Issued September 21, 1912.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF CHEMISTRY—BULLETIN No. 156.

R. E. DOOLITTLE, Acting Chief of Bureau.

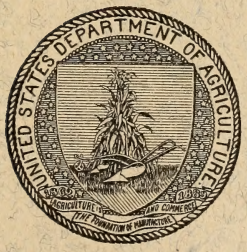
SEWAGE-POLLUTED OYSTERS AS A CAUSE OF TYPHOID AND OTHER GASTRO-INTESTINAL DISTURBANCES.

A STUDY OF AN EPIDEMIC AND OF CERTAIN INDIVIDUAL CASES.

BY

GEORGE W. STILES, Jr.,

Chief, Bacteriological Laboratory.



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LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., March 15, 1912.

Sir: The question of the purity of the oyster supplies is one which has engaged the attention of this bureau for many years, and extensive investigations have been made of native oyster beds, sewage disposal, and possible contamination of oysters with pathogenic germs. These studies have been extended to many points along the coast and in the coastal rivers, including the inlets of Providence Bay, Long Island Sound, New York Bay, and Chesapeake Bay. Most valuable information has been obtained relating to the areas of infection and the results which have been produced by consumption of oysters from infected areas. I beg to offer, therefore, with a recommendation that it be published as Bulletin 156 of the Bureau of Chemistry, the first of a series of reports on this question, embodying the results of actual research in the section of Bacteriological Chemistry. The publication of these data will not only be of interest to the consuming public, but will also be helpful to the owners of the oyster beds and the authorities controlling them in securing a speedy betterment of conditions.

Respectfully,

H. W. Wiley,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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SEWAGE-POLLUTED OYSTERS AS A CAUSE OF TYPHOID AND OTHER GASTROINTESTINAL DISTURBANCES.

INTRODUCTION.

Many years ago attention was called to the fact that infected shellfish, when consumed raw, might cause outbreaks of typhoid fever, cholera, and other intestinal diseases. This fact was especially noticeable in densely populated European coast towns and cities, near many of which were located extensive shellfish grounds grossly contaminated with sewage. In this country the question of shellfish pollution has received greater attention since the epidemic of typhoid fever traced to oysters at Wesleyan University in 1894 and the Lawrence outbreak in 1905, and particularly since the passage of the food and drugs act of 1906.

Since the season of 1908 the Bureau of Chemistry has been making extensive investigations pertaining to the oyster industry, embracing almost every feature of the problem, beginning with the examination of oysters, dredged or tonged from their beds, and carried through the various processes of handling until the oysters are ready for the consumer. Approximately 2,000 samples have been examined bacteriologically up to the present time, including oysters and clams, either shucked or in the shell, and water samples collected from over the grounds on which the shellfish grew.

This report deals principally with an epidemic of typhoid fever and other gastrointestinal disturbances following the Minisink banquet, given on October 5, 1911, at the Music Hall of Goshen, the county seat of Orange County, New York State. Some individual cases, especially at Rochester, N. Y., and the conditions surrounding the smaller banquet of schoolmasters, held at Newburgh, N. Y., are also reported.

The author wishes to acknowledge, with thanks, valuable services rendered by Dr. F. F. Russell, of the Army Medical School, Washington, D. C.; Dr. Wm. H. Park, New York City; Prof. H. W. Conn, Middletown, Conn.; Prof. Frederick P. Gorham, Brown University, Providence, R. I.; Dr. H. D. Pease, of the Lederle Laboratories, New York City; Miss Ruth C. Greathouse, of the bacteriological laboratory, Bureau of Chemistry; and the health officers, physicians, and laymen who contributed valuable information relative to the Minisink banquet.

REVIEW OF LITERATURE.

Reviews of foreign and American literature on epidemics of typhoid fever due to eating raw, infected shellfish have heretofore been presented by other writers on this subject, and in the present report only brief mention will be made of the more important and recent epidemics of this character.

(1) In the outbreak of typhoid fever at Wesleyan University during 1894, Prof. Conn,[1] of Middletown, Conn., showed that 29 cases, or 25 per cent, of the students who ate raw oysters at their fraternity banquets contracted the disease within the proper incubation period. All other articles of food which might play any part in transmitting the infection were carefully studied and excluded. He summarizes the chain of evidence as follows:

1. The dates of the cases appearing at Wesleyan, all between October 20 and November 9, plainly point to a single source of infection to which all of the afflicted students were exposed at about the same time. This must have occurred a little more than a week earlier than the appearance of the first case, and the initiation sup pers perfectly fill the conditions.

2. That these initiation suppers were the source of infection is rendered certain from the fact that four of the visitors who attended these banquets, and have had no further connection with the fraternities, have developed typhoid simultaneously with the cases in college, and by the further fact that two visiting Yale students who attended the suppers have similarly suffered from typhoid.

3. The fact that only three out of seven fraternities holding suppers on that evening suffered from typhoid, pointed to some article of food or drink used at these three suppers and not used in the other fraternities.

4. The fact that about 25 per cent of the students attending the suppers have suffered from typhoid, pointed to a universal and very active source of infection, and not to an incidental one. Whatever article of food contained the infectious material must have been eaten by nearly everyone present to account for such a large percentage of cases.

5. Only one article of food or drink was used by the three societies which was not used equally by the other four fraternities. This article of food was oysters, and they were eaten raw.

6. These oysters came from a creek, where they had been allowed to fatten for a day or more, within 300 feet of the outlet of a private sewer, and in such a position as to make contamination from the sewer a possibility. At the time that the oysters were there deposited there were two persons in the house supplying the sewer, who were in the incubation period of typhoid fever, the period during which no attention would be paid to their excreta.

7. Typhoid germs are not injured by sea water or oyster juices, and if they found their way into the oyster would certainly have lived long enough to be sent to Middletown and be served on the tables of the fraternities.

8. Twenty-three cases of typhoid fever followed among the students in attendance on the suppers at which the oysters were eaten, and 6 cases among persons in attendance and not among the present students at Wesleyan. In all of the cases of undoubted typhoid it has been possible to trace either direct or indirect connection with these oysters. The oysters were also eaten raw by one family in town, and at least one severe case of typhoid followed.

[1] Conn, H. W. The outbreak of typhoid fever at Wesleyan University. (Conn. State Board of Health Report, 1894, pp. 243–264.)

9. The use of oysters from the same locality by the students at Amherst College produced, or at all events was followed by, an outbreak of typhoid fever among the students who ate of them.

These facts, taken together, form a chain of evidence practically complete at every point and leaving no room for doubt. Whatever may be said in regard to oysters in general, the Wesleyan outbreak of typhoid was caused by a special lot of contaminated oysters.

(2) The increased prevalence of typhoid fever in Atlantic City, N. J., during the summer and autumn of 1902 was traced by Pennington and others [1] to the use of oysters and clams "floated" in Penrose Canal, which was highly polluted with sewage. The findings of a committee of five members reporting to the Atlantic City Academy of Medicine, as to the origin and cause of the infection, were approved by Dr. A. C. Abbott and Henry Leffmann.

(3) Dr. Bulstrode [2] during 1902 reported 21 cases of typhoid fever and 118 cases of gastroenteritis from a total number of 267 guests who had eaten raw oysters at the mayoralty banquets at Winchester and Southampton, England, on November 10 of that year. The oysters in question were imported from France and "laid down," or floated [3] for a few days in sewage-polluted "drinking" grounds at Emsworth. One patient who developed a fatal case of typhoid ate only one infected oyster, while others ate only two or three of these oysters.

(4) During the period from 1894 to 1902, inclusive, Dr. Newsholme,[4] of Brighton, England, investigated 241 cases of typhoid fever which he ascribed to eating infected shellfish.

(5) During the year 1902, Thresh and Wood [5] reported in the county of Essex, England, 4 cases of typhoid fever and 21 cases of illness due to eating Portuguese oysters sold on August 14 and 21 of that year.

(6) In reporting the typhoid fever cases in New York City for 1904,[6] the health official of that city shows that of the 1,786 cases reported during 1904 in the Borough of Manhattan data were obtained on 1,322 cases. Of this number, 22 cases, or 1.6 per cent, were habitual consumers of raw oysters, while 44 cases, or 3.3 per cent, habitually consumed both raw oysters and raw milk.

---

[1] Pennington, B. C., Stewart, W. B., Pollard, W. M., Marvel, P., DeSilver, J. F. Report on typhoid fever at Atlantic City. (Philadelphia Medical Journal, Nov. 1, 1902, pp. 634–635.)

[2] Bulstrode, H. T. Report upon alleged oyster-borne enteric fever and other illness following the mayoral banquets at Winchester and Southampton, and upon enteric fever occurring simultaneously elsewhere, and also ascribed to oysters. (Local Government Board, England. 32d Ann. Rept., 1902–3. Suppl., App. A, pp. 129–189.)

[3] The process of "floating," "drinking," or "plumping" oysters in the shell consists in placing them in water containing less salt content than that in which they grew. This practice is treated more fully on p. 33.

[4] Newsholme, A. The spread of enteric fever and other forms of illness by sewage-polluted shellfish. (Brit. Med. J., Aug. 8, 1903, *2:* 295–297.)

[5] Thresh, J. C., and Wood, F. L. Report on an outbreak of typhoid fever and other illnesses due to oysters. (The Lancet, Dec. 6, 1902, *2:* 1567–1569.)

[6] New York City Department of Health. Typhoid fever. (Ann. Rept., 1904, *1:* 184–188.)

(7) One of the most recent typhoid epidemics due to infected shellfish is reported by Soper,[1] 1905, at Lawrence, Long Island, N. Y. His investigations showed that 21 out of 31 cases were traced to eating oysters and clams which had been floated or grown in polluted waters in Jamaica Bay, near Inwood, L. I.

Of the oysters examined bacteriologically during November, 1904, 20 per cent showed *B. coli* in 0.1 cc of shell liquor, and 60 per cent in 1 cc quantities. According to present methods of scoring oysters in the shell, they would show only 4 points, yet they were considered to have come from badly polluted waters.

In reading Soper's account of this outbreak, there are seen to be many points in common with the Minisink epidemic to be considered in this report. The author concludes by saying:

> Your board has as much legal right to regulate the purity of shellfish as to regulate the purity of milk. One is quite as important as the other. It is, in fact, your duty to exclude from sale, in the village over which you have jurisdiction, all oysters, clams, and other shellfish which are liable to cause disease.
>
> I positively believe you will find small difficulty in accomplishing this end if you will act with firmness, moderation, and tact. It is to the interest of honest oystermen to afford you opportunities for inspecting their methods of cultivating and handling the shellfish and taking samples of the same for analysis.
>
> In the event of your finding shellfish which are unsuitable for food in your territory, you have the legal right to forbid their sale, and, if necessary, destroy them, without any compensation to the owners.
>
> Under the circumstances which exist at present, I think you would be justified in excluding from the village of Lawrence all oysters and other shellfish which have been taken from Jamaica Bay within the influence of the Arverne sewers or from the cove at Inwood, which receives the sewage of Far Rockaway.

This warning, given nearly eight years ago by a competent authority, was apparently not heeded; hence the opportunity to study another epidemic of typhoid fever, the present one at Goshen, due to eating oysters from the same locality.

(8) In presenting his thesis on the contamination of oysters, Fuller[2] reviewed the literature on this subject, which covered more than 20 separate outbreaks of typhoid fever due to infected shellfish.

(9) In speaking of the public health of Portsmouth, England, for 1907, when 233 cases of typhoid fever were reported, Dr. Fraser[3] says:

> The one article of diet which in this town has a special relationship to typhoid fever is shellfish, and during last year no fewer than 80 persons, or 34 per cent of the total number attacked, contracted typhoid from this source * * *.
>
> It seems that the only thing that can be depended upon to stop this loss of life is legislation making it illegal to collect shellfish from any places certified by local medical officers to be subject to sewage pollution. Otherwise men are sure to collect

[1] Soper, George A. Report of a sporadic outbreak of typhoid fever at Lawrence, N. Y., due to oysters. (Med. News, Feb. 11, 1905, *86:* 241–253.)

[2] Fuller, C. A. The distribution of sewage in the waters of Narragansett Bay, with special reference to the contamination of oyster beds. (In U. S. Bureau of Fisheries Rept., 1904, pp. 189–238.)

[3] Fraser, A. Enteric fever and shellfish. (Public Health, London, 1908, *22* (2): 53–54.)

and hawk the fish from such places, and the public purchases them not knowing, nor apparently caring, what their previous history has been.

(10) On February 5, 1907, M. Netter [1] and others, reported to the Academy of Medicine 33 cases of typhoid fever due to eating oysters from Cette. The cases were very virulent in character, 7 of the 33 resulting fatally. The illness usually began with diarrhea, and in some cases the disease resembled acute tuberculosis.

(11) During the year 1908, Dr. H. D. Pease, then working under the authority of Dr. Porter [2] of the New York State Board of Health, reviewed the literature on the subject of typhoid transmission from infected shellfish and made bacteriological and sanitary investigations pertaining to the oyster industry. He pointed out some of the unsatisfactory conditions prevailing in that State and called particular attention to the grossly polluted condition of Jamaica Bay.

(12) One of the most exhaustive reports on the conditions under which shellfish, other than oysters, are grown, collected, cleansed, and stored, and the relation of such treatment to the prevalence of enteric fever and other illness, is submitted by Dr. Bulstrode [3] of England. A large number of cases of typhoid fever and other gastrointestinal illness are shown to have been due to eating infected cockles, mussels, and sea food other than oysters.

On page 44 the author summarizes the review of literature in the following:

The evidence brought forward in this chapter shows—

1. That oysters, mussels, or cockles are at times responsible for isolated cases and groups of cases of enteric fever, of gastroenteritis, and of mytilotoxin poisoning.

2. That such shellfish have also to be held responsible for extensive outbreaks of enteric fever and gastroenteritis, and that the amount of mischief in this latter sense has not hitherto been adequately appreciated.

3. That these shellfish have also been shown to have played and to be still playing an important part in certain towns in maintenance of enteric-fever prevalence.

4. That for the most part the specific contamination of such shellfish takes place on the beds or layings, in the storage ponds, or in the process of "washing," but that occasionally the shellfish may become infected by the retailer.

On page 127 occur the following conclusions:

The investigation to which the foregoing report relates has brought out prominently the following considerations:

(*a*) That both enteric fever and gastroenteritis are not infrequently caused by the consumption of mussels or cockles eaten raw or imperfectly cooked.

(*b*) That the shellfish here in question are in many instances collected from natural "scalps," beds, or layings, which are liable to become specifically polluted by sewage.

[1] Netter, M. Epidemic typhoid fever due to oysters. (The Lancet, Feb. 23, 1907, *1:* 551.)

[2] Porter, Eugene H. Sanitary inspection of shellfish grounds. (New York State Board of Health, 29th Ann. Rept., 1908, *2:* 833–892.)

[3] Bulstrode, H. Timbrell. Shellfish other than oysters in relation to disease. (39th Ann. Rept. of the Local Government Board, 1909–10, Supplement.)

(*c*) That even when these shellfish are procured from localities remote from the risks of pollution they are at times washed, stored, or laid down in dangerous proximity to sewer or drain outfalls.

(*d*) That the shellfish with which this report is concerned may occasionally become polluted either specifically or otherwise by the treatment to which they are subjected by the sellers.

(*e*) That at the present time there is practically no control, in a sanitary sense, exercised over places from which these shellfish are collected or wherein they are laid down, washed or stored.

(*f*) That large quantities of the shellfish here under consideration are introduced into England and Wales from Scotland and Ireland and that, therefore, any regulations or restrictions to be effectual should apply to all parts of Great Britain and to Ireland.

(*g*) That as large quantities of shellfish are introduced into this country from abroad, notably from Holland, France, and America, any legislation directed to the control of the home industry must also take account of foreign importations.

(*h*) That so long as the state of affairs revealed in this report obtains, both with regard to home and foreign shellfish, those persons who desire to avoid contraction of shellfish-borne enteric fever or gastroenteritis should either abstain entirely from such shellfish as mussels or cockles or consume them only after they have been actually at the boiling point for at least five minutes.

(13) In Bureau of Chemistry Bulletin No. 136, by the present writer,[1] a review of the literature on shellfish contamination is submitted, together with bacteriological and other data.

THE MINISINK EPIDEMIC.

INCEPTION OF THE INVESTIGATION.

The annual firemen's parade of Orange County, N. Y., was held on October 5, 1911. On this occasion fire companies, musicians, and guests were invited from Tuxedo Park, Middletown, Highland Mills, Suffern, Port Jervis, Wurtsboro, Nyack, Newburgh, Munroe, and New York City, all of whom were present at the banquet given in honor of the Tuxedo Park Fire Department by the Minisink Hook and Ladder Co., and served that day at 6 p. m., in the music hall at Goshen, N. Y.

The following dinners and banquets were served at Goshen on this day:

(1) Minisink banquet, at Music Hall, about 155 guests present.

(2) Cataract Engine and Hose Co., at the St. Elmo Hotel, about 100 guests present.

(3) Dickman Hose Co., served at M. E. Church, about 125 guests present.

(4) Goshen Fife and Drum Corps, at the Occidental Hotel, about 50 guests present.

(5) Fire chiefs, engineers, and assistants, at Mrs. Dopp's, about 30 guests present.

[1] Stiles, Geo. W. Shellfish contamination from sewage-polluted waters and from other sources. Apr. 19, 1911.

Within a short time following this celebration a large number of illnesses occurred among those who had attended the Minisink banquet. The first ill effects noticed among those attending this particular banquet were largely diarrheal in character; however, within 10 to 30 days following the banquet 17 well defined cases of typhoid fever and 83 cases of diarrhea or bowel trouble developed. All of the cases of typhoid and diarrhea were confined to those attending the one banquet, although it was said by laymen that "bowel trouble" was somewhat prevalent in the community during that time, information which was not confirmed by the local physicians; perhaps largely because the trouble was said to have been mild in character and not sufficient to demand the attention of a physician.

On November 17, 1911, there appeared in a number of the New York newspapers a short account of an epidemic of typhoid and other illnesses following a banquet given October 5, 1911, at Goshen, N. Y. These accounts alleged that some of the oysters served on this occasion were probably the cause of the trouble. The writer's attention was first called to these reports on the above date while in New York City engaged in making a sanitary survey of the oyster grounds in that vicinity.

Thinking perhaps it would be instructive to obtain a more detailed account of the epidemic, a visit to Goshen was made that night. A number of prominent citizens who attended the banquet were interviewed, including the health officer and other local practicing physicians, all of whom gave valuable information and assistance.

After the data obtained had been compiled, certain links of evidence which were essential in order to fully establish the origin of the epidemic were found to be wanting. On November 28, 1911, a second trip to Goshen was made and additional evidence obtained; samples of water were also collected from the well furnishing the water used for drinking purposes and for washing the oyster shells on which the oysters were served.

A third visit to Goshen was made on December 15, 1911, as great difficulty had been experienced in securing positive evidence regarding the origin and shipment of the oysters said to have been served at the music hall the night of the banquet. This evidence was not finally obtained until diligent search revealed the records at the general office of the Wells-Fargo Co., New York City. During this time an inspection was made of the source from which the oysters were shipped, and samples of the shell stock and water were collected for analysis.

After all the data had been assembled, the evidence was carefully reviewed with four other experts, who were then in Washington attending the meetings of the American Association for the Advancement of Science. These were Dr. H. W. Conn, of Connec-

ticut, who reported the Wesleyan oyster epidemic of 1894; Dr. William H. Park, of New York City, whose opinions were valued because of his extensive researches; Prof. Frederick P. Gorham, of Brown University, Providence, R. I., who has for many years been actively engaged in making examinations of oysters and studying sanitary conditions; and Dr. H. D. Pease, now director of the Lederle Laboratories of New York City, who actually did the oyster work for the New York State board of health reported in 1904, and who has since that time made extensive examinations of oysters and grounds for private individuals in that State. Under the direction of Dr. Pease an independent investigation of the Minisink epidemic was made subsequent to the writer's first visit at Goshen on November 17, 1911. His conclusions are in accord with those submitted in this report.

After consulting the scientists above mentioned, it was considered desirable to obtain further information, particularly with reference to shipments of oysters from the same source to other places. Accordingly, on January 18, 1912, the fourth trip was made to Goshen and neighboring towns, one entire week being given to the collection of additional data, and on February 7, 1912, the fifth and last trip was made to Rochester, N. Y., in connection with this epidemic.

In collecting this information more than 200 people, including health officers, doctors, teachers, and laymen, were interviewed. Nearly all of these individuals were intelligent, educated men and women.

DATA COLLECTED BY CORRESPONDENCE.

After the personal visits made to individuals who were in attendance at the Minisink banquet the following letter, accompanied by a copy of the menu card used on this occasion, was sent to approximately 170 people. The names and addresses of the people who were present at this banquet were obtained largely by reference to a group picture taken during that day. The individuals were identified from the picture by persons who were well acquainted with them, but the list was verified during the personal visits and by subsequent correspondence.

JANUARY 31, 1912.

SIR: During the past three months our bacteriological chemist, Dr. George W. Stiles, has been collecting information relative to the cause of illness following the Minisink banquet given at Music Hall, Goshen, N. Y., on October 5, 1911.

In order to complete the data obtained by him and to make our records more valuable we desire to enlist your further cooperation in this matter. Please fill out the inclosed blank after you have read it carefully, and answer each question to the best of your knowledge and belief.

This information will be considered strictly confidential and only the facts and not the names will be used for our report.

An addressed return envelope is inclosed which requires no postage.

Respectfully,

H. W. WILEY, *Chief.*

Were you at the Minisink banquet? ———.
Mark with an (X) the articles eaten:

MENU.

Oysters on the half shell ( ). Number eaten ———.
Saltines ( ).
Broiled chicken ( ). Mashed white potatoes ( ).
Macaroni and cheese ( ).
Tomato salad ( ).
Bread ( ). Tea biscuit and gravy ( ).
Pickles ( ). Olives ( ). Celery ( ).
Horse radish à la Dickerson ( ).
Currant jelly ( ). Salted nuts ( ).
Ice cream ( ). Number of dishes ———. Assorted cakes ( ).
Coffee ( ). After dinner mints ( ).
Cigars ( ).

Who sat at your *right* at the table? ——— ———.
Who sat at your *left* at the table? ——— ———.
Were you sick within one month after the banquet? ———.
Did you have diarrhea (or bowel trouble)? ———.
Did you have typhoid fever? ———.
Had you had typhoid fever before October 5, 1911? ———.
When did your first symptoms begin? ———.
How long did your illness last? ———.
Who was the physician attending you? ———.
What is the address of the physician? ———.
Remarks: ——— ———.

Name ——— ———.
Address ——— ———.

From the replies received to the circular letter the following data were tabulated and figures 1, 2, and 3 constructed, including also data obtained by personal interviews:

DISTRIBUTION OF THE MINISINK CASES.

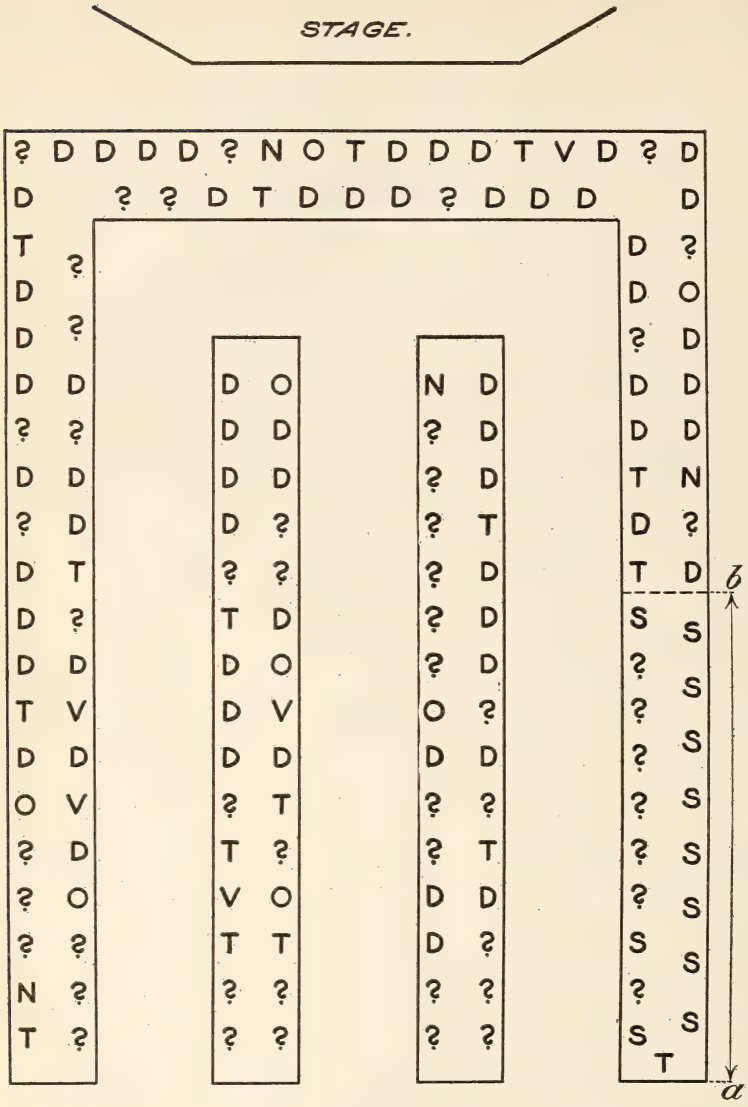
Those who attended the Minisink banquet and subsequently became ill with typhoid fever or gastroenteritis lived at the following places:

TYPHOID FEVER.

Goshen, N. Y.	10
Brooklyn, N. Y.	2
Blooming Grove, N. Y.	1
Middletown, N. Y.	1
Newburgh, N. Y.	1
Suffern, N. Y.	1
Tuxedo Park, N. Y.	1
Total	17

GASTROENTERITIS (DIARRHEA).

Goshen, N. Y.	48
Tuxedo Park, N. Y.	21
Middletown, N. Y.	9
East Hampton, Long Island, N. Y.	1
Highland Mills, N. Y.	1
Monroe, N. Y.	1
Port Jervis, N. Y.	1
Suffern, N. Y.	1
Total	83



KEY:

T = CASES OF TYPHOID FEVER - 17 V = CHAIR VACANT - 5
D = " " DIARRHŒA - 63 O = ATE NO OYSTERS, NOT SICK 8
N = GUESTS ATE OYSTERS, NOT SICK - 4 S = ATE SEAFORD OYSTERS, NOT SICK - 11
? = UNDETERMINED.

FRONT.

FIG. 1.—Arrangement of tables and guests at the Minisink banquet.

Number of oysters eaten by Minisink guests.

TYPHOID CASES.		NOT SICK.[1]	
Guests.	Oysters eaten.	Guests.	Oysters eaten.
2	2	2[2]	12
2	3	5	6
4	4	1	5
1	5	1	4
3	6	2	3
1	8	2	1

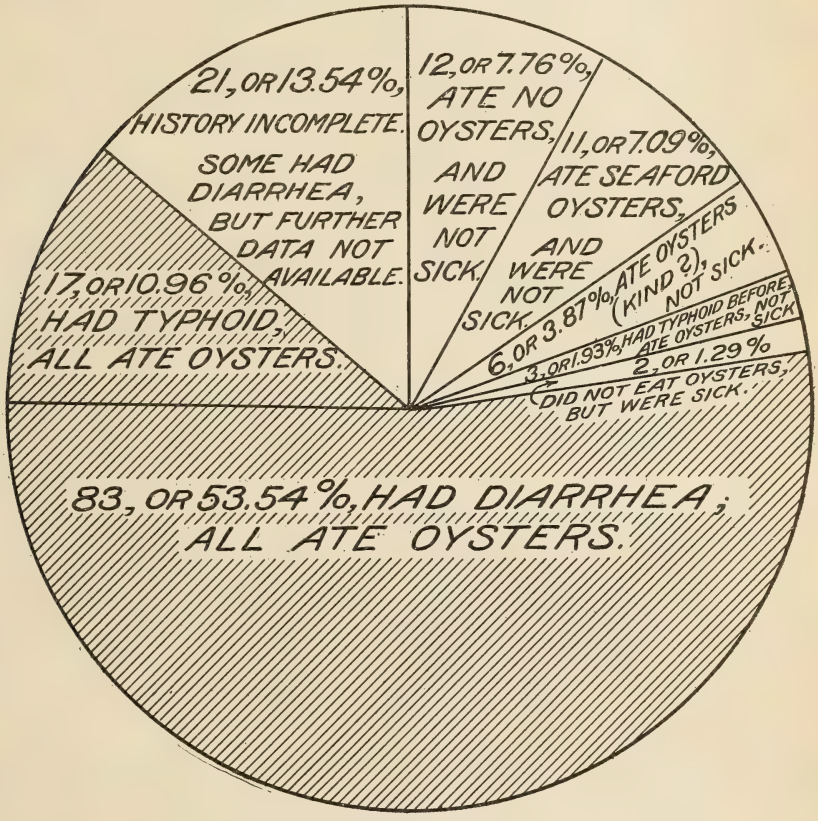


FIG. 2.—Graphic statement based on total number (155) of guests at Minisink banquet.

GASTROENTERITIS (DIARRHEA).

Guests.	Oysters eaten.	Guests.	Oysters eaten.
1	20	30	6
1	18	7	5
3	12	8	4
1	10	1	3
1	9	3	2
1	8	1	1

Of the 170 letters sent to guests there were 107 replies reporting as follows: Diarrhea, 60; typhoid, 14; miscellaneous, 33; 8 returned unclaimed, making a total of 115 letters accounted for. One of the

[1] See figure 2, explaining these and 7 other similar cases. [2] Both had had typhoid fever previously.

Minisink guests who had typhoid ate nothing except his plate of 6 oysters. He had previously attended a special dinner at 4 p.m. with 29 other men and came to the music hall at 6 p. m. to take part in the program. It is to be noted that he is the only person among the 30 at the 4 o'clock dinner who was ill afterwards. This

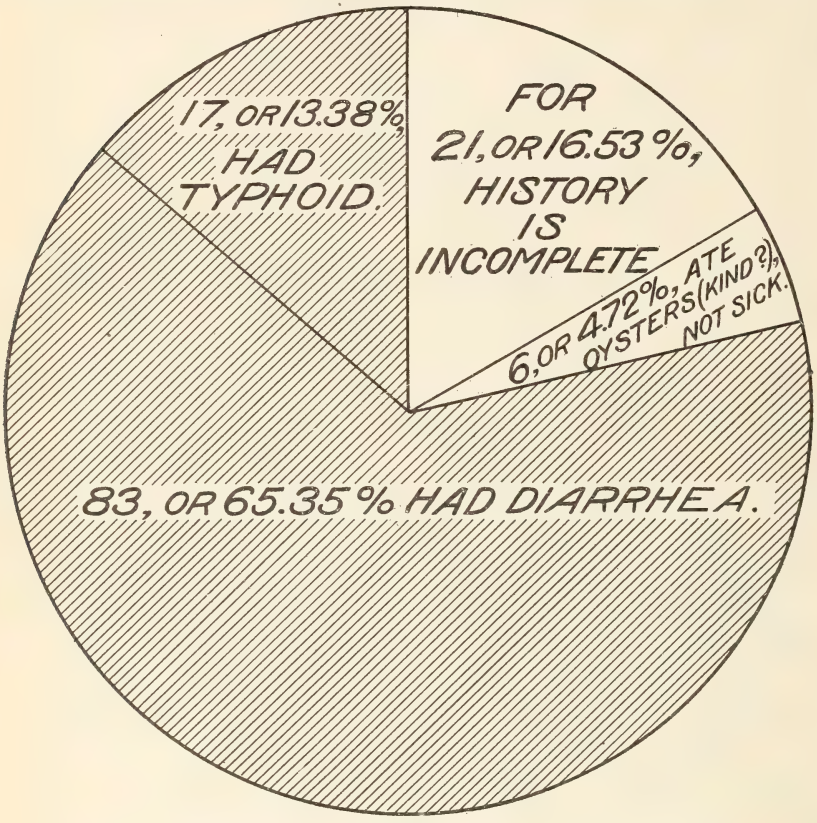


FIG. 3.—Graphic statement based on 127 guests who ate Jamaica Bay oysters.

case is one of the strongest links in the chain of evidence against the Rockaway oysters served at the Minisink banquet.

Statement concerning 14 of the Minisink typhoid cases.

Date of beginning of illness.	Number of oysters eaten.	Length of illness, etc.
1911.		
Oct. 7	6	3 months and 13 days; illness began with diarrhea.
19	4	12 weeks; had diarrhea intermittently before typhoid symptoms were in evidence.
22	2	8 weeks in bed; no diarrhea soon after banquet.
12	4	Fever lasted 42 days; no diarrhea.
6	6	Fever lasted about 5 weeks; had diarrhea in beginning.
6	8	7 weeks; had diarrhea in beginning.
7	6	Over 2 months; had diarrhea at first.
19	4	Eight weeks in bed; disease began with diarrhea.
12	2	Fever ran 21 days, 2 months sick; had diarrhea.
Nov. 1	4	Illness lasted 11 weeks; had diarrhea.
Oct. 19	5	Illness lasted 2 months (fever 28 days).
28	3	In bed 4 weeks; had diarrhea at first for 3 or 4 days.
Nov. 1	3	Illness lasted 3 months; no diarrhea soon after banquet.
1	.....	Died November 17; ate oysters; number not determined.

A detailed statement was not received from 3 of the 17 cases, but the information was obtained from personal visits, and all three of the cases ate oysters. The period of incubation was within the proper limits, and the cases were diagnosed by competent physicians as typhoid fever. In most instances Widal's test was made, with positive results in each case.

Length of illness due to gastroenteritis (diarrhea).

Number of guests.	Weeks.
1	6
1	4
4	3
14	2
11	1
1	[1] 5
6	4
4	3
3	2

One of the guests who ate oysters at the Minisink banquet and had diarrhea died one week following the banquet. She had chronic kidney disease and her death was doubtless hastened by the severe diarrhea. Before the banquet, and for three days afterwards, she was in her usual health, but with the onset of diarrhea she rapidly collapsed. Her husband was one of the 17 who had typhoid fever.

Since the illnesses reported to the health officer and physicians were wholly confined to the Minisink banquet, no cases having occurred among the guests at the four other dinners, a study of the menu served at this banquet was considered one of the first essentials. However, before going into a detailed consideration of the menu, a general discussion of Goshen and its surroundings is deemed advisable.

GOSHEN WATER SUPPLY.

When an epidemic of gastrointestinal disease breaks out in any community, the first thought is to examine the water supply. Goshen is located about 60 miles from New York City on the Erie Railroad, and the water for this town of 3,000 or more inhabitants is furnished by a general impounded lake supply and by numerous private wells.

According to the State board of health reports, the general supply at times shows some evidence of surface pollution. The source of this contamination, according to the local health officer, is probably a barnyard located on the watershed of the reservoir.

All of the water used at the Minisink banquet, both for drinking purposes and for washing the oyster shells, came from the well near Music Hall. This well is moderately shallow, with an open top, and the water is drawn by an endless chain pump. It is located quite

[1] Days.

near the front of a dwelling, but no dangerous source of pollution was observed.

Two samples of water were collected from this well on November 29, 1911, shortly after a rain. The bacteriological examination showed the presence of gas-forming organisms of the *B. coli* type in 5 cc quantities, but not in 1 cc in either sample.

The water from the well had been continually used, both before and after the day of the banquet, by a large proportion of the children attending school nearby and by a number of local residents. No illness of any description was ever attributed to drinking it, therefore the water used at the Minisink banquet could not be held responsible for the epidemic following that occasion.

GOSHEN MILK SUPPLY.

The next general food supply to receive attention was the milk used in Goshen and at the banquet on October 5. In general, the milk of Goshen was furnished by four dairymen. According to the health officer, no case of typhoid fever had occurred on any of the four dairy farms during the entire season prior to the banquet. In fact, there had been only five or six cases of typhoid reported in that whole town and vicinity during the entire summer, and in most instances these appeared to have been contracted while visiting away from home, and were in families having no connection with the dairy farms.

The milk and cream used at the Minisink banquet was furnished from a number of local sources. It was donated in various quantities by different individuals, and probably represented the entire source of supply of the four dairymen on that date. Owing to the fact that the cream and milk was largely used for the coffee and cooking, and that no cases of illness followed the other dinners, it does not seem probable that milk played any part whatever in the causation of the epidemic following the Minisink banquet.

CONSIDERATION OF THE MENU.

A consideration of the menu served at the banquet showed that the three articles, celery, ice cream, and oysters on the half shell, were the only food products eaten on this occasion which in any way could be held accountable for the spread of typhoid organisms. In this connection, however, it may be well to mention that the tomato salad served was made from fresh, whole, ripe, home-grown tomatoes, which were prepared and handled in a cleanly manner. No widespread epidemic of this character could have resulted from such a product. Of the 100 guests made ill, 41 did not eat the tomato salad, 7 of the 17 who had typhoid fever, and 34 of the 83 who had diarrhea; so this article was not the cause of the trouble.

CELERY.

The celery served at the banquet was grown about 4.5 miles from Goshen on the same farm and was furnished from the same lot as that used at the St. Elmo Hotel and the Methodist Church on October 5. No illness occurred at either of those two places. There were 6 of the 17 typhoid cases and 17 of the 83 diarrhea cases, or 23 of the 100 persons made ill, who did not eat celery, and 11 people who ate celery and oysters who were not sick; thus celery was not the source of the difficulty.

ICE CREAM.

The ice cream served was manufactured at a factory located between Goshen and Middletown, N. Y. From this same lot was also furnished that used at the St. Elmo Hotel and the Methodist Church on October 5, where no illnesses occurred. There were 9 guests who did not eat oysters; however, they did eat ice cream, but no illness resulted, while 4 of the typhoid cases, and 7 of the diarrhea cases, or 11 guests did not eat ice cream, but all of them did eat "Rockaway" oysters. This evidence shows that the ice cream was not the cause of the illnesses following the banquet.

OYSTERS ON THE HALF SHELL.

With two exceptions, all of the people who had typhoid fever or diarrhea following the Minisink banquet on October 5, 1911, ate raw oysters served on the half shell. One of the two exceptions was a lady who had worked hard that day preparing for the banquet and at night suffered from "indigestion," which attacks were not uncommon with her. She did not eat oysters. The other case of illness began two weeks later, and was called "biliousness." It is reasonable to believe that among 155 people there would be at least one or two who would have some intestinal derangement following an ordinary banquet, even if no infected food were served.

The oysters for this banquet were furnished by a local retail merchant, designated dealer C. There were ordered for this occasion 1,000 oysters, to serve 6 oysters per plate for 160 guests, with instructions that they should be freshly shucked at the store and delivered to the banquet hall out of the shell. It was intended to place the shucked oysters on shells before serving, and the shells used were taken from the same lot of shell stock which was opened at the store and sold to the banquet. As the oysters were opened, the empty shells were thrown into an empty oyster barrel, in which container they reached Music Hall; thus fresh oyster shells were used at the banquet, and, contrary to unfounded reports, no stale shells were used on this occasion. The dealer explained that the shells of all former oysters had been discarded and hauled away by farmers, who sought them eagerly for poultry food.

After arriving at the music hall, the oyster shells were carefully scrubbed at the nearby pump, just described as the source of water used for this banquet. These shells were cleaned by two men who used new brushes and the cleansed shells were placed in clean tubs. The same men who scrubbed the shells had done so on two former occasions of this character and no epidemics of typhoid followed those banquets. The previous history of these two individuals is well known by the health officer, and they never have had typhoid fever. They are cleanly in their habits, and an examination of their urine by the Lederle Laboratories gave negative results for typhoid bacilli.

This detailed account of these oyster shells is given because a report was circulated, by some one who had not investigated the matter, that the oyster shells were responsible for the illnesses following the banquet. The possibility of the oysters becoming contaminated from old infected shells was recognized, but careful investigation and consideration of all the facts in the case show no basis whatever for such a conclusion. The physical characters of these shells will be described later in connection with the differentiation of the oysters used at the banquet.

SOURCE OF THE OYSTERS.

At the time of making the first two visits to Goshen the writer was informed that all oysters sold by dealer C were received from dealer E of New York City, and accordingly the oysters served at the Minisink banquet were said to have come from the above firm. A visit to dealer E revealed the fact that one barrel of shell oysters had been shipped from New York City on October 2, reaching Goshen on the 3d,[1] or two days before the banquet. The purchase and sale books of the New York firm showed that these oysters came from the Great Kills oyster grounds off the south side of Staten Island, N. Y. From the past history of these grounds it did not seem probable that shellfish from this locality would give rise to so many cases of typhoid fever and diarrhea; thus additional evidence was necessary to solve the problem as to the origin of the oysters.

At the time of making the third visit to Goshen, a complete list of all the shipments made by express or freight to dealer C within one week prior to the banquet was obtained. The Wells, Fargo Express Co. is the only express company represented at Goshen; thus a search of this company's records was sufficient to give complete information. The list of express articles for this period could not be identified by dealer C, as his bookkeeping was incomplete; thus it became necessary to inspect the records of the general office of the

[1] Wells, Fargo & Co. express waybill 2, clerk 66, weight 275 pounds, New York, N. Y., Oct. 2, 1911, 1 barrel oysters.

Wells, Fargo Express Co. at New York City. Here it was ascertained that dealer C had received oysters from three different shippers during the week before the banquet, one of which was the shipment from dealer E sent on October 2, 1911, from New York, leaving the other two consignments yet to be accounted for.

It was shown by the express records[1] that one barrel of oysters in the shell was shipped on October 3, 1911, by dealer B from Fulton Market, New York City, arriving at Goshen on the 4th; and on October 4 one 5-gallon tub of opened oysters was shipped from dealer F,[2] Seaford, Del., arriving at Goshen on October 5, 1911, the day of the banquet. The express records for the Seaford shipment at the Goshen office were entered as having been received on October 6, but it was explained that the clerk systematically entered the record on the day following the receipt of the shipments. This entry caused considerable difficulty in accounting for the presence of freshly opened bulk oysters in the establishment of dealer C on the day of the banquet as claimed by him.

On December 12, 1911, the oyster shucking plant of dealer F at Seaford, Del., was inspected; samples of water used in washing oysters were collected, also oysters taken from the same beds as were the oysters shipped to dealer C at Goshen, N. Y.

The plant was in a moderately good sanitary condition, perhaps above the average in cleanliness; and the well water used for washing oysters did not show *B. coli* in 5 cc, though they were present in 10 cc quantities.

The oysters came from near the mouth of Nanticoke River, in Chesapeake Bay, Md., and they scored 14 points, showing a passing mark. From an inspection point of view, the consumption of these oysters could not have been held responsible for any serious outbreak of disease.

During the fourth trip to Goshen it was learned that about 4 quarts of the 5-gallon tub of shucked oysters, received in bulk by dealer C, were furnished to the Minisink banquet on account of shortage in the original delivery; thus complicating the situation as regards the kind and source of the oysters which appeared responsible for all the sickness among the Minisink guests.

It was learned that oysters were served at the Occidental Hotel for 50 of their guests on October 5, 1911, and they were supplied by dealer C from the same 5-gallon lot of shucked oysters received from Seaford, Del., from which were furnished the 4 quarts for the Minisink banquet. No illness followed the dinner at the Occidental; thus these oysters were considered not to have been the cause of

[1] Wells, Fargo & Co. waybill 13, clerk 24, weight 250 pounds, New York, N. Y., Oct. 3, 1911, 1 barrel oysters.

[2] Wells, Fargo & Co. waybill 95, clerk 95, 5 gallons oysters, weight 60 pounds, advanced charges 37 cents.

any illnesses at the Minisink banquet. This view was sustained by subsequent investigations. It was shown that the bulk shucked oysters, or the last delivered, were largely served at the end of one long table, where no illnesses occurred, with one exception. This exceptional case was one of the waitresses, seated at the end of the table marked *a–b* in the diagram (fig. 1), who ate her dinner after serving the men, and the plate of oysters served her was brought by a young man from a portion of the table where the first lot of shell oysters, which some one else refused to eat, were served. This waitress developed typhoid fever, representing the only case of illness at that end of the table, where about 20 guests were served.[1] In addition to this evidence, a quart or more of the bulk oysters were left over and taken home by one of the ladies, and were eaten by a number of persons, none of whom developed any illness whatever. Considering the source of these opened oysters and the negative results following their consumption, it is plain that they were not responsible for the trouble experienced.

Having satisfactorily eliminated the Seaford opened bulk oysters as a factor in the causation of disease at the Minisink banquet, the other two shipments of shell oysters, received on October 3 and 4 by dealer C, were considered more in detail. The barrel of 900 shell oysters was received at Goshen from dealer E on October 3, 1911, two days before the banquet. As there appeared to be quite a demand for oysters at that time it is probable that these oysters were quickly consumed. This view is taken because the order for 1,000 oysters could not have been wholly filled from a lot containing 900 oysters at the time of receipt, even though none of the shipment had been sold during the two days elapsing before the banquet. It was shown by dealer C that all of the oysters, opened freshly from their shells in his shop, came from the last shipment he received, and they had been ordered as "special;" thus this fact would also strengthen the position that the oysters from dealer E were not used on this occasion.

Information subsequently obtained showed that other oysters taken from Great Kills at the same time as the shipment to Goshen were sold by dealer E to other retail dealers in different parts of New York State and no ill effects could be connected with their consumption.

When the facts became established that oysters were apparently responsible for the diseases following the Minisink banquet, all of the accumulated information pertaining to the quality and the probable chances of oyster contamination along the entire Atlantic coast was considered. It had been recognized for some time that Jamaica

[1] Note the arrangement of cases in the table diagram. The table to the right, from *a* to *b*, was served with Seaford oysters and the plates marked "S."

Bay was badly polluted, and, in fact, as will be subsequently shown, many samples of oysters and water had been taken from Jamaica Bay at the very time the oysters were taken from this place for shipment to Goshen. These examinations led to a series of seizures and condemnations of oysters from this bay, the first of which was made on October 12, 1911.[1]

The first intimation that "Rockaway" or Jamaica Bay oysters played any part in the problem under solution was on November 29, 1911, the day before Thanksgiving, after searching the records at the Wells, Fargo & Co. general offices in New York City. It was then too late in the day to obtain information from dealer B, and it was not until December 15 that positive information was obtained as to the source of the "Rockaway" oysters.

Soon after obtaining information relative to the shipment of oysters to Goshen by dealer B on October 3 from Fulton Market, New York City, a visit was made to this firm's establishment. Here it was ascertained that the oysters in question were "Rockaways" which came from dealer A, located at Indian Creek, near Canarsie, Long Island. The complete system of bookkeeping followed by dealer B made it possible to establish this fact beyond any doubt. The source of the oysters under dispute then lay between the Great Kills oysters and the Rockaways taken from Jamaica Bay. Having shown that either the Great Kills oysters or the Rockaways were the infected oysters, a further study of the physical characteristics of these two varieties was made.

During the early part of the investigation inquiries were made at Goshen regarding the color of the oysters served at the Minisink banquet. The testimony showed that few, if any, "green" oysters were observed on that occasion. This fact would tend to substantiate the belief that the oysters were of the Rockaway variety, as it is commonly known that many of the Great Kills oysters have a decidedly green color at certain seasons of the year. Since many people object to this color these oysters are not so generally sold to be eaten raw on the half shell. They are more largely used for stews and particularly for fried oysters in which the color would be concealed. On the other hand "Rockaway" oysters are sold largely for half-shell purposes, and would generally be ordered for banquets in preference to the Great Kills oysters.

A close study of Rockaway and Great Kills oyster shells shows considerable difference in their physical appearance. The Jamaica Bay or Rockaway shells grow very rapidly, owing to the great food value of those waters. This fact is recognized by practical oystermen and these grounds have been eagerly sought for the rapid maturing of shell stock. This quick growth causes very long, thin

[1] U. S. Dept. Agr., Office of the Secretary, Notice of Judgment 1380.

brittle tips on many of the shells. Those in deeper waters or in the channels grow less rapidly than those on the flats, or shallow water. The tips of many Rockaway shells can be easily broken because of their brittleness and thinness, and many of these shells give evidence of softening and degeneration. They appear as though some acid or chemical had acted upon the shell, thus dissolving a portion of its structure. The practical oysterman realizes the soft character of the Rockaway oyster shells, as they are nearly all "tonged" by hand from their beds instead of using power dredges, such as are operated in the Great Kills region.

The Great Kills oysters generally grow less rapidly, their shells are stronger and tougher, the tips are not easily broken by handling, and they withstand shipping as far as the Pacific coast. These facts substantiate the belief that Rockaways, and not the Great Kills oysters, were used at the Minisink banquet.

An investigation of the kind of oyster shells used at the music hall led to the discovery that they had been buried the day following the banquet near music hall beside a telephone pole. About 4 dozen of the shells were recovered and identified by the man who buried them. They were brought to the laboratory, washed, and matched with a similar number of oyster shells taken by the writer on December 5, 1911, from the floating bins of dealer A, at Canarsie, Long Island. A study of Plate I shows the character of the oyster shells and the close similarity of those served at the music hall and those obtained direct from Jamaica Bay.

This evidence seems sufficient to show positively that Great Kills oysters were not served at the Minisink banquet, which conclusion was reached after taking into consideration all of these facts and the analyses subsequently submitted from these two localities.

CASES STUDIED AT ROCHESTER, N. Y.

On October 3, 1911, one barrel of Rockaway oysters from dealer A was shipped by dealer B to a dealer in Rochester, N. Y., followed by one barrel on the 11th, two on the 12th, and one on the 14th of October. During the year 1911, 76 cases of typhoid fever were reported in Rochester;[1] of this number 48 were reported during the months of October, November, and December, the latter month having 23 of the 76, or more than 30 per cent of the cases reported for the year. It is a recognized fact that the typhoid death rate of Rochester is normally exceedingly low. During the year there had been no epidemics ascribed to milk infection, and the water had apparently played little part in the transmission of typhoid bacilli.

When presented with the facts that certain shipments of infected shellfish had been received during October at Rochester, the health officer of that city admitted the probability of their being the most

[1] Report of the bureau of health of the city of Rochester, December, 1911, p. 3.

PLATE I.

COMPARISON OF OYSTER SHELLS SERVED AT BANQUET WITH SHELLS FROM JAMAICA BAY.

important factor in the greatly increased number of typhoid cases reported during October, November, and December. There was obtained from the health office a list of cases reported during these months in 1911, and January, 1912, and 33 of these cases were personally investigated. Careful inquiry was made as to the possibility of contact, the sanitary conditions of premises, the water and milk used, and whether or not raw oysters were consumed within one month prior to the illness. The weight of evidence obtained as to the probable source of infection gave the following results:

Oysters, source undetermined	8
"Rockaways"	5
Unknown	8
Contact	6
Summer resorts (water)	4
Water (not Rochester supply)	1
Milk	1
Total	33

According to this table, oysters appeared to be responsible for 13, or 39.4 per cent, of the 33 cases investigated. The cases were widely scattered throughout the city, and in nearly all instances they appeared among well-to-do families where sanitary conditions were exceptionally good.

Among the cases reported as eating "Rockaway" oysters, it was almost impossible to trace the oysters back to the specific dealer from whom they were obtained; however, all of the firms from whom these oysters were purchased handled Rockaways almost to the exclusion of other oysters at the time when they were eaten and when the infection probably began.

The visit to Rochester was made on January 8 and 9, about four months after the shipment of oysters in October; thus, owing to the length of time elapsed, it was more difficult to trace the cases directly to any one of the five shipments made at that time. In most cases in which oysters appeared responsible for the infection, other members of the same family were not made ill; however, in nearly every instance the infected person was the only one who ate the oysters raw. Those who ate cooked oysters escaped the infection. In fact, it was generally observed that in most instances oysters were cooked—not eaten raw, as is the custom in many coast towns located near oyster grounds. If this is generally true in Rochester, it will explain why more people did not contract typhoid fever from eating these oysters, especially the shipment of October 3, 1911, which came from the same lot served at the Minisink banquet at Goshen, N. Y., on October 5, 1911; had they been eaten raw, the same disastrous results would doubtless have followed their consumption.

It should be said that a number of the cases reported in Rochester had been brought from neighboring towns, and some of those inter-

viewed belonged to this class. As opportunity was not afforded to visit these towns, no information relative to the source of oysters eaten was obtained. Data in regard to excessive diarrhea or other intestinal diseases were not available, owing to the fact that cases of this character were not reported to the health office; hence there was no way of locating persons who may have been afflicted with such disturbances.

SCHOOLMASTERS' BANQUET, NEWBURGH, N. Y.

During the Minisink investigation it was learned that a shipment of one-half barrel of shell oysters had been made from dealer A, located at Indian Creek, by a Fulton Market firm, to Newburgh, N. Y., on October 12, 1911. These oysters were served at the schoolmasters' banquet, given at a Newburgh hotel on the following day. There were present at this banquet about 60 teachers and their guests, representing some 8 counties of the State. The names and addresses of the individuals attending this banquet, together with a list of the articles of food served on this occasion, were obtained.

A circular letter similar in character to that sent the guests of the Minisink banquet was prepared and sent to each of these 60 individuals. Of the 57 who replied, 1 stated that he did not attend the banquet, leaving a total of 56 individuals who were present. The menu served at this banquet contained oysters on the half shell, soup, fish, roast chicken, cooked vegetables, salad, ice cream, cake, and coffee.

These letters showed that 50 of the 56 guests had eaten raw oysters, and of this number 13, or 23.2 per cent, had gastrointestinal disturbances, in most instances beginning 2 or 3 days later, and somewhat similar in character to the cases following the Minisink banquet. Information relative to one positive case of typhoid fever, or 2 per cent of those eating oysters, was obtained, the illness beginning about 12 days after the banquet. A personal visit to this individual showed a clear history of oyster infection. It was the discovery of this case and a study of his previous history which revealed the fact that he had attended the Newburgh banquet. No other member of his family attended this banquet, and no one was ill. In reporting this case of typhoid fever to the State department of health, the local health officer's card stated that no oysters had been eaten 20 days prior to the illness. This is but one of a number of such instances encountered while making the personal investigations.

The excuse given by another physician for not reporting "raw shellfish" as having been eaten within the proper incubation period was the fact that the patient could not ordinarily afford to buy oysters; it was self-evident that the card had been filled out in the physician's office without even asking the patient what he had eaten. The facts showed that he had eaten raw oysters at the Minisink banquet. One

very important fact was learned during this house-to-house investigation, and that was the absolute necessity of thoroughness, paying particular attention to details, and not ignoring information which would in any way shed light on the problem under consideration. The average physician does not have time to obtain the proper kind of a case history, which would, in many instances, give valuable data.

Of the 13 guests who suffered from diarrhea, 6 had previously had typhoid, also 3 of those who ate oysters and were not sick; thus there were 9 individuals who were practically immune; however, the one case of typhoid reported claimed to have had the same disease many years before.

One man writes:

I beg to say that my wife was also a guest at the hotel, but not at the banquet, and that she also was troubled for a week afterwards with severe diarrhea. She had eaten oysters on the half shell.

Another man, who was not sick following this banquet, said:

You will see by the articles crossed on the menu that there was little chance of my being infected by what I ate. I am very particular when partaking of food away from home, hence the lightness of my repast.

You may derive some satisfaction from my statement on learning that I am very fond of ice cream, and on that night I ate a double portion, so that probably the ill effects of the banquet came from the oysters or meats and not from the ice cream.

Five men attended from this city and four of them were more or less affected. One was positively ill for some days with all the symptoms of ptomain poisoning. At our last banquet on February 9, 1912, at the same place, more or less complaint was heard of the illness caused by the banquet of three months before, and there was no little complaint of the quality of the food served this time.

The oysters used at the schoolmasters' banquet were evidently not so badly infected as were those used at the Minisink banquet. They probably came from the water at Indian Creek on October 11, 1911, or 9 days after those sent to Goshen.

DISTRIBUTION OF CASES OF ILLNESS DUE TO EATING ROCKAWAY OYSTERS.

The cases of typhoid fever and gastroenteritis ascribed to eating "Rockaway" oysters, obtained either from dealer A at Indian Creek [1] or from other parts of Jamaica Bay, as set forth in this report, are tabulated as follows:

TYPHOID FEVER.

Minisink banquet	17
Rochester, N. Y.	5
Washington, D. C.	2
Suffern, N. Y.	1
Schoolmasters' banquet	1
Brooklyn, N. Y.	1
Total	27

[1] The cases ascribed to Rochester ate "Rockaway" oysters which were not definitely traced to dealer A. Two of the cases credited to Washington and one to Brooklyn came from a shipper located near dealer A.

	GASTROENTERITIS (DIARRHEA).
Minisink banquet	83
Schoolmasters' banquet (including 1 hotel guest)	14
Washington, D. C.	2
Total	99
Total number of cases of typhoid and diarrhea	126

In the case at Suffern, N. Y., raw oysters were eaten within the proper incubation period from the same lot as were shipped to Goshen on October 3, 1911. As far as could be ascertained all the other oysters sold from this same shipment were cooked before eating; however, there were said to have been a number of cases of diarrhea reported in this town during October, and three or four cases of typhoid outside of the town concerning which no information was obtained. Figure 4 sets forth these data in graphic form.

INSANITARY CONDITION OF JAMAICA BAY.

PREVIOUS REPORTS.

Oysters from Jamaica Bay are generally sold under the name "Rockaways." This designation appears on the menu cards at hotels and restaurants where they are served; thus they are known to the consuming public as "Rockaway" oysters. The insanitary condition of Jamaica Bay and vicinity was fully set forth by Porter[1] in 1908; however, no steps appear to have been taken to prevent the sale of these contaminated oysters, or prevent further pollution of the waters of this bay. The practice of floating oysters in polluted waters at Inwood and Indian Creek was also apparently known to have existed, but no action was taken to stop this dangerous procedure. In the present report reference is made to the Lawrence investigations, in which it was shown by Soper in 1904 that 21 out of 31 cases of typhoid fever were traced to oysters floated at Inwood, Long Island, N. Y.

In speaking of the floats from which these oysters were taken, that report says:

> That the waters in which these floats were located were badly polluted was amply demonstrated by the chemical and bacteriological examinations made at a time when conditions were known to be far better than when the cases of the disease developed. Samples of oysters were likewise examined bacteriologically, and of them 25 per cent were shown to contain certain bacteria of the *Bacillus coli communis* type in one-tenth of a cubic centimeter of the shell water, and in 60 per cent in 1 cubic centimeter of the same.
>
> The sanitary survey showed the discharge of imperfectly treated sewage, from a population of 15,000, less than half a mile from the oyster floats; in fact, some were very much nearer. Aside from this pollution, there were many individual sewers, manure piles, dump heaps, piles of cesspool sludge, which contributed to the pollution of the water adjacent to the floats.

[1] Porter, Eugene H. Sanitary inspection of shellfish grounds. (New York State Board of Health, 29th Ann. Rept., 1908, *2*: 833-864.)

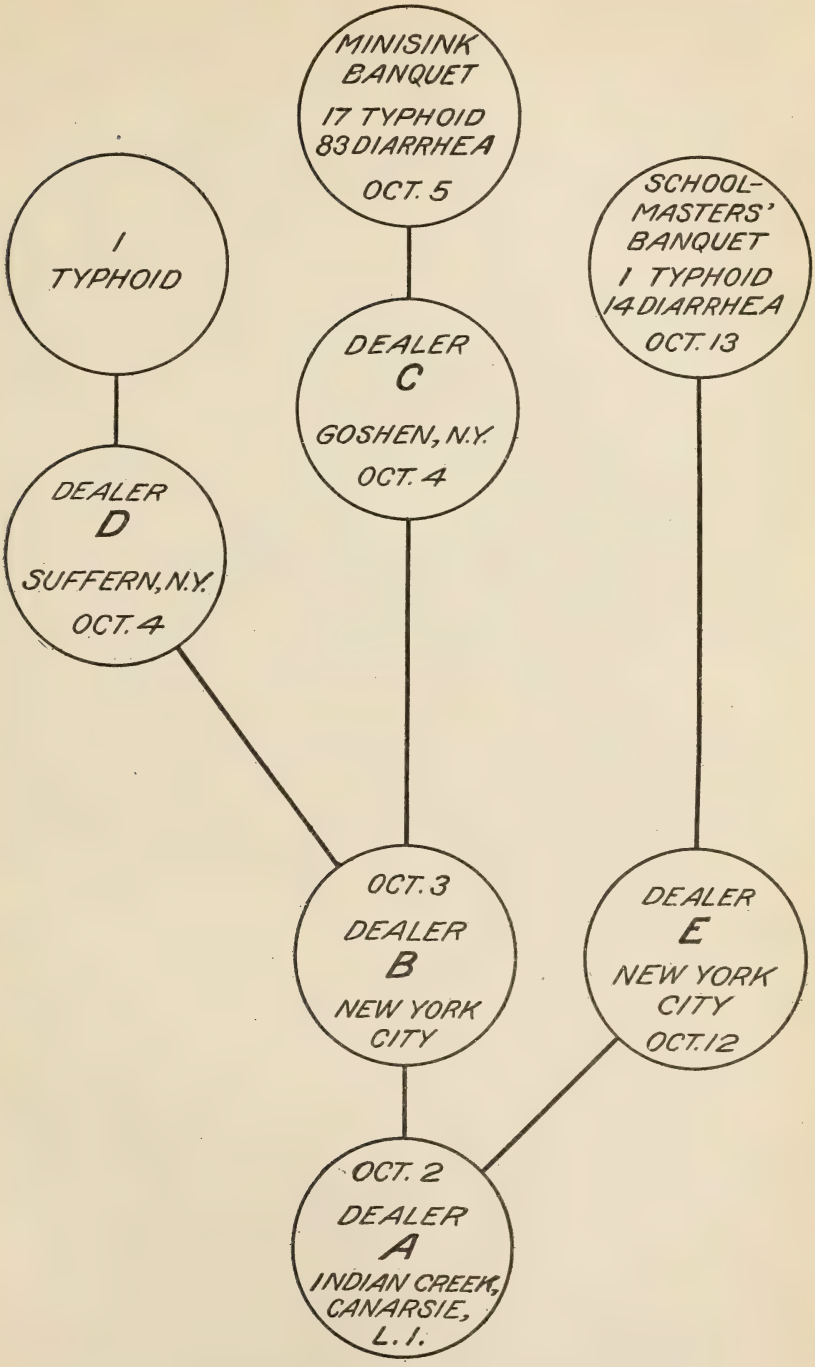


FIG. 4.—Cases of typhoid and enteritis traced back to Rockaway oysters sold by dealer A.

Since that report so completely covers the situation under discussion, the following descriptive data are also submitted:

The Jamaica Bay oyster beds are leased by the State and constitute the largest oystering district in New York State waters. They are said to yield from 500,000 to 1,000,000 bushels yearly. The principal shipping points from this bay are at Canarsie, Inwood, and near Flatbush Bay, although large quantities of oysters are taken direct by schooners to New York markets.

Area of Jamaica Bay inside of Rockaway Point estimated exclusive of marshes to be 16,690 acres. Mean range of tide 4 feet. Tidal daily volume passing in and out twice daily is roughly 2,900 million cubic feet.

The principal points of pollution are at the four sewage disposal plants at Sheepshead Bay, East New York, Jamaica, and Far Rockaway, at the outlet of Paerdegat and Kings County hospital sewers into Paerdegat Basin, at Bergen Beach, at Canarsie, and along Rockaway Beach district. In addition to these points, pollution reaches the bay from various summer cottage colonies, the principal colonies being located at Plum Beach, at Sand Bay, east of Canarsie, along Mill Creek, at Ramblersville or Remsen Landing, along Bergen and Cornell creeks, and at the several stations on the bay of the Rockaway Beach Railroad.

The pollution differs greatly at most points in the summer and winter seasons. The Sheepshead Bay disposal plant, using the chemical precipitation method, which the other three plants also use, receives sewage from a normal population of 2,000 in winter to a summer population of 40,000 to 50,000 on special days. The treatment is practically ineffective.

Bergen Beach is visited by from 50,000 to 60,000 persons weekly in summer, and the sewage, from an average of 8,000 persons daily, is discharged into the bay.

Paerdegat Basin receives sewage from a permanent population of over 10,000 persons.

Canarsie is visited by an average of 16,000 persons daily in the summer season, including 30,000 on Sundays, and practically all the sewage from this population reaches the bay.

A permanent population of considerably over 50,000 persons contribute sewage to the New Lots or East New York disposal plant. An average of 10,000,000 gallons of sewage and storm water per day is pumped at this plant, and in addition a relief by-pass is in operation from 11 o'clock a. m. until midnight. The plant is so much overtaxed, the sewage being detained for only 17 to 20 minutes, that the treatment is practically ineffective.

At Sand Bay, 127 cottages, at Old Mill Creek, 176 cottages, at Ramblersville, 220 cottages, at Bergen Creek, 50 cottages, at Cornell Creek, 53 cottages, and along the line of the Rockaway Beach Railroad, over 200 cottages, have privies which discharge into the water or onto marshes subject to tidal overflow.

The Jamaica disposal plant, effluent from which is discharged into a branch of Bergen Creek, treats the sewage from about 18,000 persons out of a total population of 25,000 in Jamaica. The plant has ample capacity as a chemical precipitation plant, although under the best of operating conditions a reduction of organic matter and bacteria of about 50 per cent only is possible.

The Far Rockaway disposal plant receives sewage from a normal population of 6,500 and a summer population of 30,000. During the summer season the plant is undoubtedly overtaxed.

The Rockaway Beach district varies greatly in population. In the winter season, from October to June, the population is about 6,000 as based on the registration. During the summer season the average daily population is from 55,000 to 60,000, and on a conservative estimate, based on the traffic figures of the railroad and steamboat

lines carrying passengers to this district, the population in this district on certain days may reach as high as 125,000 to 150,000.

Twenty-nine public sewers discharge sewage from this varying population directly into Jamaica Bay.

By studying the accompanying maps and illustrations (Pl. II and fig. 5) it will be seen that Jamaica Bay is located dangerously near a large city and into it many million gallons of sewage empty daily.

In addition to the published report of the New York State Board of Health for 1908, additional information was obtained from inspection

FIG. 5.—Map of Jamaica Bay showing principal sewer outlets and oyster beds (shaded areas).

trips made at various intervals during the winter season of 1911–12, at which time samples of water and oysters were collected for examination.

HENDRIX STREET SEWER AND DISPOSAL PLANT.

On January 25, 1912, an inspection was made of the Hendrix Street sewage disposal plant, located at the foot of Hendrix Street, Brooklyn, N. Y. This plant was said to have been built in 1892–93 for treatment of a maximum capacity of 3,000,000 gallons of sewage daily. At present they endeavor to treat approximately 10,000,000 gallons daily, while the total outflow of the entire sewer is estimated at about 18,000,000 gallons under normal dry-weather conditions, at least one-fourth more during heavy rains, all of which empties into a flume nearly 1 mile in length which discharges into Jamaica Bay.

There was being used in this plant at the time of inspection about 4,000 pounds of lime to treat 10,000,000 gallons of sewage, or 1

pound of slacked lime to 2,500 gallons of raw sewage. Four-ounce samples of sewage, one collected before and one after treatment, were examined, with the following result:

Examination of sewage samples before and after treatment.

Determinations.	Before treatment.	After treatment.
	Parts per million.	
Chemical analyses: [1]		
Ammonia	45.0	50.0
Nitrogen as nitrites	.0	.0
Nitrogen as nitrates	.0	.0
Chlorin	60.0	60.0
	Organisms per cc.	
Bacteriological analyses:		
On plain agar at 25° C.	7,100,000	4,900,000
On plain agar at 37° C.	3,700,000	4,000,000
B. coli	10,000	10,000

[1] Chemical analyses made by W. W. Skinner, Water Laboratory, Miscellaneous Division, who comments as follows: "In the case of sewage, the results of the analysis show this to be probably a raw product, both before and after treatment. But the examination, so far as made, seems to indicate that the treatment has little effect upon the character of the material." Owing to the small amount of the sample, it was impossible to make further chemical analyses.

The bacteriological results show that one sample of sewage at the time of collection contained more bacteria at 25° C. before treatment than after treatment; however, the sample after treatment with lime contained a higher total number of organisms at 37° C. The number of *B. coli* was unchanged.

The results, both chemically and bacteriologically, would indicate practically no change resulting from treatment of this sewage at this disposal plant. It was said that in addition to the lime used there was also about 50 gallons of crude phenol used per month in washing down the walls of the sedimentation basins during cleaning.

In the accompanying illustration is shown the disposal plant in the background, with the flume some 26 feet wide in the foreground. The flume is reenforced with crossbeams, which cause its peculiar appearance (see fig. 6).

Besides the Hendrix Street disposal plant, the Jamaica and Far Rockaway plants are operated in a similar manner; the output, however, is only a few million gallons daily.

The Paerdegat sewer, having a daily discharge of about 2,000,000 gallons, empties into Jamaica Bay, a short distance to the west of Indian Creek, where nine oyster dealers, including dealer A, float their oysters. To the east of the mouth of Indian Creek empty the 18,000,000 gallons of sewage from the Hendrix Street sewer (see fig. 6).

In addition to the effluent from the public trunk sewage systems of Brooklyn and vicinity, there are numerous small sewers located all

BIRD'S-EYE VIEW OF THE FIVE BOROUGHS FORMING GREATER NEW YORK, 1904.

along the south side of Jamaica Bay which empty their contents into these waters. Aside from these sewers, hundreds of private cottages, hotels, and summer resorts discharge their sewage directly into the waters, in some instances almost immediately over the oyster beds, or near where clams are dug on the flats.

Considered as a whole, Jamaica Bay may be considered as one great basin into which many millions of gallons of human sewage are constantly flowing, and doubtless myriads of typhoid organisms from this sewage find their way over a portion of the shellfish grounds through the medium of polluted water. The bacteriological examina-

FIG. 6.—Hendrix Street sewage disposal plant, Brooklyn, N. Y.

In the foreground note the top of the reinforced flume, 26 feet wide, through which more than 18,000,000 gallons of sewage, practically raw, enters Jamaica Bay daily.

tion of all of the water and oyster samples taken from Jamaica Bay has shown marked evidence of pollution, as set forth in the accompanying tables.

FLOATING OYSTERS.

Plates III and IV represent views of the oyster houses occupied by dealer A and others. The oysters are brought by boat from the grounds and unloaded through "trapdoors" at the sides of the buildings, as shown in the illustration, or, in some cases, the boats may enter the cellars during high tide and there be unloaded. During low tide this creek is nearly dry, and it is said that fresh-water springs are located under the houses. By closing the flood gates during ebb tide, the water under the houses is kept almost free from salt, and the oysters "drink" under these conditions. The water under the houses

shown in these plates contains about 1 per cent less salt than that in Jamaica Bay where the oysters grow; thus they "plump" up by osmotic action. Upon analysis it was found that this water where the oysters were stored was badly polluted. In some places visible masses of human fecal matter were observed in the rear or at the sides of these buildings, a few feet from the banks of the stream. Doubtless the oysters were directly polluted by men who discharged their excretions into these dark cellars. This possibility was admitted by some of the oystermen at that place.

BACTERIOLOGICAL DATA ON WATER AND OYSTERS FROM JAMAICA BAY.

METHODS OF EXAMINATION.

Water.—The bacteriological examination of water collected over oyster beds or from oyster floats was made in the usual manner for water samples of this character. The method used is fully presented in Bureau of Chemistry Bulletin 139[1] and is based on the report of the Special Committee on Water Analysis of the American Public Health Association.

Briefly, the operation consists in the inoculation of lactose peptone ox-bile media with definite quantities of the water sample, which are incubated at 37° C. for two or three days, when the presence of *B. coli* is determined by subcultures and isolation in pure cultures. The presence of *B. coli* in the majority of 1 cc samples is considered as evidence of serious pollution, particularly when inspection shows probable contamination from human sources.

Oysters and other shellfish.—Oysters from Jamaica Bay were examined in the same manner as those from other sources. In general, the methods outlined by the Committee on Shellfish Examination[2] were followed, as set forth in an article read before the laboratory section of the American Public Health Association, Milwaukee, September, 1910.[3]

The samples of oysters were taken for examination either from their beds by tongs or from floats, and in most instances were shipped to the Washington laboratory for analysis; some few analyses were made in the branch laboratory at New York City. Those shipped to Washington were placed in water-tight cases surrounded by ice, no water coming in contact with the oysters. Before opening the shells,

[1] American Mineral Waters, Skinner, Stiles, and Haywood. Bul. 139, Bureau of Chemistry, June 13, 1911.

[2] Preliminary Report of the Committee on Standard Methods of Shellfish Examination. Reprinted from the Journal of the American Public Health Association, August, 1911, vol. 1, No. 8.

[3] Stiles, Geo. W. The bacteriological examination of shucked and shell oysters. (Journal of the American Public Health Association, September, 1911, No. 9, pp. 623–631.)

FIG. 1.—OYSTER HOUSE OF DEALER A AT INDIAN CREEK, NEAR CANARSIE, LONG ISLAND, N. Y.

Taken January 25, 1912, with the tide rising. Note the closed trapdoors through which oysters are unloaded from boats. A trapdoor in the floor above permits entrance from the interior of the building.

FIG. 2.—OYSTERS IN THE CELLAR UNDER HOUSE OF DEALER A.

Picture taken December 15, 1911, at low tide, when only a portion of the shells were under water.

FIG. 1.—VIEW OF INDIAN CREEK, NEAR CANARSIE, LONG ISLAND, WHERE NINE OYSTER DEALERS FLOAT OYSTERS IN THE CELLARS OF THEIR HOUSES.

Arrow points to Dealer A's house.

FIG. 2.—A THREE-COMPARTMENT PRIVY LOCATED DIRECTLY OVER INDIAN CREEK NOT FAR BELOW DEALER A.

This is one of the immediate and specific sources of pollution in this creek.

they were well scrubbed, dipped quickly in boiling water, and opened with sterile instruments, the liquor from each oyster being collected in a separate sterile petri dish. Quantities of 1 cc, 0.1 cc, and 0.01 cc of shell liquor were planted in lactose-peptone ox-bile fermentation tubes, and incubated in the same manner as was observed in making the water analysis. *B. coli* were also isolated and studied in pure culture in the same manner as in the case of water.

The method of scoring oysters was the same for all the samples herein submitted, and is that recommended and known as "The

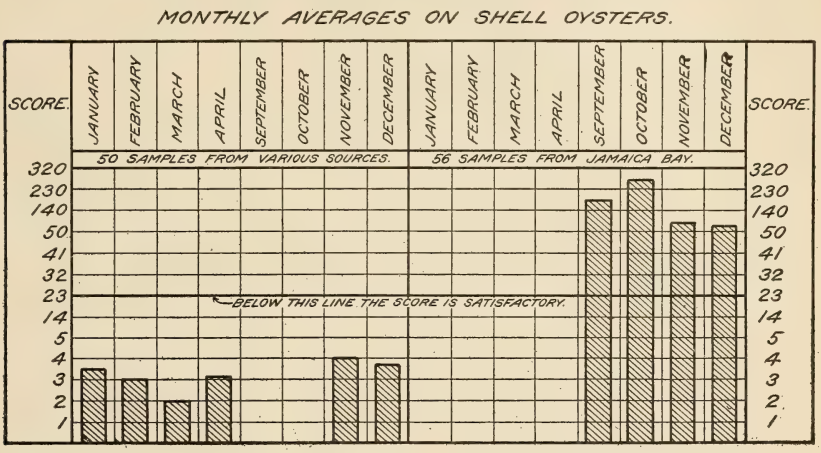


FIG. 7.—Average monthly score on shell oysters from different sources.

American Public Health Association Method of Scoring Oysters for *B. coli*," summarized as follows:

The presence of *B. coli* in each oyster of the five examined is to be given the following values, which represent the reciprocals of the greatest dilutions in which the test for *B. coli* is positive:

If present in 1 cc but not in 0.1 cc, the value of 1.

If present in 0.1 cc but not in 0.01 cc, the value of 10.

If present in 0.01 cc but not in 0.001 cc, the value of 100, etc.

The addition of these values for the five oysters would give the total numerical value for the sample and this figure would be the score for *B. coli*.

Monthly average scores for oysters from various sources and from Jamaica Bay are shown on figure 7.

TABULATED DATA.

Water from Jamaica Bay and tributaries.

[Bacteriological examination of *all* of the samples collected from this bay.]

No.	Date.	*B. coli* present in—	NaCl.	Location.
	1908.	*cc.*	*Per cent.*	
1	Apr. 11	1.0	(1)	Pumpkin patch; water 17 feet deep.
2	...do.....	1.0	.....	Pumpkin patch; water near surface.
3	...do.....	1.0	.....	Surface sample near Canarsie.
4	...do.....	1.0	.....	Big Channel; 18 feet deep; 1½ miles from shore.
5	...do.....	1.0	.....	Broad Channel; east, below railroad bridge; surface sample.
6	...do.....	.1	.....	Broad Channel; 10 feet deep.
7	...do.....	1.0	.....	Yellow Bar; water 6 feet deep.
8	...do.....	(2)	.....	Ruffle Bar; surface sample.
9	...do.....	(2)	.....	Ruffle Bar; deep sample.
10	...do.....	1.0	.....	Southeast from Ruffle Bar; water 2 feet deep.
11	...do.....	1.0	.....	Southeast from Point of Ruffle Bar; water 1 foot deep.
12	...do.....	1.0	.....	Brandt Point; water 15 feet deep.
13	...do.....	.1	.....	Brandt Point; surface sample.
	1911.			
14	Sept. 28	.1	[3] 2.81	Northeast from Hammel, Broad Channel; 12 feet deep; low tide. See oyster sample No. 1.
15	...do.....	.1	2.81	Above railroad bridge, Broad Channel; water 12 feet deep. Low tide.
16	...do.....	1.0	2.85	Above drawbridge; Broad Channel. Low tide.
17	...do.....	1.0	2.85	One mile west of drawbridge; Broad Channel. Low tide.
18	...do.....	5.0	2.90	Off Rockaway Park, ½ mile from shore. Low tide.
19	...do.....	.1	2.89	Water 2 feet deep; 100 yards of sma' sewer on shore. Low tide.
20[4]	Oct. 12	.1	1.75	Floating bins, under oyster house, Inwood, Long Island. Duplicates.
21[4]	...do.....	.1	1.82	Do.
22	...do.....	.1	2.56	Over storage floats, outside of oyster house in canal, Inwood, Long Island.
23	...do.....	1.0	2.71	Collected during the afternoon; ebb tide about 2 hours; vicinity of Broad Channel, and Silver Hole, above railroad bridge, over oyster grounds.
24	...do.....	1.0	2.72	Do.
25	...do.....	5.0	2.74	Do.
26	...do.....	5.0	2.83	Do.
27	...do.....	1.0	2.68	Do.
28	...do.....	.1	2.70	Do.
29	...do.....	.1	2.67	Do.
30	...do.....	1.0	2.70	Do.
31	...do.....	1.0	2.68	Do.
32	...do.....	.01	2.68	Sample near Hammel, above railroad bridge.
33	Dec. 15	.1	.67	Indian Creek, near Canarsie, outside of dealer A's oyster house.
34	...do.....	.1	.87	Do.
35	...do.....	.001	.52	Under dealer A's oyster house where oyster samples Nos. 45 to 50, inclusive, were collected.[5]

[1] Sodium chlorid determinations not made.

[2] *B. coli* determined only in 1 cc or less quantities at that time.

[3] Sodium chlorid determinations made by L. C. Mitchell, Food Inspection Laboratory, Bureau of Chemistry.

[4] *B. typhosus* isolated from oysters taken this day from these waters. See oysters Nos. 14 to 36, inclusive.

[5] Jamaica Bay oysters were taken from this bin under dealer A's oyster house on Oct. 2, 1911, and shipped to Goshen, N. Y., on Oct. 3, arriving there Oct. 4, the day before the banquet at Music Hall on Oct. 5, 1911. It was this lot of oysters which was responsible for 17 cases of typhoid fever, with 1 death, at Goshen, N. Y. The results show that the waters of Jamaica Bay are badly polluted with sewage.

Shell oysters from various sources showing satisfactory bacteriological results.

No.	Date.	Organisms per cc. at—		Gas-producing organisms (each score based on 5 oysters).			Score.	Source.
		25° C.	37° C.	In 1 cc.	In 0.1 cc.	In 0.01 cc.		
	1910.							
1	Mar. 11	3,600	500	4	1	0	5	Lower Providence River.
2	Mar. 25	3,800	1,800	2	1	0	3	Great South Bay, Long Island, N. Y.
3	...do.....	6,100	700	2	2	0	4	Do.
4	...do.....	1,100	230	1	1	0	2	Do.
5	...do.....	3,000	1,000	0	0	0	0	Do.
6	...do.....	600	230	1	0	0	1	Do.
7	...do.....	500	50	1	1	0	2	Do.
8	Mar. 29	3,800	400	1	0	0	1	Do.
9	...do.....	10,500	4,400	2	0	0	2	Do.
10	...do.....	9,900	200	[1] 0	[1] 0	0	0	Do.
11	...do.....	4,000	2,700	2	1	0	3	Do.
12	...do.....	10,000	2,000	1	1	0	2	Do.
13	Apr. 9	5,000	2,000	4	0	0	4	Delaware Bay (unfloated).
14	...do.....	7,000	1,000	3	0	0	3	Do.
15	Nov. 18	3,000	3,000	4	1	0	5	Great Kills, Staten Island, N. Y.
16	Dec. 2	60,000	2,000	[2] 6	[2] 1	0	2.5	Do.
17	Dec. 10	600	1,100	4	1	0	5	Do.
18	Dec. 13	13,000	100	4	1	0	5	Do.
19	Dec. 14	100,000	6,000	2	0	0	2	Source not determined.
20	...do.....	92,000	5,000	4	1	0	5	Do.
21	Dec. 16	90,000	700	4	1	0	5	Great Kills, Staten Island, N. Y.
22	...do.....	40,000	3,000	2	0	0	2	Oyster Bay, Long Island, N. Y.
23	Dec. 31	150	20	1	0	0	1	Great Kills, Staten Island, N. Y.
24	...do.....	2,700	160	5	0	0	5	Do.
	1911.							
25	Jan. 6	50,000	2,000	4	1	0	5	Market oysters; source undetermined.
26	...do.....	13,000	3,000	1	0	0	1	Great Kills, Staten Island, N. Y.
27	...do.....	11,000	300	3	0	0	3	Do.
28	...do.....	20,000	[3]	1	0	0	1	Do.
29	Jan. 13	14,000	2,400	4	0	0	4	Do.
30	...do.....	4,000	800	5	0	0	5	Do.
31	Jan. 14	20,000	1,000	4	0	0	4	Patuxent River, Md.
32	...do.....	80,000	60,000	3	0	0	3	Do.
33	...do.....	60,000	16,000	4	0	0	4	Do.
34	Jan. 20	50,000	3,000	5	0	0	5	Norfolk, Va.
35	Feb. 21	11,000	2,000	2	1	0	3	Patuxent River, Md.
36	...do.....	6,000	800	2	2	0	4	Warwick River, Md.
37	Feb. 27	70,000	3,000	1	1	0	2	Great Kills, Staten Island, N. Y.
38	Nov. 10	44,000	10,000	4	1	0	5	Norfolk, Va.
39	Nov. 16	8,000	4,000	4	1	0	5	Do.
40	Nov. 17	2,600	400	3	0	0	3	"Cherrystones," from Virginia.
41	...do.....	1,200	1,100	5	0	0	5	Do.
42	Nov. 22	2,500	1,000	1	0	0	1	Great South Bay, Long Island, N. Y.
43	...do.....	7,000	6,000	2	2	0	4	Norfolk, Va.
44	...do.....	8,000	4,600	4	1	0	5	Do.
45	...do.....	16,000	8,000	3	2	0	5	Do.
46	Nov. 27	250,000	100,000	3	0	0	3	New York, N. Y.
47	...do.....	15,000	2,000	3	1	0	4	Do.
48	Dec. 14	120,000	20,000	2	0	0	2	Nanticoke River, Md.
49	Dec. 4	37,000	22,000	3	2	0	5	Norfolk, Va.
50	Dec. 16	10,000	8,000	4	1	0	5	Chincoteague, Va. (unfloated).
							[4] 3.31	

[1] Out of 4 oysters. [2] Out of 14 oysters. [3] Less than 100. [4] Average score.

NOTE.—These oysters were examined according to the recommendations of the Committee on Standard Methods of Shellfish Examination.

Oysters from Jamaica Bay.

No.	Date.	*B. coli* determinations (each score based on 5 oysters).			Total score (points).	Organisms per cubic centimeter, plain agar, at—	
		1 cc.	0.1 cc.	0.01 cc.		25° C.	37° C.
	1911.						
1	Sept. 28	5	5	1	140	.....	.....
2	Sept. 29	5	5	2	230	15,000	15,000
3	...do.....	5	5	2	230	11,000	6,000
4	...do.....	5	5	1	140	7,000	5,000
5	Oct. 9	5	5	1	140	.....	.....
6	...do.....	5	5	2	230	.....	.....
7	...do.....	5	4	2	140	.....	.....
8	...do.....	5	5	1	140	450,000	140,000
9	...do.....	5	4	1	50	320,000	110,000
10	Oct. 10	5	5	4	410	.....	.....
11	Oct. 11	5	5	2	230	.....	.....
12	...do.....	5	5	1	140	11,000	7,000
13	...do.....	5	5	2	230	.....	.....
14	Oct. 12	5	5	3	320	.....	.....
15	...do.....	5	4	2	140	.....	.....
16	...do.....	5	5	3	320	19,000	2,600
17	...do.....	5	5	3	320	8,000	3,400
18	...do.....	5	5	4	410	25,000	5,500
19	...do.....	5	5	3	320	8,000	3,200
20	...do.....	5	5	2	230	95,000	6,700
21	...do.....	5	5	4	410	6,000	1,000
22	...do.....	5	5	4	410	7,000	4,700
23	...do.....	5	5	0	50	42,000	7,600
24	...do.....	5	4	2	140	14,000	2,500
25	...do.....	5	4	1	50	61,000	6,000
26	...do.....	5	5	3	320	4,000	3,000
27	...do.....	5	5	4	410	14,000	20,000
28	...do.....	5	5	5	500	8,000	7,000
29	...do.....	5	5	5	500	4,700	2,600
30	...do.....	5	5	3	320	4,100	3,800
31	...do.....	5	4	3	230	13,000	9,000
32	...do.....	5	4	4	320	5,000	3,000
33	...do.....	5	5	3	320	6,000	2,700
34	...do.....	5	5	3	320	9,000	5,000
35	...do.....	5	5	4	410	7,000	4,000
36	...do.....	5	5	2	230	250,000	40,000
36a	Nov. 20	5	3	1	41	110,000	50,000
36b	...do.....	5	3	2	50	700,000	500,000
36c	...do.....	5	5	1	140	1,000	5,000
36d	Nov. 22	5	5	1	140	16,000	47,000
36e	...do.....	5	4	2	140	19,000	6,000
36f	...do.....	5	5	2	230	250,000	40,000
37	Nov. 24	5	3	0	32	1,200	1,100
38	...do.....	5	2	0	23	2,000	1,000
39	...do.....	5	3	0	32	3,000	5,000
40	...do.....	5	5	2	230	20,000	8,000
41	...do.....	5	4	1	50	33,000	25,000
42	...do.....	5	1	1	23	50,000	20,000
43	...do.....	5	2	1	32	60,000	52,000
44	...do.....	5	3	1	41	30,000	20,000
45	Dec. 15	5	2	0	23	100,000	2,000
46	...do.....	5	3	1	41	9,000	5,000
47	...do.....	5	4	2	140	50,000	400
48	...do.....	5	4	2	140	50,000	300
49	...do.....	5	4	0	41	700,000	120,000
50	...do.....	5	5	0	50	270,000	50,000

NOTE.—No. 1 collected from Silver Hole, near Broad Channel, Jamaica Bay, N. Y., by Dr. Stiles. Nos. 2, 3, and 4 taken from Fulton Market, New York; said to have been 1 day out of water. Nos. 5, 6, 7, 8, and 9 from dealer, New York City; probably 2 days out of water. No. 10 from market, New York; unfloated. Nos. 11, 12, and 13 from dealer, New York. Nos. 14 to 36, inclusive, from seized lot; all floated near Inwood. Nos. 37 to 44, inclusive, collected by Inspector Holton from Silver Hole, near Broad Channel. Nos. 45 to 50, inclusive, from dealer; floated at head of Indian Creek, near Canarsie, L. I.

ISOLATION OF ORGANISMS.

B. COLI AND B. PARATYPHOSUS TYPES.

During the investigations pertaining to Jamaica Bay in 1908 a number of organisms were studied from the water and oyster samples collected direct from this bay. The gas-producing organisms were classed as belonging to the *B. coli* and *B. cloacæ* groups. In reviewing these records it is observed that some of the atypical types more closely resemble the paratyphoid type than the *B. coli* or paracolon group.

From the oyster and water samples collected from dealer A on December 15, 1911, there were a number of *B. coli*-like organisms isolated, and others which resembled the *B. paratyphoid* group.[1] One strain agglutinated typhoid immune serum in dilutions of 1:100, but not in higher dilutions. This serum was active in dilutions of 1:1,000 on typhoid cultures; it was obtained from Maj. F. F. Russell, of the Army Medical School.

In their discussion of the paratyphoid bacillus, Muir and Ritchie[2] show the close similarity existing among various strains of this group. They say:

> With regard to the effects of other sera on the paratyphoid bacillus, it may be said that usually a typhoid serum will require to be used in greater concentration to clump this bacillus than is necessary to obtain an effect with the typhoid bacillus itself. * * * While the paratyphoid bacillus originates a disease resembling typhoid fever, it has also been found in the stools of typhoid patients, and mixed infections may occur. Both organisms have been observed together in the stools in typhoid carriers, and pure paratyphoid carriers are also stated to occur.

Among the 83 cases of gastroenteritis resulting from the Minisink banquet, a large majority of them exhibited symptoms not unlike a mild typhoid infection, and in some instances the course of the disease was from four to six weeks in duration, although in most cases not longer than one week or 10 days. For the most part, the illness began in from 24 to 48 hours after the banquet, while in some cases four or five days or a week elapsed before the first symptoms were noticeable. The onset of the illness was usually attended by severe abdominal pains, cramps, profuse diarrhea, loss of appetite, and general gastro-intestinal disturbances. In some of the more severe cases diarrhea, loss of weight, gaseous distention, and weakness were prominent features requiring the services of a physician for a considerable length of time. None of these cases was reported as typhoid fever, although many were termed "ptomain poisoning" by laymen, and castor oil was generously used in Goshen following the Minisink banquet.

TYPHOID ORGANISMS.

Among the organisms described in Bureau of Chemistry Bulletin 136, by the author, four strains were obtained which resembled

[1] Park, W. H., and Williams, Anna W. A Textbook of Pathogenic Bacteria and Protozoa, 1910, p. 270.
[2] Manual of Bacteriology, 1910, p. 382.

B. typhosus biologically, but did not agglutinate typhoid immune serum. These cultures were obtained in 1908 from Jamaica Bay oysters. The description of those organisms is identical in character to that of a culture isolated from oysters which had been allowed to "drink" under an oyster house at Inwood, Long Island, on October 12, 1911, in a similar manner as were the oysters floated at Indian Creek, near Canarsie. The oysters from Inwood were seized and condemned by the United States Government.[1]

It will be recalled that the oysters furnished the Minisink banquet came from the floats on October 2, 1911, or 10 days before the oysters floated at Inwood, Long Island, from which the above organism was isolated.

The cultural characteristics of the organism isolated from the oysters floated at Inwood are as follows:

Morphology and staining properties: Gram-negative, actively motile bacilli, rods usually straight with slightly rounded ends, varying in size from about 0.4 to 0.8 by 1.5 to 4 microns, generally somewhat longer and more slender than *Bacillus coli.* No chains, spores, or capsules observed.

Biological characters: Plain agar: Soft, grayish white, moderately abundant growth. Endo's medium: Small pearly dewdrop colonies.

Peptonized beef broth: Rendered uniformly turbid with no ring or membrane.

Potato: No visible growth.

Alkaline litmus milk: Unchanged or faintly alkalinized after a slight initial acidity.

Sugar solutions: No gas production in dextrose, lactose, or saccharose.

Nitrate solution: Nitrates absent.

Dunham's solution: Indol not present.

Gelatin: Not liquefied, more or less circular, flat, whitish growth on surface, filiform stab.

Agglutination: Positive in 1:1,000 dilutions after five minutes. The typhoid serum was furnished by Dr. Russell of the Army Medical School.

This organism is considered to be a typical strain of *B. typhosus.* To confirm this opinion, cultures were submitted to Dr. F. F. Russell, of the Army Medical School, and Dr. Wm. H. Park, of the New York City Department of Health, who agreed with these findings. This organism was isolated in pure cultures by Ruth C. Greathouse, a scientific assistant in the Bacteriological Laboratory of the Bureau of Chemistry, from oysters received on October 19, 1911, or seven days after the oysters were taken from the water. These oysters were from the lot seized, were taken from the floats at Inwood, L. I., and were in apparently good physical condition. The typhoid culture, together with 24 other cultures in bouillon 24 hours old, including members of the *B. coli, B. paratyphosus,* and *B. paracoli* groups, were primarily isolated from Endo's plates made directly from the oyster liquor without enrichment. The cultures which produced no gas (15 in number) were incubated in lactose-dextrose litmus agar

[1] U. S. Dept. Agr., Office of the Secretary, Notice of Judgment 1380.

tubes, prepared according to the formula used by Russell.[1] Of the 15 cultures thus inoculated, 5 showed reactions corresponding to Russell's description of the typhoid organism and were submitted to the writer for identification. One of these 5 cultures was subsequently found to be *B. typhosus* and confirmed as above described. The 4 other cultures were discarded because they were feebly motile; no attempt was made to rejuvenate or increase their motility.

The organisms described as paratyphoid and paracolon were classified wholly from their morphological and biological characteristics on differential media, including their reaction on Russell's double sugar litmus agar, dextrose, lactose, and saccharose fermentation tubes, milk, etc. No agglutination tests were made on these strains. In addition to these organisms a strain resembling *B. alcaligenes* was also recovered and studied in the same manner as were the others.

After having been out of water for 21 days at 39° F., oysters from the same lot that contained the typhoid bacilli were examined by the author. A large number of strains of organisms were isolated from 24-hour Endo's plates, prepared directly from the shell liquor of these oysters, and transferred to Russell's double sugar agar tubes. Of the cultures showing reactions for *B. typhosus* on this medium, further study was made on differential media and by agglutination tests.

One strain resembling *B. typhosus* thus isolated was at first only moderately motile, but it possessed all the other biological characteristics of typhoid bacilli. Its motility was greatly increased by growing on gelatin for two generations. The agglutination tests were made by using one-day gelatin stock cultures grown at room temperature. These tests were made in dilutions of 1:1,000 macroscopically, and confirmed in hanging drop preparations in dilutions

[1] Russell, F. F. The Isolation of Typhoid Bacilli from Urine and Feces, with the Description of a New Double Sugar Tube Medium. (Reprinted from The Journal of Medical Research, vol. 25, No. 1.) Enough 5 per cent aqueous solution of litmus is added to plain agar (2 per cent to 3 per cent), with a reaction of about +0.8 per cent to phenolphthalein, to give it a distinct purple violet color, the amount of litmus depending on color of agar (dark requiring more than the light), and the reaction is then adjusted by adding sodium hydrate until the mixture is neutral to litmus. Then 1 per cent of lactose and 0.1 per cent of glucose are added, dissolved in a small amount of hot water, and the medium tubed as for slants. After tubing, pack slants loosely in basket and sterilize them for 10 minutes on first day and 15 minutes on second day in an Arnold sterilizer; then slant and store in dark place.

On this double sugar tube the typhoid bacillus gives, after an incubation period of from 8 to 18 hours, an extremely characteristic appearance; the surface growth is filiform and colorless on a blue background; the upper part of the tube is unchanged in color, but the lower part, the butt, is a brilliant uniform red. The entire point of the medium rests upon the difference between the changes produced by the growth of the typhoid bacillus under aërobic and those produced under the imperfect anaërobic conditions found in the butt of the tube, where the bacillus obtains its oxygen by breaking down the glucose, with the liberation of considerable acid; on the surface, however, in the presence of free oxygen, no acid is formed.

The colon bacillus, which is often slow in producing acid on the Endo plate, shows abundant gas and acid formation on this medium. The tube is reddened throughout, both above and below, and since the abundant lactose is attacked equally with the glucose there is exuberant gas formation.

The *Bacillus fecalus alcaligenes* and other alkali formers leave the medium unchanged or slightly bluer.

of 1:200 with serum from the same lot previously mentioned, and used on the culture isolated by Miss Greathouse from oysters examined on October 19, 1911. It should be said, in connection with the isolation of these two strains of typhoid organisms, that no other cultures of typhoid bacilli were being used in the laboratory at that time. There was a pure culture in stock kept with other organisms in the ice box, but there was no connection whatever between the stock cultures and those isolated from the Jamaica Bay oysters.

Inwood is a station located near the eastern end of Jamaica Bay, while Indian Creek, near Canarsie, is a small stream flowing into the northwestern portion of the same bay. Both sections are subject to gross human pollution. The conditions prevailing at the two places are somewhat similar, and the results obtained from an examination of the shellfish collected from both are practically the same, being highly polluted in each instance.

PROBABLE CAUSE OF THE GASTROENTERITIS (DIARRHEA).

From a study of the clinical symptoms, onset of illness, and duration of the disease, together with the presence of paratyphoid bacilli in oysters taken from dealer A, the conclusion is reached that the diarrhea or bowel trouble can probably be ascribed to the presence of paratyphoid bacilli (said by some authors to be indistinguishable from or closely allied to the Gaertner bacillus) in the oysters served at the Minisink banquet. It is apparent that the disease was due to bacterial infection, arising from the multiplication of the organisms in the body after ingestion, and not to "ptomains," as suggested by some.

Ptomains are formed most commonly during the decay of animal matter. They are essentially the decomposed animal tissue, not excretions of the bacteria, although the bacteria are responsible for the decomposition. Such decomposition does not occur usually in the body, even in animal matter taken as food. In abnormal conditions, if food remains in the body until putrefied, ptomains may be formed in the intestinal contents. When decomposed food containing ptomains is received in the digestive tract, or originally good food decomposes there, the mucous membrane and blood may take up ptomains from this decomposed food, which ptomains affect the tissues like other poisons.

Substances of quite varied chemical constitution are classed under the head of ptomains solely on account of their origin in proteid decomposed by bacterial action. Bacterial toxins are to be distinguished from ptomains. Toxins are substances which are or have been a part of the body of the bacteria; some are secretions from the germ, others are liberated only in case of the death and breaking down of the germ itself. In this latter class is the toxin of typhoid fever, which is therefore particularly different in its origin and action

from ptomains. The toxins are much more poisonous than ptomains and each one is produced by a specific germ.

Some cases of sickness due to food have been classed as ptomain poisoning, when this cause was later discovered to be the ingestion in the food of a particular bacillus which multiplied in the body and by its toxin produced intestinal and other disturbances. Such cases are not ptomain poisoning but may be classed as food poisoning.

SUMMARY.

(1) There is undisputed evidence to show that infected oysters, clams, mussels, scallops, and other shellfish may cause typhoid fever and other gastrointestinal disturbances when consumed by susceptible individuals.

(2) The epidemics of typhoid fever, due to ingestion of polluted sea food, have in most instances been traced to shellfish floated in polluted water, although there is also evidence that oysters and other shellfish, grown in polluted waters and directly consumed without transplanting for a time in pure waters, may be the source of typhoid infection.

(3) The investigations pertaining to the Minisink banquet, held at Goshen, N. Y., on October 5, 1911, show conclusively that the "Rockaway" oysters served on this occasion were wholly responsible for the typhoid and gastroenteritis cases following this banquet.

(4) There were 17 well-defined cases of typhoid fever, with one death, and 83 cases of gastroenteritis (diarrhea) traced directly to eating "Rockaway" oysters from Jamaica Bay, floated at Indian Creek, near Canarsie, Long Island, N. Y.

(5) In addition to the typhoid and other intestinal disorders following the consumption of "Rockaway" oysters at the Minisink banquet, there were also 10 other cases of typhoid and 16 of diarrhea traced to eating "Rockaway" oysters, some of which came from the same lot furnished for the Minisink banquet.

(6) The bacteriological examination of water and shellfish collected from Jamaica Bay shows that this body of water is dangerously polluted; the laboratory data are substantiated by the sanitary inspection, which shows that millions of gallons of raw sewage discharge daily into this bay, and, in many instances, in close proximity to or directly over oyster beds.

(7) Typhoid bacilli were isolated in pure culture after 7 and 21 days from oysters which had been floated at Inwood, Long Island, N. Y., on October 12, 1911, and kept out of water in storage at 39° F. Organisms of the *B. coli* and *B. paratyphosus* groups were also isolated from oysters floated at Indian Creek, near Canarsie, Long Island. They were probably the cause of the gastroenteritis cases following the Minisink banquet.

(8) This investigation comprises a complete study of all the factors which would materially contribute to typhoid infection. Each item of the menu served at the Minisink banquet was carefully considered, and the "Rockaway" oysters served were the only articles of food consumed by all of those who had typhoid or gastroenteritis following this banquet.

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