officer to be called the State oyster protector, whose duty it shall be to enforce the provisions of this act, under the direction of Mr. Eugene G. Blackford, Commissioner of Fisheries, in charge of oyster investigation.

§ 5. This act shall take effect immediately.

APPENDIX "E."

RULES OF THE COMMISSIONERS OF FISHERIES.

In Relation to Granting of Franchises in Lands Under Water for the Purpose of Shell-Fish Cultivation, Adopted September 5, 1887.

First. The commissioners will meet on the first Monday of each month at the office of the commission in the city of New York, for the purpose of hearing and granting applications for franchises.

Second. Applications for franchises will be recived by the clerk of the commissioners at any time, and the date of the reception will be indorsed at once upon the application.

Third. Printed forms of application will be furnished by the clerk of the commission.

Fourth. No grant of land will be made in excess of two hundred and fifty acres.

Fifth. The terms "occupation and use" will be held to mean, in the opinion of the commissioners, at least one year's actual occupation and use in planting and cultivating shell-fish.

Sixth. Beds of oysters of natural growth will be held to mean permanent beds, not sporadic beds, of oysters growing naturally in sufficient quantities to be worked profitably.

Seventh. In making applications, applicants must state on oath, that they believe that the grounds applied for are not already designated as natural beds, or occupied, unless by applicant. That the applicant wishes them for the purpose of cultivating shell-fish, and that the applicant is a resident of the State, and has been for at least one year next preceding date of application.

Eighth. Applicants must describe in detail the lands applied for, giving their location, number of acres wanted, etc.

Ninth. The grants of lands will be made as nearly as possible in accordance with the description given in the applications, but the commissioners will not grant lands bounded by other than by north and east lines except in cases where the shore lines prevent, and in special cases.

Tenth. Long Island sound will be divided into townships, sections and lots.

Eleventh. When an application has been made, the commissioners will cause the engineer to designate the vacant sections or lots nearest and incuding if possible the plot described, up to the limit of the land to be granted in each case. If no objection arises, the lands so desig-

nated will be granted and franchises issued upon payment to the clerk of the commissioners, of the proper fees and charges.

Twelfth. The lands applied for, if granted, will be buoyed or staked out under the direction of the engineer, who will place the owner at each of his respective corners and show him where to drop his buoys or plant his stakes, but in all cases the buoys, ground-tackle and stakes shall be supplied and furnished by the grantee or owner of the franchises.

Thirteenth. After the franchise has been granted the owner will be required to keep the corners of his property distinctly staked or buoyed in accordance with the law; and each corner stake or buoy shall have stamped or otherwise permanently marked upon it a particular number, which number will be furnished by the engineer.

Fourteenth. Records of the position of each stake or buoy at the several corners of the lands granted by the commissioners are on file at this office, and in the event of the loss of any of these stakes or buoys, the owners can have them re-set upon application, and the payment of the actual expenses of re-setting.

Fifteenth. The charge for surveying shall be twenty-five cents per acre, with ten per cent additional for every corner in excess of four in any one lot, provided no lot shall be surveyed for less than one dollar.

Sixteenth. Franchises may be sold, transferred, leased or assigned, but no person, firm or corporation will be allowed to hold in excess of 250 acres.

Seventeenth. All transfers of franchises must be recorded at the office of the commissioners, and a transfer fee of fifty cents will be charged.

Eighteenth. No franchise will be granted until one month's notice of the application for such franchise shall have been given by posting in a conspicuous place in the office of the Shell-Fish Commissioner, and in the office of the town clerk of the town nearest the lands applied for.

Ninteenth. The franchises thus granted shall be deemed to be personal property, and courts of law and of equity shall have power and jurisdiction thereto as though such franchises were actually personal property.

Twentieth. For the purpose of hearing and granting applications for franchises in lands under water, three commissioners shall constitute a quorum of the Board.

Twenty-first. The clerk shall give a bond in the penal sum of $5,000 for the faithful performance of his duties, and the prompt payment by him to the State treasury of all moneys received by him for the sale of franchises.

Twenty-second. The accounts of the clerk will be audited at each monthly meeting of the commission, by a committee to be appointed by the president of the commission.

Twenty-third. No grant of lands in present occupation and use shall be made except to the actual occupant and owner thereof, provided said occupant or possessor, within one year from June 16, 1887, shall make application for and purchase the same.

Twenty-fourth. All disputes as to boundary lines will be referred to the engineer, and the decision of the engineer, if agreed to by the commissioners, will be final.

Twenty-fifth. Whenever any grant of land so made shall fail to be occupied in good faith for the cultivation of shell-fish by the grantee thereof within two years after the date of said grant, the land so granted shall revert to the State.

Twenty-sixth. All franchises, except where the land has been in occupation or cultivation, shall be disposed of at public auction to the highest responsible bidder, after two weeks notice of the proposed sale to be posted in the office of the commissioners and to be published once in each week for two weeks in a newspaper published in the county where the lands lie.

AMENDMENT TO RULES 26.

One month's public notice shall be given by posting in the office of the commissioners in the city of New York, and by advertisement in two newspapers, each published in the county where the lands to be disposed of shall be situated, that on a day to be stated in such notice and within one week from the date of the last publication thereof, sealed bids will be received for grants to be specified by their survey number.

On a day to be also stated in such notice, all the bids shall be opened by the commissioners, at a meeting of the Board to be held for that purpose. The opening of the bids may be postponed, and in case of a failure to have a quorum of the commission present, shall lie over until the next meeting.

No bid for a sum of less than one dollar per acre for such lands shall be considered, and the Board shall have discretion to accept such bids as they shall deem for the best public interest and to reject any and all bids that they shall not deem it good policy to accept. Franchises in conformity to these conditions may then be issued in the manner provided by law. The vote on each proposed grant shall be taken by yeas and nays, which shall be entered upon the journal, and the affirmative vote of a majority of all the members of the commission shall be necessary to each grant.

Twenty-seventh. The commissioners reserve the right to reject any and all bids.

Twenty-eighth. All objections to the granting of franchises shall be filed with the clerk, and notices of hearing before the commission shall be given to applicants and objectors.

Twenty-ninth. These regulations may be amended only at a regular meeting of the commission after notices in writing to all the commissioners of the proposed amendment.

APPENDIX "F."

FORM OF APPLICATION.

To the Commissioners of Fisheries of the State of New York:

The application of ....., a resident of the town of ..... in the county of ..... and State of New York, respectfully shows; that he has resided in said State more than one year next preceding the date of this application; that the grounds herein described are not now natural oyster beds; and have not been designated according to the provisions of the act hereinafter mentioned as natural oyster beds; that he wishes and intends to use said grounds for planting and cultivating shell-fish; that he does not own a franchise for oyster cultivation directly or indirectly or indirectly on any grounds under water which with that applied for will exceed 250 acres.

That he has been in the actual occupation and use of said lands in planting and cultivating shell-fish for at least one year before the date of this application.

He therefore respectfully requests that said commissioners, pursuant to an act entitled "An act to promote the cultivation of shell-fish," passed by the Legislature of New York, June 16, 1887, will grant him, in the name and behalf of the State of New York, a perpetual franchise for planting and cultivating shell-fish, in ..... acres of ground, located under the waters of the State, in the town of ....., in the State aforesaid, which grounds are more particularly bounded and described as follows, to wit:

.....

.....

Dated at ....., N. Y., this ..... day of ..... A. D. 188..

Sworn to before me this .....
day of ..... 188..

.....

Applicant.

APPENDIX "G."

NOTICE.

Notice is hereby given that ....., of the town of ....., N. Y., has made application to the Commissioners of Fisheries, State of New York, for a perpetual franchise in and to .... acres of lands under the waters of the State, located and described as follows:

.....

.....

On Monday, ..., the Commissioners of Fisheries will meet at their office, ..., New York city, for the purpose of hearing and granting applications for perpetual franchises, and any objections to the granting of the above mentioned application will then be heard.

By order of

THE BOARD OF COMMISSIONERS OF FISHERIES.

APPENDIX "H."

AFFIDAVIT OF POSTING.

TOWN OF ..... } ss.:
County of ..... }

.....being duly sworn, deposes and says, that on the.....day of.....188.., he posted the notice of the application of.....
of .....
to the Commissioners of Fisheries, State of New York, for franchises in lands under the waters of the State, in the office of the Shell-fish Commissioner, and in the office of the town clerk of the town nearest the lands applied for, as required by law.

Sworn to this.....day of.....188..

.....

APPENDIX "I."

SHELL-FISH COMMISSIONER'S CERTIFICATE.

NEW YORK, ... , 188..

To the Commissioners of Fisheries, State of New York:

GENTLEMEN.—I hereby certify that .... is the occupant of the lots described in the application attached, and that the land applied for is not natural growth oyster land and has not been designated by me as such.

....,

Shell-Fish Commissioner.

APPENDIX "K."

ENGINEER'S CERTIFICATE.

NEW YORK, ..., 188...

To the Commissioners of Fisheries, State of New York:

GENTLEMEN.—I hereby certify that the lands described in sections 1, 2, 3, 4 and 5, in the attached application (No. .....), of ..... of ..... does do not aggregate, together with the oyster lands already granted applicant, more than two hundred and fifty acres.

Remarks:

.....

.....

....,

Engineer.

APPENDIX "L."

CLERK'S CERTIFICATE.

To the Commissioners of Fisheries, State of New York:

GENTLEMEN.—I hereby certify, that no objections have been received to the granting of the application of .....

.....

of .....

for a franchise in ..... lot in .....

.....

.....,

Clerk.

APPENDIX "M."

INDORSEMENT.

Application No. .....

Name of applicant .....

Address .....

Number of acres applied for .....

Where located.....

Notice, when posted.

Shell-Fish Commissioner's office....., 188..

Town clerk's office....., 188..

Character of land.....

.....

Report of Shell-Fish Commissioner.....

.....

Report of engineer.....

.....

Remarks by clerk.....

.....

APPENDIX "N."

FORM OF FRANCHISE.

WHEREAS,.....

.....

resident of the State of New York, ha , pursuant to an act entitled "An Act to promote and protect the cultivation of shell-fish, etc." passed by the Legislature June 16, 1887, made application to the Commissioners of Fisheries of the State of New York for a grant of a perpetual franchise for planting and cultivating shell-fish in the grounds hereinafter bounded and described, wherein he represent that he ha resided in the State of New York more than one year next preceding the date of said application; that the said grounds are not natural oyster beds, and have not been set apart, reserved or designated, according to the provisions of the said act, as natural oyster beds; and that the said lands have been in actual occupation and use in planting and cultivating shell-fish for at least one year before the date of application, that he wish and intend to use said grounds for planting and cultivating shell-fish, which application is dated the ..... day of ..... A. D., 188.., and was

filed with the clerk of said commissioners on the ..... day of ..... A. D., 188.., stating the name and residence of said applicant and the location, area and description of the grounds applied for, and was posted in a conspicuous place in the office of the Shell Commissioner, and also in the office of the town clerk of the town nearest to the lands applied for, and all the other rules and regulations of the Fishery Commission, made in pursuance of the aboved mentioned act have been fully complied with; and

WHEREAS, No valid objections having been made thereto, and the area of said grounds not being, in the opinion of the commissioners, of unreasonable extent, the said grounds having been surveyed, located and delineated on the map of the commissioners; the actual cost of surveying and mapping said grounds amounted to ..... dollars and the price of said grounds at ..... per acre, amounting to ..... dollars, having been paid by said applicant, to the commissioners for the benefit of the State of New York; now, therefore,

KNOW ALL MEN BY THESE PRESENTS, That the State of New York, acting by and through the Commissioners of Fisheries, in consideration of the premises and especially for the sum last above-mentioned, duly received from said applicant, hath given and granted, and by these presents doth give and grant unto the said applicant ....., and to .... legal representatives forever, a perpetual franchise for the purposes of shell-fish cultivation in the lands applied for under the waters of this State, consisting of ..... acres, bounded and described as follows, that is to say:

.....

.....

To have and to hold the same unto the said grantee and ..... legal representatives or successors, forever; provided, that said grantee shall at once cause the said grounds to be plainly marked by stakes, bouys, ranges or monuments, which stakes, bouys, ranges or monuments shall be continued by the said grantee and ..... legal representatives; and provided further, that the grantee or holder of said grounds shall actually use and occupy the same for the purposes named in good faith and for no other purpose, and that this grand is accepted by said grantee subject to all the provisions of the act aforesaid; and provided further, that the said grantee does not now and shall not in future acquire more than 250 acres of land for shell-fish cultivation. And it is stipulated, conditioned and agreed that if the grantee herein shall cease to actually use and occupy the premises hereby granted for shell-fish cultivation, or shall use them for any other purpose what-

ever; or now owns or shall hereafter acquire lands under the act aforesaid, which together with the lands hereby granted, shall be in excess of 250 acres, or shall have been guilty of any misrepresentation in the acquisition of this grant, then this grant shall be void, and the lands herein described shall forthwith revert to the State of New York. In case any dispute as to the boundaries of the land hereby granted shall arise, it shall be determined by the engineer of the Fishery Commission.

IN WITNESS WHEREOF, the Commissioners of Fisheries, in behalf of the State of New York, by virtue of the authority vested in them by by said act, have hereto set their hands and seals this ..... day of ..... A. D., 188....

Signed, sealed and delivered in presence of

.....

Grant of shell-fish franchise to ....., dated ....., 188.... Recorded ....., 188...., in book ....., page ....., acres in the town of .....

APPENDIX "O."

ASSIGNMENT.

KNOW ALL MEN BY THESE PRESENTS, That of the town of ..... , county of .....and State of New York, in consideration of the sum of .....dollars received to ..... full satisfaction ha.... sold, assigned and conveyed, and by these presents..... do .... sell, assign, and convey to ..... of the town of ..... and State of New York, all such right, title and interest as ..... have or ought to have in and to the perpetual franchise for planting and cultivating shell-fish in the following described grounds, to wit:

.....

.....

being the same franchise granted to .... of the town of....., in the county of ..... and State of New York, by the Commissioners of Fisheries of New York by grant dated the ..... day of ..... A. D., 188.., and recorded in the office of the Commissioners of Fisheries aforesaid, in book ..... , page ..... To have and to hold the same unto the said assignee and ..... legal representatives forever, subject nevertheless to all the conditions, reservations, stipulations and provisions in said grant of said commissioners contained and also

of the act entitled, "An act to promote and protect the cultivation of shell-fish, etc.," passed by the Legislature of the State of New York, June 16, 1887, and that the franchise shall be forfeited if more than 250 acres are held at one time.

In witness whereof,.....have hereunto set.....hand and seal this.....day of....., A. D., 188...

Signed, sealed and delivered in presence of

.....

.....

STATE OF NEW YORK, } *ss.:*
County of.....

On the.....day of..... 18...,
personally appeared before me.....
to be known to be the person described in and who executed the foregoing statement and acknowledged that he executed the same.

(Indorsed). Assignment .....to.....

Dated....., 18... Recorded....., 18..., in book....., page.....